Yandicoogina Iron Ore Project – Revised Proposal

Public Environmental Review

November 2015

State Assessment Number: Assessment No. 2017

Prepared for Rio Tinto by Eco Logical Australia

Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. The environmental impact assessment process is designed to be transparent and accountable, and includes specific points for public involvement, including opportunities for public review of environmental review documents. In releasing this document for public comment, the EPA advises that no decisions have been made to allow this proposal to be implemented.

Hamersley Iron – Yandi Pty Limited proposes to construct and operate a new mine pit, waste dumps and associated infrastructure at Pocket and Billiard South, located in the central Pilbara region of Western Australia. In accordance with the Environmental Protection Act 1986, a Public Environmental Review (PER) document has been prepared which describes this proposal and its likely effects on the environment. The PER document is available for a public review period of six weeks from **2nd November 2015** closing on **14th December 2015**.

Comments from government agencies and the public will assist the EPA to prepare an assessment report in which it will make recommendations to government.

Printed and CD copies of this document may be obtained from Ms Melinda Brand at Rio Tinto Iron Ore, 152-158 St Georges Terrace, Perth or +61 8 6211 6991. Hard copies of the document cost of $10 (including postage); CDs will be provided free of charge.

The PER may also be accessed through the proponent's website at: http://www.riotinto.com/ironore/documents-9622.aspx.

Why write a submission?
A submission is a way to provide information, express your opinion and put forward your suggested course of action – including any alternative approaches. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged with electronic submissions being acknowledged electronically. The proponent will be required to provide adequate responses to points raised in submissions. In preparing its assessment report for the Minister for Environment, the EPA will consider the information in submissions, the proponent's responses and other relevant information. Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the Freedom of Information Act 1992, and may be quoted in full or in part in the report.

Why not join a group?
If you prefer not to write your own comments, it may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small

group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the PER document or on specific elements. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

When making comments on specific elements of the PER:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable; and
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER document;
- if you discuss different sections of the PER document, keep them distinct and separate, so there is no confusion as to which section you are considering; and
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: **14th December 2015**

The EPA prefers submissions to be made at:
https://consultation.epa.wa.gov.au.

Alternatively, submissions can be

- posted to: Chairman, Environmental Protection Authority, Locked Bag 10, EAST PERTH WA 6892; or
- delivered to the Environmental Protection Authority, Level 8, The Atrium, 168 St Georges Terrace, Perth.

If you have any questions on how to make a submission, please ring the Office of the Environmental Protection Authority on 6145 0800.

Executive summary

INTRODUCTION

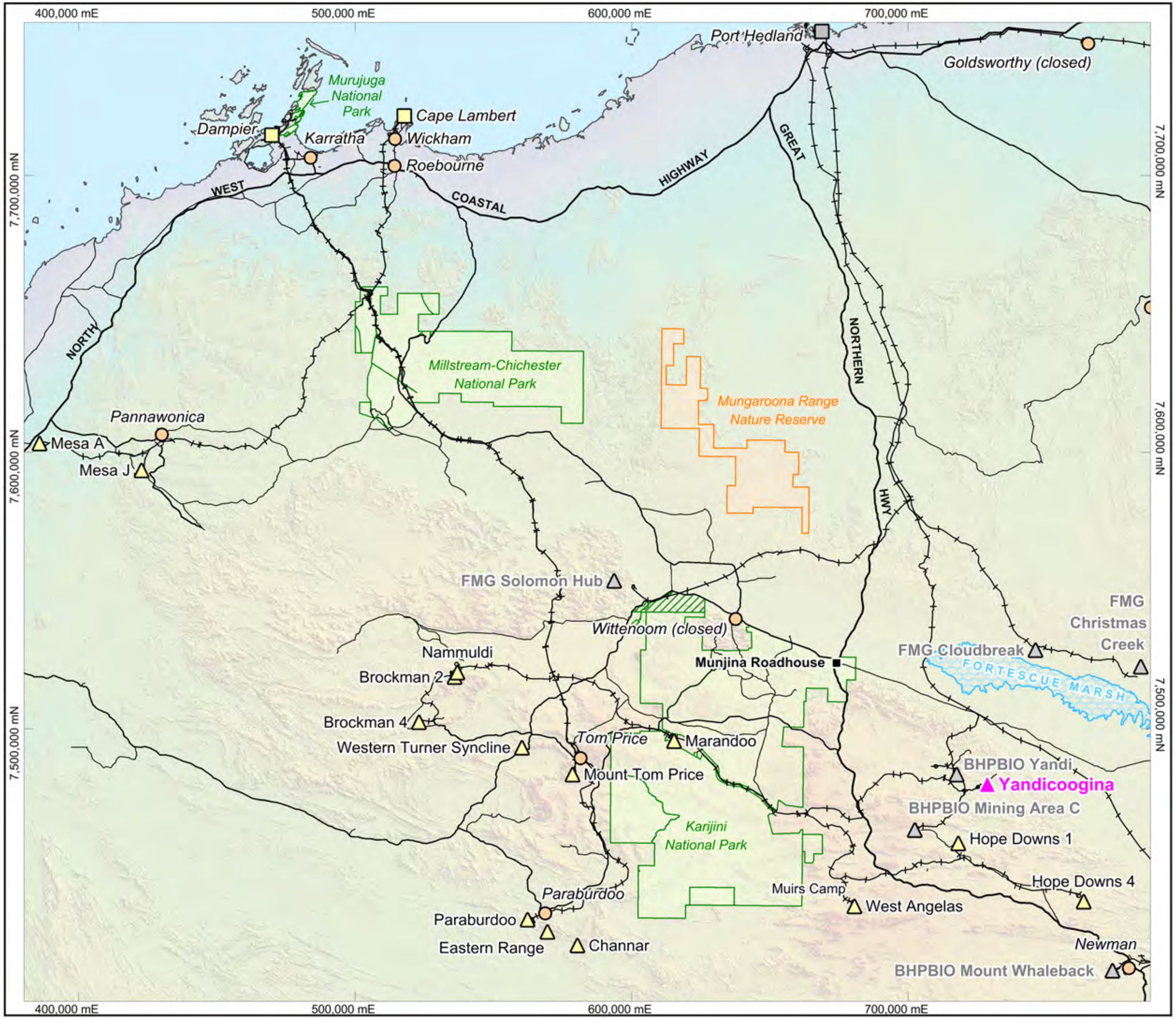
This Public Environmental Review (PER) has been prepared to assess the potential environmental impacts of the proposed 'Yandicoogina Pocket and Billiard South Iron Ore Development' (the Proposal).

The Proposal is located in the central Pilbara region of WA approximately 90 km north west of Newman and 300 km south east of Dampier (**Figure ES1**). The Proposal deposits are centred on a substantial channel iron deposit (CID), located immediately east of the existing Yandicoogina Operations (Yandi Operations: Junction Central (JC) and Junction South East (JSE) deposits; and the more recently approved Junction South West (JSW-A & C) and Oxbow deposits; **Figure ES2**). The Proposal is a revision to the existing Yandi Operations as approved under Ministerial Statement No. 914 (MS 914) in 2012 and involves construction and operation of a new mine pit, waste dumps and associated infrastructure. The purpose of the proposal is to enable sustained production from the existing Yandi Operations by providing replacement tonnages as the existing approved resources are depleted. The Proposal contemplates saleable ore production up to 31 Million tonnes per annum (Mtpa) with an expected operational mine life of approximately 16 years. The Proponent for the Proposal is Hamersley Iron – Yandi Pty Limited (herein 'the Proponent'), a wholly owned member of the Rio Tinto Group.

EXISTING YANDI OPERATIONS

The existing Yandi Operations is subject to the *Iron Ore (Yandicoogina) Agreement Act 1996*, and comprise a number of individual pits located within a continuous CID formation, which also forms a major aquifer in the area. The existing Yandi Operations, as approved, currently consists of:

- five open cut pits within the CID: JC, JSE and JSW-C (currently operating); and JSW-A and Oxbow (approved but not yet operating);
- a 90 km rail line to Juna Downs;
- mine infrastructure (e.g. product stockpiles, waste dumps, topsoil, low grade stockpiles, waste fines storage facilities and haul roads);
- associated infrastructure (e.g. overland conveyors, mine access roads, offices, warehouses, accommodation, bore fields, fuel storage facilities and utilities);
- abstraction of 53 gigalitres per year (GL/y);
- a water management system including on-site reuse of water abstracted from pit dewatering, and discharge of surplus volumes into creek systems;
- dry and wet processing plants;
- flood protection structures; and
- power and communications infrastructure.

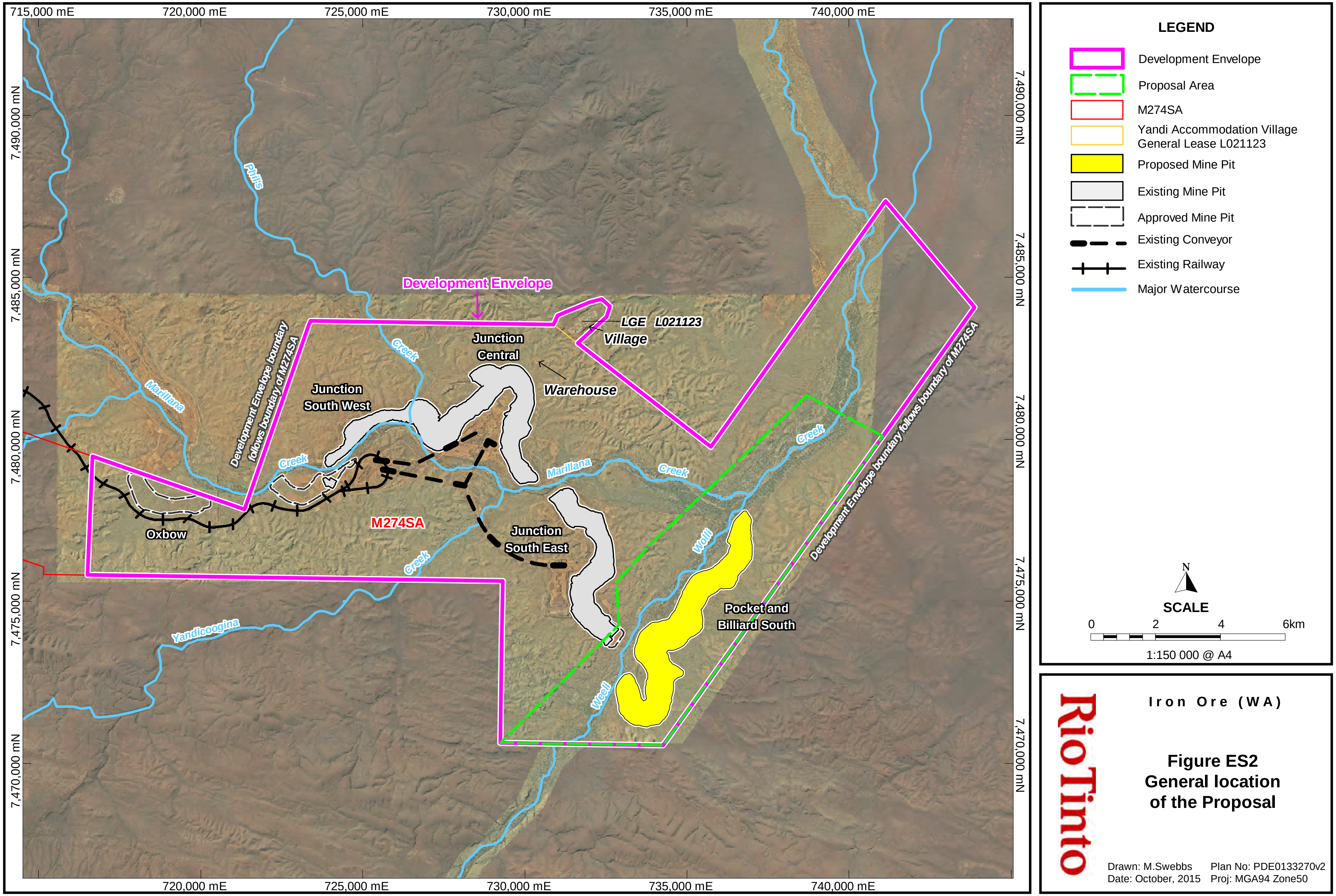


Rio Tinto

Iron Ore (WA)

Figure ES1
Regional setting of the Proposal

Drawn: M.Swebbs
Date: Aug, 2015
Plan No: PDE0128513v1
Proj: MGA94 Zone50



Rio Tinto

Iron Ore (WA)

Figure ES2
General location of the Proposal

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0133270v2
Proj: MGA94 Zone50

Geospatial Information and Mapping

DESCRIPTION OF THE PROPOSAL

The Proposal will minimise the disturbance footprint by optimising the use of existing infrastructure already installed at the existing Yandi Operations. Key additional components of the Proposal are:

- **A new below water table open cut iron ore pit** to the east of the existing Yandi Operations within the CID.
- **Temporary surface waste dumps**, including mineral waste dumps, sub-grade dumps, low grade ore dumps and topsoil and subsoil stockpiles.
- **Major infrastructure, including:**
    - **A flood protection levee** along the western margin of the pit.
    - **A diversion drain** along the eastern margin of the new pit.
    - **A culvert-floodway** creekline crossing structure.
- **Supporting mine infrastructure** – haul roads and ramps, mine access and internal road network, dewatering pumps and associated pipelines, discharge outlet(s), power and communications.

In addition, a number of the Yandi Operation's existing facilities and processes will be upgraded or integrated as part of the Proposal including:

- **Trucking ore** back to the existing Yandi Plant.
- **Yandi plant** including JC and JSE processing plants (including a wet plant), and associated conveyors, stackers, reclaimers, train load-out and other materials handling infrastructure.
- **A water management system** including on-site reuse of water abstracted from pit dewatering, and discharge of surplus volumes into creek systems. Discharge infrastructure servicing the existing Yandi Operations will be used where possible.
- **Mine support facilities** (e.g. power supply infrastructure, communications infrastructure, offices, explosives storage, waste water treatment plants etc.).

The Proposal is scheduled to be commissioned with first ore production from the first half of 2019, however project schedules may change, depending on business priorities.

Rio Tinto's existing rail network will be used to transport mined and processed ore from the Proposal to existing port operations at Cape Lambert.

A summary of the existing Yandi Operations and the Proposal key characteristics, which together would comprise the Yandicoogina Iron Ore Project – Revised Proposal (hereafter Revised Proposal), are outlined in **Table ES1**.

Table ES1: Summary of the existing Yandi Operations, the Proposal and the Revised Proposal Key Characteristics

Characteristic	Yandi Operations (existing)	The Proposal (additional proposed)	Yandi Operations (Revised Proposal)
Short description	The proposal is to develop Iron Ore deposits Junction Central, Junction South East, Junction South West and Oxbow, located in the central Pilbara region of Western Australia, on mining lease 274SA. Key aspects of the proposal include: • Ore transport and storage infrastructure (including rail link) – car dumpers, conveyors, stockyards, ore stackers and ore reclaimers, and storage infrastructure, rail loops; • Rail corridor allowing for rail lines and associated infrastructure; • Construction and operations support infrastructure; • 220kV power network, including switchyard and powerlines; • A diesel-fired power station and transmission lines; • Dry and wet processing plants (including in pit waste fines storage facilities); • Flood protection structures; • Accommodation camps; • Access roads; and • An airstrip.	The proposal is to develop a below water table open cut Iron Ore mine at Pocket and Billiard South, located in the central Pilbara region of Western Australia, on mining lease 274SA. Key aspects of the proposal include: • Temporary surface waste dumps; • Major infrastructure including a flood protection levee, a diversion drain and Weeli Wolli Creek crossing; and • Supporting mine infrastructure including power spur, haul roads and ramps, mine access and internal road network, and dewatering infrastructure (dewatering pipeline, bores and outlets).	The proposal is to develop Iron Ore deposits Junction Central, Junction South East, Junction South West, Oxbow and Yandi PBS, located in the central Pilbara region of Western Australia, on mining lease 274SA. Key aspects of the proposal include: • Ore transport and storage infrastructure (including rail link) – overland conveyors, stockyards, ore stackers and ore reclaimers, and storage infrastructure, rail loops. • Rail corridor allowing for rail lines and associated infrastructure. • Construction and operations support infrastructure. • 220kv power network including switchyard, back-up diesel power and transmission lines. • Dry and wet processing plants (including in pit waste fines storage facilities). • Flood protection structures and creek crossings. • Accommodation camps. • Access roads.
Physical elements			
Mine and associated infrastructure	Vegetation clearing up to 5,600 ha within Restricted Clearing Area 1; and Vegetation clearing up to 60 ha within Restricted Clearing Area 2	Vegetation clearing up to 1,300 ha for mining and waste dumps Vegetation clearing up to 500 ha for infrastructure	Vegetation clearing up to 7,400 ha within Revised Proposal Development Envelope. Vegetation clearing up to 129 ha within proposed Restricted Clearing Area.

Characteristic	Yandi Operations (existing)	The Proposal (additional proposed)	Yandi Operations (Revised Proposal)
Railway and associated infrastructure	90 km rail line	No additional rail required	No additional rail required.
Operational elements			
Dewatering	No more than 35 GL/year from Junction South East and Junction Central operations. No more than 18 GL/year from Junction South West A, Junction South West C and Oxbow operations.	Approximately 50 GL/year for the Proposal	No more than 83 GL/year for the entire Revised Proposal.
Surface water discharge	Up to 16 GL/year from Junction South West A, Junction South West C and Oxbow operations.	Approximately 50 GL/year for the Proposal	Up to 78 GL/year for the entire Revised Proposal. No water flow or pooling further than 17 km downstream from the Marillana Creek and Weeli Wolli Creek system confluence.

The key characteristics of the Revised Proposal, as per EAG 1 *Defining the Key Characteristics of a Proposal* (EPA 2012a), are also listed in **Table ES2**.

Table ES2: Key Proposal Characteristics

Summary of the Proposal		
Proposal title	Yandicoogina Iron Ore Project – Revised Proposal	
Proponent name	Hamersley Iron – Yandi Pty Limited	
Short description	The proposal is to develop Iron Ore deposits Junction Central, Junction South East, Junction South West, Oxbow and Pocket and Billiard South, located in the central Pilbara region of Western Australia, on mining lease 274SA. Key aspects of the proposal include: • Ore transport and storage infrastructure (including rail link) –overland conveyors, stockyards, ore stackers and ore reclaimers, and storage infrastructure, rail loops. • Rail corridor allowing for rail lines and associated infrastructure. • Construction and operations support infrastructure. • 220kv power network including switchyard, back-up diesel power and transmission lines. • Dry and wet processing plants (including in pit waste fines storage facilities). • Flood protection structures and creek crossings. • Accommodation camps. • Access roads.	
Physical elements	**Location**	**Proposed Extent**
1. Mine and associated infrastructure	Figure 4 and Figure 79	Vegetation clearing up to 7,400 ha within Revised Proposal Development Envelope. Vegetation clearing up to 129 ha within proposed Restricted Clearing Area.
Operational elements	**Location**	**Proposed Extent**
1. Dewatering	Figure 34	No more than 83 GL/year for entire Revised Proposal.
2. Surface water discharge	Figure 34	Up to 78 GL/year for entire Revised Proposal. No water flow or pooling further than 17 km downstream from the Marillana Creek and Weeli Wolli Creek system confluence.

ASSESSMENT PROCESS

The Proposal was referred to the Western Australian (WA) Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986* (EP Act) on 4 July 2014. The EPA determined that the Proposal required environmental assessment at the level of PER (with a six week public review period), whereby the Proponent must fulfil the requirements of Section 10.2 of the *Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2012* for environmental assessment prescribed under the EP Act.

The EPA issued an Environmental Scoping Document (ESD) for the Proposal on 31 December 2014. The ESD provides an outline of the key environmental factors, a description of the scope of the assessment of the Proposal and an indicative timeline for the assessment process.

Subsequent to a six week public review period of the PER document, the Proponent will respond to any public submissions received and then the EPA will assess the Proposal and submit its assessment report to the Minister for the Environment. The Minister will publish the EPA report and subsequent to the determination of appeals (if any) received on the findings or recommendations of the EPA's assessment report, the Minister will then decide whether or not the Proposal should be implemented and if so, under what conditions.

The Proposal was also referred to the Commonwealth Department of the Environment (DoE) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 26 September 2014. DoE determined that the Proposal was 'not a controlled action' on 25 October 2014 (Decision notice 2014-7343), and therefore does not require assessment and approval under the EPBC Act.

The ESD was prepared with input from other WA decision making authorities and the Proponent. The EPA identified seven preliminary key environmental factors relevant to the Proposal that require detailed consideration by the Proponent. These preliminary key environmental factors were:

- Flora and Vegetation;
- Terrestrial Fauna;
- Subterranean Fauna;
- Hydrological Processes;
- Inland Waters Environmental Quality;
- Rehabilitation and Closure (integrating factor); and
- Offsets (integrating factor).

The EPA identified air quality, amenity and (indigenous) heritage as 'other environmental factors' that it considers relevant to the Proposal. Other environmental factors are also addressed in this PER to demonstrate how the Proposal will meet the relevant EPA objectives and principles.

ENVIRONMENTAL IMPACTS AND MANAGEMENT

Assessment of the key environmental factors and other environmental factors is provided below.

HYDROLOGICAL PROCESSES AND INLAND WATERS ENVIRONMENTAL QUALITY

The Proposal Area is located within the Weeli Wolli Creek surface water catchment, with Weeli Wolli Creek flowing through and adjacent to the Proposal Area from south of the Proposal ore deposits. Weeli Wolli Creek is part of an ephemeral system characterised by a generally singular, meandering low-flow channel set within a broader floodplain. The high flow channel comprises a gravel-bed stream, with large gravel bars present within the channel and more active anabranches. These numerous anabranches of the Weeli Wolli Creek that cross the Proposal Area convey flows towards the creek as a result of episodic high rainfall events.

Weeli Wolli Creek drains parallel to the Proposal ore deposits in a predominantly north easterly direction, receiving flows from Marillana Creek (its major tributary), and terminates as an alluvial fan at the Fortescue Marsh, outside of the Revised Proposal Development Envelope.

The Proposal will operate within a modified and managed hydrological system. The existing approved mining operations within the Weeli Wolli Creek catchment undertake dewatering and discharge activities as part of their mining operations and have modified the natural hydrological conditions of Marillana and Weeli Wolli Creeks since the mid 1990's and mid 2000's, respectively. The BHP and Rio Tinto mining operations that occur within the CID (Rio Tinto's existing Yandi Operations, BHP's Marillana Creek [Yandi]), are within the same hydrological and hydrogeological setting as the Proposal, with the dewatering and discharge activities undertaken to manage the productive aquifers of the CID. Hamersley HMS's Hope Downs 1 upstream operation occurs in a different local hydrogeological setting; however discharges into the same catchment (into Weeli Wolli Creek), which ultimately recharges the aquifers in the vicinity of the Revised Proposal (adjacent to Junction South East and the Proposal Area).

The groundwater levels in the aquifers underlying Weeli Wolli Creek have increased in recent history, as a consequence of surplus water discharge from upstream mining operations. In some locations along Weeli Wolli Creek, the groundwater table has risen such that it is now only a few metres from the surface. Dewatering associated with the Proposal will lower the artificially elevated groundwater table. After mining, however, the aquifers beneath Weeli Wolli Creek are projected to return to within approximately 10% of their natural (pre-mining) levels, which will enable Weeli Wolli Creek to return to the ephemeral system that existed prior to continuous surplus water discharge from mining activities in the area.

Development of the Proposal will modify local topography and intercept a portion of surface water flows. The Proposal mine pit will marginally encroach into the Weeli Wolli Creek floodplain, requiring a flood protection levee to be installed to prevent floodwaters from Weeli Wolli Creek flowing into the mine pit. Additionally, as the Proposal ore deposit is entirely located on the east side of Weeli Wolli Creek, a creek crossing via a culvert-floodway structure and an upgrade to the existing road crossing to an engineered floodway will be required to access facilities at the existing Yandi Operations. The changes associated with surface hydrology are confined to specific sections of Weeli Wolli Creek and are considered unlikely to affect the wider catchment flows.

Due to the nature of the orebody being located below the water table, dewatering will be required to allow for mining. Peak cumulative abstraction volumes from the existing Yandi Operations and the Proposal of up to 83 gigalitres per year (GL/y) are modelled to occur within the first 6 years of mining. Local maximum drawdown during this period would be most pronounced along the CID aquifer and is predicted to be in the order of 75 to 85 m below ground level (bgl).

The Proposal will contribute at its peak up to 50 GL/y of the total 83 GL/y abstraction from the Revised Proposal. Of the 50 GL/y, up to approximately 70% is estimated to be associated with surplus water discharge from the upstream Hope Downs 1 project that has infiltrated into the downstream Weeli Wolli Creek floodplain and CID aquifers. Groundwater abstracted through the dewatering network will be integrated with the existing and proposed site water demand, with surface water of up to 78 GL/y discharged to Marillana and Weeli Wolli Creeks. The remaining 5 GL/y (to a maximum of 11 GL/y for the Revised Proposal) is expected to be used for on-site operations purposes across the Revised Proposal.

Surplus water will be discharged and constrained to a well defined low-flow channel, with the modelled wetting extent within the existing MS 914 approved footprint of 17 km beyond the Marillana – Weeli Wolli Creek confluence. Given the wetting front is expected to remain within existing approved limits, it is considered that there will be minimal additional effects on the downstream hydrological system of Weeli Wolli Creek and negligible impacts are expected on Fortescue Marsh.

FLORA AND VEGETATION

The Proposal Area lies within the within the Hamersley and Fortescue subregions of the Pilbara bioregion. The majority of the landscape within the Proposal Area is considered to be typical of the Hamersley subregion, while the creek systems have affinities with the Fortescue subregion. Twenty-three vegetation units have been mapped and described in the Proposal Area, grouped according to the following major landforms with which they are associated:

- Vegetation of Major Creeklines and Tributaries.
- Vegetation of Minor Creeklines, Floodplains and Valleys.
- Vegetation of Hills, Ridges and Breakaways.
- Vegetation of Plains.

Further refined mapping within the riparian zones in Marillana and Weeli Wolli Creeks was also undertaken, differentiating 13 riparian sub-associations throughout the greater Yandicoogina area.

None of the vegetation types recorded in the Proposal Area represent Threatened Ecological Communities or Priority Ecological Communities. Some of the vegetation units recorded are considered to have elevated local conservation significance, specifically those that support riparian vegetation species *Melaleuca argentea*, *Eucalyptus camaldulensis and Eucalyptus victrix.*

Vegetation clearing will be required to enable development of the mine pit and associated infrastructure. The Proposal Area covers approximately 4,486 ha of which a maximum of 1,800 ha (including 69 ha of riparian zone vegetation) is proposed to be cleared for the Proposal. The majority of vegetation proposed to be cleared was assessed to be in Good condition (46% of all mapped vegetation) and has been historically impacted by grazing and trampling by domestic and feral animals, weed invasion, frequent fire, and mining and exploration activities.

Riparian vegetation in the vicinity of the Proposal Area has been subject to the effects of groundwater drawdown and discharge of surplus groundwater by existing approved mining activities within the catchments of Marillana Creek since the mid 1990s and Weeli Wolli Creek since the mid 2000s. Dewatering associated with the Proposal will lower the water table by approximately 75 to 85 m bgl over two to three years, with the water table in the vicinity of the mine pit remaining at that depth for the duration of mining. Approximately 50 GL/y of surplus water is proposed to be discharged from a new discharge outlet, adjacent to the existing discharge outlet (DO9) as a result of developing the Proposal, with the total peak discharge from the Revised Proposal being approximately 78 GL/y. Surface water modelling indicates Weeli Wolli Creek could accommodate the maximum discharge rate without exceeding MS 914 condition 6-3, which limits the perennial surface water wetting front to 17 km downstream of the Marillana and Weeli Wolli Creek confluence. Local impacts around the discharge outlet and immediate vicinity are likely to be associated with waterlogging, which may result in declining health of some species.

One flora species, *Lepidium catapycnon* (Hamersley Lepidium), listed under the *Wildlife Conservation Act 1950* as Threatened (Declared Rare) Flora and under the EPBC Act as Vulnerable, has been recorded in the Proposal Area. *L. catapycnon* was recorded in areas that were originally designated for waste dumps in earlier versions of the conceptual design; however, the Proponent re-configured the waste dumps to avoid known and recorded populations of *L. catapycnon*. Further, all recorded populations of *L. catapycnon* have currently been designated as 'areas of special protection from ground disturbance' and therefore will not be cleared.

Four records (37 individuals) of *Goodenia nuda* (Priority 4) will be impacted by the Proposal. Rio Tinto records show that *Goodenia nuda* has been recorded at least 551 locations across the Pilbara surveys, including 5,862 individual plants. The loss of the individuals recorded from the Proposal Area is therefore considered negligible and would not affect the species' conservation status.

Vegetation clearing will be minimised as much as practicable and restricted to the extent approved by clearly delineating areas and adhering to internal ground disturbance procedures for areas to be cleared. Disturbed areas will be rehabilitated following completion of mining, in accordance with the Yandicoogina Closure Plan.

TERRESTRIAL FAUNA

Terrestrial Vertebrate Fauna

Five fauna habitat types have been mapped in the Proposal Area: Alluvial Plain (Flood Plain), Mulga woodland, Hilltops and Slopes, Pediment Slope and Major Drainage Line. These habitats are considered to be common and widespread in the Hamersley and

Fortescue subregions of the Pilbara bioregion, and are therefore not restricted to the Proposal Area.

Five conservation listed terrestrial vertebrate species have been recorded in the Proposal Area, including four species listed under the EPBC Act and/or the *Wildlife Conservation Act 1950* (WC Act), and one species listed in the Parks and Wildlife Priority Fauna List, as follows:

- Pilbara Olive Python, *Liasis olivaceus barroni* (Vulnerable, Schedule 1);
- Fork-tailed Swift, *Apus pacificus* (Migratory, Schedule 3);
- Eastern Great Egret, *Ardea modesta* (Migratory, Schedule 3);
- Rainbow Bee-eater, *Merops ornatus* (Migratory, Schedule 3); and
- Western Pebble-mound Mouse, *Pseudomys chapmani* (Priority 4).

An additional species, the Chocolate Wattled Bat (*Chalinolobus morio*), while currently not listed under Commonwealth or State legislation, is also considered to be of regional significance as the population appears to be geographically restricted, with records existing only at Weeli Wolli Spring and extending along Weeli Wolli Creek and Marillana Creek.

Clearing of terrestrial fauna habitat is required to facilitate construction of the mine and associated infrastructure. Clearing will include up to 69 ha of riparian zone vegetation. Approximately 87 ha of core habitat, which includes riparian zone vegetation, will be lost within the Proposal Area for the conservation listed Pilbara Olive Python. Aside from one record of a Rainbow Bee-eater, the records of the Western Pebble-mound Mouse are the only conservation listed species recorded within the proposed mine pit and waste dump locations.

Vegetation clearing is not anticipated to cause any significant fragmentation of habitat or disruptions to ecological linkages. The Proposal Area contains fauna habitats that are consistent with the surrounding landscape. Based on the distribution of land systems, fauna habitats occurring in the Proposal Area are well represented in the surrounding area, and connectivity will remain with the intact habitats outside the Proposal Area.

Short Range Endemic Fauna

Twenty potential short range endemic (SRE) invertebrate specimens were recorded from within the Proposal Area, with genetic analysis determining six putative species. Of these species, four mygalomorph spider species are considered to represent potential SREs: Idiopidae sp. I1, Idiopidae sp. I9, Nemesiidae sp. N42 and Nemesiidae sp. N44. All species have been previously observed outside the Proposal Area. These species have been recorded in multiple land systems and substrate types, suggesting they are not restrained to a specific landscape-scale habitat unit. Therefore the probability that these mygalomorph spiders possess a narrow spatial distribution is lower, and thus it is less likely that the removal of potential SRE habitat within the Proposal Area will adversely affect these species.

Aquatic Fauna

The most recent aquatic fauna surveys completed in 2013 and 2014 recorded 283 invertebrate fauna taxa in the Proposal Area. Several undescribed hyporheic taxa were considered to be new species, including species *Cephalodella* n. sp. and *Lecane* 'bulloid' n. sp. Five stygobitic amphipod/isopod species were considered to be potential SREs, of these, two (*Maarrka weeliwolli* and *Pygolabis weeliwolli*) appear to be restricted to Marillana Creek and Weeli Wolli Creek. Three fish species were observed, none of which are conservation listed. Limited aquatic fauna habitat will be lost or fragmented as a result of the Proposal, as the low-flow channel will remain in situ and larger rainfall events will continue to provide natural flood flows in Weeli Wolli Creek, which sustains connection upstream to Weeli Wolli Spring and downstream to Fortescue Marsh. In addition, surplus water discharge has increased the range extent due to increased water availability.

SUBTERRANEAN FAUNA

Stygofauna

A total of 13 phases of stygofauna sampling have been conducted in and around the Revised Proposal Development Envelope since 2003. A total of 2,761 specimens from 62 taxa have been found in the Proposal Area to date, 39 of which occur within the proposed mine pit boundary. Of the 39 taxa recorded within the proposed pit boundary, three species are not known from any other records outside this area: *Notobathynella* sp., *Billibathynella* sp. B02 and *Brevisomabathynella* cf. *pilbaraensis*. These species are not currently conservation listed.

Excavation of the mine pit would result in direct loss of individuals and habitat, and alteration of habitat would also occur as a result of groundwater abstraction and discharge.

The taxa that are present in the proposed pit footprint and the drawdown cone of depression are most at risk from the Proposal. However, the habitat in which the stygofauna occur extends beyond the predicted area of impact from pit excavation and groundwater drawdown. Almost half of the stygofauna assemblage recorded from the Revised Proposal Development Envelope is known from the wider region and the frequency of wider ranging taxa indicates there is unlikely to be geographically restricted taxa. It is considered likely that the three taxa recorded only from the proposed pit would occur throughout the broader alluvials, colluvium calcrete and CID units and therefore would not be significantly impacted by the Proposal. The paucity of records of these taxa may be an artefact of sampling, rather than an indication of an extremely restricted distribution. Due to the large abundance of stygofauna throughout the Proposal Area and the broader Weeli Wolli Creek and Marillana Creek catchments, it is considered unlikely that there will be a substantial regional impact on stygofauna.

Troglofauna

Two phases of troglobitic fauna surveys were undertaken across the Proposal Area and additional troglofauna were opportunistically collected during stygofauna sampling. Six potential troglobitic fauna specimens have been recorded in the Revised Proposal Development Envelope, three of which have been recorded within the Proposal Area: *Myrmopopaea* sp. nov (confirmed troglobite), *Draculoides* sp. indet (confirmed troglobite) and Pauropoda sp. indet (unconfirmed troglobite). *Myrmopopaea* sp. nov. is the only taxon recorded from within the proposed pit boundary and it is not currently known from any other locations.

The excavation of the mine pit will result in the direct removal of the habitat for troglobitic fauna. However, the low number of specimens recorded within the Proposal Area indicates it is unlikely that troglobitic fauna inhabit the ore deposit in high densities.

The confirmed troglobite *Myrmopopaea* sp. nov. was recorded from interconnected calcrete and alluvium formations within the proposed pit area. These largely interconnected geological formations are located adjacent to, and extend parallel to Weeli Wolli Creek and contain sufficient interstitial spaces and cavities to allow movement of troglobitic fauna. This habitat continuity outside the Proposal Area suggests that all three troglofauna taxa are likely to occur outside the proposed pit.

REHABILITATION AND CLOSURE

The proposed closure strategy, described within the Yandicoogina Closure Plan, has been developed to create a safe, stable, non-polluting landform that supports a native ecosystem. The available overburden and waste materials will be utilised to stabilise the pit walls adjacent to the floodplain and to create a spillway that will facilitate flood water ingress into the final mine void during the peak of large flood events.

The volume of overburden and waste material generated by implementing the Proposal is relatively low compared to the volume of ore extracted. As a consequence, there is insufficient overburden and waste material available to backfill into the pit to cover the groundwater table on closure. Proximity to Weeli Wolli Creek is also an important consideration in development of the closure strategy. Removal of the flood protection levee of closure will reduce the stressors on the riparian floodplain vegetation, but will also enable flood water to interact with the final mine void.

Pit lakes are expected to develop either side of the flood ingress area. The groundwater aquifers, dewatered by implementing the Proposal, will recover to natural (pre-disturbance) levels and provide the base flow for the pit lakes. Flood water entering the mine void will result in rapid increases in the pit lake water levels, creating a dynamic wetland environment on the fringe of the Weeli Wolli Creek floodplain.

Research and trials are required to develop an appropriate revegetation strategy for the wetland areas that will be developed inside the final mine void. Outside of the final void area, rehabilitation will be completed using standard practice techniques, as successfully implemented across Rio Tinto's Pilbara mining operations.

The following closure objectives have been established for the Yandi Operation and will be applied to the Revised Proposal:

- Rehabilitated landforms are stable and designed to manage floodwater appropriately.
- The environmental and cultural heritage values associated with creek flows and function are maintained post-closure.
- Environmental values of Fortescue Marsh are not compromised.

- Water quality within pit lakes support natural ecosystems and are compatible with post-mining land use.
- Alluvial groundwater systems support remnant phreatophytic vegetation.
- Final landforms are rehabilitated to be compatible with post-mining land use.
- Public safety hazards have been addressed.

Completion criteria to measure closure implementation success against these closure objectives have been recommended within the Yandicoogina Closure Plan. The completion criteria will be refined based on information developed during implementation of the Proposal, from baseline studies and rehabilitation trials, then finalised with stakeholders as the Proposal approaches closure.

During the life of the Proposal, investigations will be undertaken and an adaptive management approach will be used to ensure that risks to closure are identified and addressed so as to meet the EPA's objective for rehabilitation and closure.

The key anticipated long term outcomes are as follows:

- Pit walls of the final mine void that are adjacent to Weeli Wolli Creek are stabilised in a way that prevents the creek from collapsing into the mine voids post-closure ensuring continued function of Weeli Wolli Creek.
- All areas disturbed for mining (with the exception of pit walls) and infrastructure that are not required by the State (under conditions of applicable State Agreements) are rehabilitated to a condition compatible with the post-mining land use following decommissioning.
- Creation of two pit lakes and associated dynamic wetland environment within the mine void with water levels that will rise and fall in accordance with flooding of the creek systems.
- Regional hydrogeological impacts are minimised and adequately managed.
- Outside of the mining disturbance areas and more than 2 km from the Proposal mine voids, water levels are largely predicted to return to pre-disturbance levels.
- No impacts to the hydrological regime of the Fortescue Marsh as a result of closure of the site.

OTHER FACTORS

Aboriginal Heritage

Aboriginal archaeological and ethnographic surveys have been completed across the proposed footprint and for the majority of the Proposal Area, with numerous Aboriginal archaeological sites recorded, ranging from low to high in archaeological and cultural significance. 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. Aboriginal heritage sites could potentially be disturbed by proposed activities such as clearing, dewatering, excavation and surface water discharge, although it is Rio Tinto's policy to avoid heritage sites, wherever practicable.

A heritage zone is currently delineated around Weeli Wolli Creek, due to the association of this site with camping activities, ceremonial activities and other cultural activities.

However, it is noted that part of the proposed mining activities occur within this zone. Any long term alteration to the regional water regime will be undertaken in consultation with local traditional owner groups.

The Proposal is expected to have some effect on the ethnographic cultural values of Weeli Wolli Creek, however any disturbance within the Weeli Wolli Creek heritage zone or of other archaeological/ethnographic sites will be in accordance with the provisions of the *Aboriginal Heritage Act 1972* (WA) and will have the consent of the relevant Traditional Owners. Rio Tinto will maintain ongoing consultation with Aboriginal stakeholders over the life of the Proposal, in accordance with processes established for the existing Yandi Operations.

Air Quality

Dust will be generated by construction and mining activities such as vegetation clearing, earthworks and mining (including blasting), vehicle movements and dry ore processing, stockpiling, reclaiming and transport.

As the majority of the Iron Ore at the Proposal is below watertable ore, the moisture content of the ore will reduce the likelihood of dust-related impacts from materials handling. Additionally, the Proposal is remote from sensitive air quality receptors, with other mining operations being the nearest premise.

Amenity

Temporary visual effects in the immediate region around the mine pit will occur from the development of the waste dumps and infrastructure/facilities. The extent and condition of riparian vegetation is also expected to be reduced in the long term as the creeks are ultimately returned to the pre-mining ephemeral system.

During mine closure, the maintenance of aesthetic values for cultural and amenity purposes are an important consideration. Rehabilitation is expected to return the visual amenity as much as possible to the original pre-disturbance landscape. Two pit lakes will be created within the Proposal Area and while changing components of the pre-mining amenity, they are expected to create new ecosystems.

OFFSETS

The Proponent has considered measures to avoid, minimise and rehabilitate impacts to environmental values throughout the design of the Proposal. Taking into account these measures, the following significant residual impact arising from the Proposal has been identified:

- Clearing of up to 1,731 ha of native vegetation in Good to Excellent condition within the Proposal Area, including fauna habitat (excluding riparian zone vegetation[1]).
- Clearing of up to 69 ha of native riparian zone vegetation[1] within the Proposal Area, including fauna habitat.

The EPA has established a strategic conservation initiative to coordinate offsets in the Pilbara. Consistent with the WA Environmental Offsets Guidelines, it is considered that

[1] For the purposes of the offset calculation, riparian zone vegetation is classified as vegetation units within the riparian zone comprising C-coded and F2 coded vegetation located within the RCA.

the residual impact of disturbance of vegetation in Good to Excellent condition or riparian zone vegetation is significant and will therefore require compensation via an offset. A standard offset approach has been developed by the EPA in regard to this residual impact and it has been applied consistently to projects in the Pilbara. As such, the Proponent is proposing to contribute funding of $1,500 (excluding GST) per hectare of native vegetation, and funding of $3,000 (excluding GST) per hectare of riparian zone vegetation cleared to a government-established conservation offset fund or an alternative offset arrangement providing an equivalent outcome as determined by the Minister.

ENVIRONMENTAL MANAGEMENT

The Proponent is a member of the Rio Tinto Group, which has extensive experience in managing the development, operation and environmental compliance of Iron Ore mining projects similar to the Proposal. This experience, along with stakeholder consultation, has been used to define the potential environmental impacts from the Proposal, and the proposed mitigation and management measures. The Proponent aims to conduct its business in an efficient and environmentally responsible manner that is compatible with the expectations of stakeholders. A systematic process of environmental management has been adopted, which improves the likelihood that significant environmental impacts have been identified, investigated and mitigated, as far as practicable. As a result, there is greater certainty in achieving desirable environmental outcomes.

Environmental Management System

Rio Tinto requires its operations to implement and maintain an EMS that provides a model for continuous improvement, the key elements of which include assessing environmental risk and legal requirements, developing objectives and targets for improvement, training, operational control, communication, emergency response, corrective actions, audits and reviews.

Environmental Management Plans

The following key Yandi Operations site specific management documents will be implemented to manage potential impacts associated with the Proposal:

- Yandicoogina Monitoring and Management Plan, which includes:
  - Yandicoogina Vegetation and Groundwater Dependant Ecosystems Monitoring and Management Plan; and
  - Yandicoogina Surface Water Discharge Monitoring and Management Plan;
- Yandicoogina Weed Action Plan:
- Proponent's Pilbara-wide Significant Species Management Plan, including Yandi Operations site specific addendum; and
- Yandicoogina Closure Plan.

Environmental Values Statement

As part of the approval for the existing Yandi Operations, an Environmental Values Statement (EVS) was developed for Weeli Wolli Creek. The current EVS for the Weeli Wolli Creek catchment, included in the revision to the Yandicoogina Monitoring and Management Plan, identifies three high level values; Fortescue Marsh, Flora and

Vegetation and Stygofauna. Other recognised values include fauna, heritage and social aspects.

Environmental Control Instruments and Proposed Environmental Conditions

There are a number of existing regulatory controls that will ensure that environmental values are protected during implementation of the Proposal including requirements under the EP Act regarding discharges and emissions and the Rights in Water and Irrigation Act regarding dewatering. Another of these controls includes environmental conditions in a Ministerial Statement that may be issued by the Minister for Environment allowing the Proposal to be implemented as approved.

The Proponent has proposed environmental conditions for consideration by the Minister for Environment. These conditions are based on those outlined in MS 914 for the existing Yandi Operations, which would be superseded by a new Ministerial Statement, subject to approval of the Revised Proposal.

OUTCOMES

In summary, the key outcomes of the assessment for the Proposal, relating specifically back to the ESD include:

<u>Hydrological processes and Inland waters environmental quality</u>

- Natural surface water systems and flows – potential impacts likely to be minor due to the main creekline surface water flowpaths being maintained and can be managed through typical stormwater management measures such as levees around the pit, diversion drains around waste dumps, and culverts under roads.
- Surface water resources – discharge wetting front will be within existing approved limits, and therefore there will be negligible additional impacts on the downstream hydrological system of Weeli Wolli Creek.
- Altered flow regime to the Fortescue Marsh – surface water wetting front associated with the additional discharge from the Proposal is predicted to remain within existing approved limits of MS 914.
- Potential contamination of surface water and groundwater – acid rock drainage risk at the Revised Proposal Development Envelope has been assessed as low. Site drainage will be designed to minimise or eliminate surface runoff into areas where activities with a potential risk of hydrocarbon contamination occur. Management of waste dumps will ensure that risks of contamination of surface and groundwater are minimised. Groundwater discharged at the surface is fresh and is currently monitored and managed following ANZACC guidelines for freshwater ecosystems.

<u>Flora and vegetation</u>

- Clearing of up to 1,800 ha of vegetation (including 69 ha riparian vegetation).
- Stress and loss of some riparian vegetation associated with dewatering activities (drawdown), particularly more groundwater dependant vegetation and younger recruitment/augmented areas of riparian vegetation sustained by pre-existing

discharge, with the vegetation expected to return to a more 'natural' state (i.e. pre-mining).

- Loss of some riparian vegetation associated with surplus water discharge, particularly waterlogging affects and the establishment of waterlogging tolerant species including sedges and rushes, though overall impacts will be limited to the currently approved footprint limit within MS 914 (17 km downstream from confluence of Marillana and Weeli Wolli Creeks).
- No loss of known and recorded individuals of *Lepidium catapycnon* (Hamersley Lepidium); redesign of the waste dumps has avoided recorded individuals.
- Other vegetation communities within the Proposal Area are largely typical of that occurring in similar habitats elsewhere in the region, or are considered relatively widespread in the Pilbara beyond the Proposal Area.
- Removal of some individuals of Priority 4 flora species (*Goodenia nuda*), which will not affect the species' conservation status.
- Rehabilitation using native vegetation of areas disturbed by the Proposal, consistent with the Yandicoogina Closure Plan.

<u>Terrestrial fauna</u>

Terrestrial vertebrate fauna

- Clearing of up to 1,800 ha of terrestrial fauna habitat over the life of the project and habitat degradation due to the altered groundwater regime (some tree deaths within the riparian zone), which may lead to local reductions in current fauna populations in the Proposal Area.
- The habitat types present in the Proposal Area are considered to be well represented in the local and regional area. It is considered likely that terrestrial fauna will continue to persist in the remaining habitats within and adjacent to the Proposal Area during operations.
- Clearing will result in the direct removal of up to 1,800 ha of potential SRE habitat within Proposal Area; this habitat is considered widespread locally and regionally.
- Limited aquatic habitat will be lost or fragmented as a result of the Proposal.
- Vegetation clearing within the Proposal Area is not anticipated to cause any significant fragmentation of habitat or disruptions to ecological linkages.
- Progressive rehabilitation, with consideration given to restoring pre-mining fauna habitat values where practicable.

Short range endemic fauna

- Four mygalomorph spider species are considered to represent potential SREs: Idiopidae sp. I1, Idiopidae sp. I9, Nemesiidae sp. N42 and Nemesiidae sp. N44.
- All species have been previously recorded outside the Proposal Area.
- Potential SRE habitat within the Proposal area is considered widespread locally and regionally.

Aquatic fauna

- The most recent aquatic fauna surveys in 2013 and 2014 recorded 283 invertebrate fauna taxa in the Proposal Area.
- Some undescribed hyporheic taxa are potential new species.
- Five stygobitic amphipod/isopod species were considered to be potential SREs.
- Three fish species were observed, none of which are conservation listed.
- Limited aquatic fauna habitat will be lost or fragmented as a result of the Proposal, as the low-flow channel will remain in situ and larger rainfall events will continue to provide natural flood flows in Weeli Wolli Creek, which sustains connection upstream to Weeli Wolli Spring and downstream to Fortescue Marsh.

<u>Subterranean fauna</u>

- Thirteen phases of stygofauna sampling have been conducted in and around the Revised Proposal Development Envelope since 2003.
- A total of 2,761 specimens from 62 taxa have been recorded in the Proposal Area to date, 39 of which occur within the proposed mine pit boundary.
- Of the 39 taxa recorded within the proposed pit boundary, three species are not known from any other records outside this area: *Notobathynella* sp., *Billibathynella* sp. B02 and *Brevisomabathynella* cf. *pilbaraensis*. These species are not currently conservation listed and current distribution is considered likely to be an artefact of sampling.
- Direct mortality and reduction in available subterranean habitat will occur as a result of pit excavation and groundwater drawdown.
- Potential impacts will be localised to the proposed pit area and the groundwater drawdown zone during mining operations. However, it is not expected to significantly impact subterranean assemblages and species persistence.
- The continuous nature of the alluvium, colluvium and calcrete units in which the subterranean fauna were predominately recorded indicates that geology is not a limiting factor in the distribution of the taxa currently known from the proposed pit area and the groundwater drawdown zone within the Proposal Area.
- The risk of pollutants being transported into the subterranean habitats is likely to be low and restricted to localised areas.

<u>Rehabilitation and closure</u>

- Pit walls of the final mine void that are adjacent to Weeli Wolli Creek are stabilised in a way that prevents the creek from collapsing into the mine voids post-closure, ensuring continued function of Weeli Wolli Creek.
- All areas disturbed for mining (with the exception of pit walls) and infrastructure that are not required by the State (under conditions of applicable State Agreements) are rehabilitated to a condition compatible with the post-mining land use following decommissioning.

- Creation of a dynamic wetland environment within the mine void, including two pit lakes and associated lake fringe, with water levels that will rise and fall in accordance with flooding of the creek systems.

- Regional hydrogeological impacts are minimised and adequately managed.

- Outside of the mining disturbance areas and more than 2 km from the Proposal mine voids, water levels are largely predicted to return to pre-disturbance levels.

- No impacts to the hydrological regime of the Fortescue Marsh as a result of closure of the site.

<u>Other Factors</u>

Aboriginal heritage

- Aboriginal heritage sites could potentially be disturbed by proposed activities such as clearing, dewatering, excavation and surface water discharge; however it is Rio Tinto's policy to avoid heritage sites, wherever practicable.
- Any disturbance to archaeological/ethnographic sites will be in accordance with the provisions of the *Aboriginal Heritage Act 1972* (WA) and will have the consent of the relevant Traditional Owners.

Air quality

- The proposal will generate dust during construction and mining activities such as vegetation clearing, earthworks and mining (including blasting), vehicle movements and dry ore processing, stockpiling, reclaiming and transport.
- Existing Rio Tinto procedures and practices used at the existing Yandi Operations to effectively prevent significant dust emissions will be applied to the Proposal.

Amenity

- Temporary visual effects in the immediate region around the mine pit with the use of waste dumps and infrastructure/facilities.

- Extent and condition of riparian vegetation is expected to be reduced in the long term as the creeks (that are currently receiving discharge water from mining operations) are ultimately returned to an ephemeral system.

- Rehabilitation is expected to return the visual amenity as much as possible to the original pre-disturbance landscape. Two pit lakes will be created within the Proposal Area; while changing components of the pre-mining amenity, they are expected to create new ecosystems.

- The management measures outlined in the Yandicoogina Closure Plan are expected to maintain the key amenity values after mine closure.

Offsets

Taking into account measures to avoid, minimise and rehabilitate impacts, the following significant residual impact arising from the Proposal has been identified:

- Clearing of up to 1,731 ha of native vegetation in Good to Excellent condition within the Proposal Area, including fauna habitat (excluding riparian zone vegetation[2]).

- Clearing of up to 69 ha of native riparian zone vegetation[2] within the Proposal Area, including fauna habitat.

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[2] For the purposes of the offset calculation, riparian vegetation is classified as vegetation units within the riparian zone comprising C-coded and F2 coded vegetation located within the RCA.

Contents page

Tables

Figures

Part 1 – Introduction

This part introduces and broadly outlines the Proposal and the purpose and scope of this document. This part also outlines development alternatives considered and describes the stakeholder engagement process undertaken for the Proposal.

1. Introduction

1.1 Overview

Hamersley Iron – Yandi Pty Limited is seeking to develop a new brownfields iron ore mine pit to sustain its existing Yandicoogina Operations (Yandi Operations). This Proposal is referred to as the 'Yandicoogina Pocket and Billiard South Iron Ore Development' (the Proposal) and will involve construction and operation of a new mine pit, waste dumps and associated infrastructure to enable sustained production from the existing Yandi Operations. Collectively, the Proposal and the existing Yandi Operations are referred to as the 'Revised Proposal'.

The Proposal is expected to have a total throughput of up to 31 million tonnes per annum (Mtpa), as the existing Yandi Operations are depleted, and is expected to have an operational mine life of approximately 16 years.

1.2 Proponent

The Proponent for the Proposal is Hamersley Iron – Yandi Pty Limited ('the Proponent'). The Proponent is a wholly owned member of the Rio Tinto Group and forms part of Rio Tinto's global Iron Ore business. This includes several wholly owned subsidiaries and joint venture initiatives in the Pilbara region of north west Western Australia (WA).

The Proponent contact person in relation to the environmental approvals process for the Proposal is:

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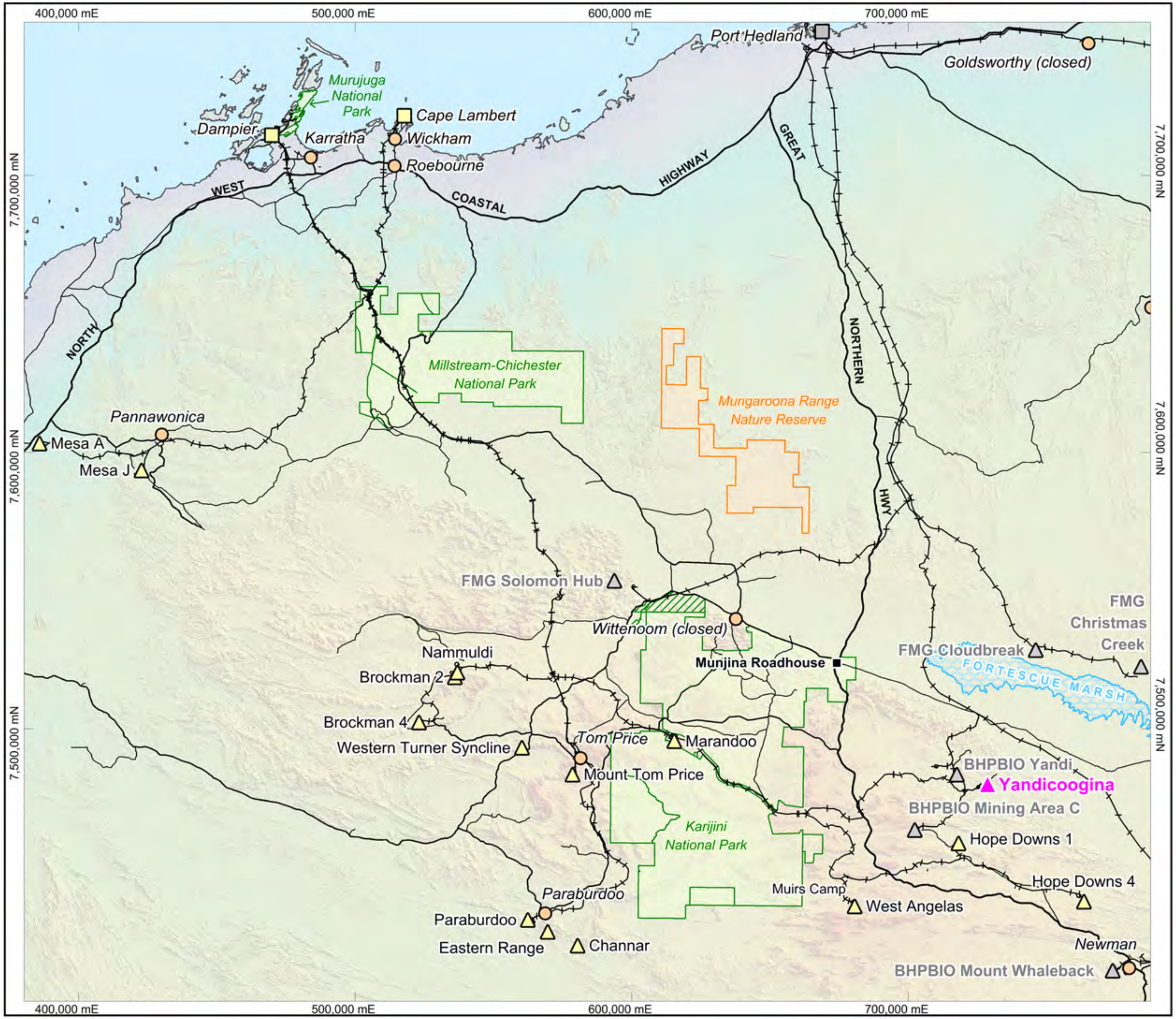
Telephone: +61 8 6211 6991
Facsimile: +61 8 9327 2696
Email: melinda.brand@riotinto.com

1.3 Location of the Proposal and Proposal elements

The Proposal (the Proposal) is located in the central Pilbara region of WA approximately 90 kilometres (km) north west of Newman and 300 km south east of Dampier (

Figure 1). The Proposal deposits are located immediately east of the existing Yandi Operations Junction Central (JC) and Junction South East (JSE) deposits and the more recently approved Junction South West (JSW) and Oxbow deposits (**Figure 2**).



LEGEND

- Yandicoogina Project
- Rio Tinto Mine
- Rio Tinto Port
- Town
- Other Mine (BHPBIO & FMG)
- Other Port (BHPBIO & FMG)
- Railway
- Highway
- Major Road
- Minor Road
- National Park
- Proposed Addition to Karijni National Park
- Nature Reserve

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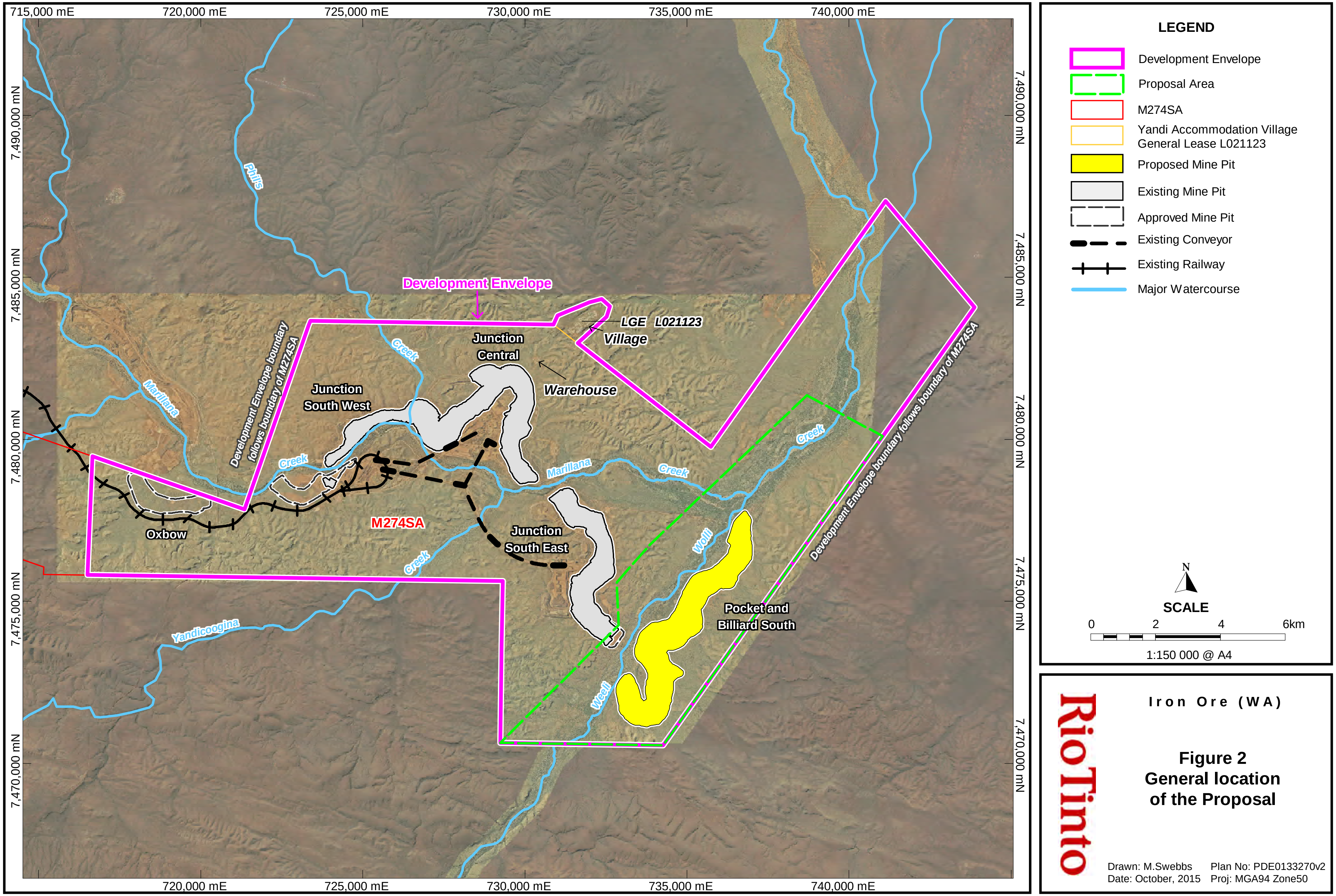
RioTinto

Iron Ore (WA)

**Figure 1
Regional setting
of the Yandi
PBS Proposal**

Drawn: M.Swebbs
Date: Aug, 2015

Plan No: PDE0128513v1
Proj: MGA94 Zone50



Rio Tinto

Iron Ore (WA)

Figure 2
General location of the Proposal

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0133270v2
Proj: MGA94 Zone50

Geospatial Information and Mapping

The Proposal is centred on a substantial CID immediately to the east of the existing Yandi Operations. The Proposal is a revision to the existing Yandi Operations as approved under Ministerial Statement No. 914 (MS 914) in 2012, and includes the following key additions:

- A new below water table open cut pit and associated infrastructure (ore and waste dumps and haul roads).
- Supporting infrastructure (light vehicle roads, creek crossing, flood protection levees, diversion drains, dewatering infrastructure, power and telecommunications).
- Additional dewatering of the CID aquifer, including discharge to local creeks.

The Proposal will utilise processing and materials handling infrastructure already installed at the existing Yandi Operations.

1.4 Proposal context

1.4.1 Existing Yandi Operations

The existing Yandi Operations are currently centred over three mining areas: JC, JSE and JSW (A & C); with a replacement orebody Oxbow due to come online in 2017.

The mine pits are all contained within a continuous CID orebody, which also forms a major aquifer in the area. Approximately 80% of the orebody is situated below the pre-mining water table and as a consequence, dewatering is a key requirement of mining activities for the existing Yandi Operations.

The existing Yandi Operations, as approved, currently consists of:

- Five open cut pits within the CID: JC, JSE and JSW-C (currently operating); and JSW-A and Oxbow (approved but not yet operating).
- A 90 km rail line to Juna Downs.
- Mine infrastructure (e.g. product stockpiles, waste dumps, topsoil, low grade stockpiles, waste fines storage facilities and haul roads).
- Associated infrastructure (e.g. overland conveyors, mine access roads, offices, warehouses, accommodation, bore fields, fuel storage facilities and utilities).
- Abstraction of up to 53 gigalitres per year (GL/y).
- A water management system including on-site reuse of water abstracted from pit dewatering, and discharge of surplus volumes into creek systems.
- Dry and wet processing plants.
- Flood protection structures.
- Power and communications infrastructure.

The key characteristics of the existing Yandi Operations, as described in Schedule 1 of MS 914, and the Proposal key characteristics, which together comprise the Yandicoogina Iron Ore Project – Revised Proposal, are outlined in **Table 1**.

Table 1: Summary of Revised Proposal key characteristics

Characteristic	Revised Proposal		
	Yandi Operations (existing)	**The Proposal (additional proposed)**	**Yandi Operations (Revised Proposal)**
Short description	The proposal is to develop Iron Ore deposits Junction Central, Junction South East, Junction South West and Oxbow, located in the central Pilbara region of Western Australia, on mining lease 274SA. Key aspects of the proposal include: • Ore transport and storage infrastructure (including rail link) – car dumpers, conveyors, stockyards, ore stackers and ore reclaimers, and storage infrastructure, rail loops. • Rail corridor allowing for rail lines and associated infrastructure. • Construction and operations support infrastructure. • A diesel-fired power station and transmission lines. • Dry and wet processing plants (including in pit waste fines storage facilities). • Flood protection structures. • Accommodation camps. • Access roads. • An airstrip.	The proposal is to develop a below water table open cut Iron Ore mine at Pocket and Billiard South, located in the central Pilbara region of Western Australia, on mining lease 274SA. Key aspects of the proposal include: • Temporary surface waste dumps; • Major infrastructure including a flood protection levee, a diversion drain and Weeli Wolli Creek crossing; and • Supporting mine infrastructure including power spur, haul roads and ramps, mine access and internal road network, and dewatering infrastructure (dewatering pipeline, bores and outlets).	The proposal is to develop Iron Ore deposits Junction Central, Junction South East, Junction South West, Oxbow and Yandi PBS, located in the central Pilbara region of Western Australia, on mining lease 274SA. Key aspects of the proposal include: • Ore transport and storage infrastructure (including rail link) – overland conveyors, stockyards, ore stackers and ore reclaimers, and storage infrastructure, rail loops. • Rail corridor allowing for rail lines and associated infrastructure. • Construction and operations support infrastructure. • 220kv power network including switchyard, back-up diesel power and transmission lines. • Dry and wet processing plants (including in pit waste fines storage facilities). • Flood protection structures and creek crossings. • Accommodation camps. • Access roads.
Physical elements			
Mine and associated infrastructure	Vegetation clearing up to 5,600 ha within Restricted Clearing Area 1; and Vegetation clearing up to 60 ha within Restricted Clearing Area 2	Vegetation clearing up to 1,300 ha for mining and waste dumps Vegetation clearing up to 500 ha for infrastructure	Vegetation clearing up to 7400 ha within Revised Proposal Development Envelope. Vegetation clearing up to 129 ha within the proposed Restricted Clearing Area.
Railway and associated infrastructure	90 km rail line	No additional rail required	No additional rail required.

Characteristic	Revised Proposal		
	Yandi Operations (existing)	The Proposal (additional proposed)	Yandi Operations (Revised Proposal)
Operational elements			
Dewatering	No more than 35 GL/year from Junction South East and Junction Central operations. No more than 18 GL/year from Junction South West A, Junction South West C and Oxbow operations.	Approximately 50 GL/year for the Proposal	No more than 83 GL/year for the entire Revised Proposal.
Surface water discharge	Up to 16 GL/year from Junction South West A, Junction South West C and Oxbow operations.	Approximately 50 GL/year for the Proposal	Up to 78 GL/year for the entire Revised Proposal. No water flow or pooling further than 17 km downstream from the Marillana Creek and Weeli Wolli Creek system confluence.

1.4.2 Approvals history of the existing Yandi Operations

Iron Ore mining at the existing Yandi Operations is subject to the *Iron Ore (Yandicoogina) Agreement Act 1996*, which came into effect on 22 October 1996. Mining at JC received approval from the Minister for the Environment on 24 May 1996 (MS 417) and was subsequently amended on 1 October 1999 (MS 523). Mining at JSE received approval from the Minister for the Environment on 22 October 2005 (MS 695), with mining activities commencing at JC and JSE in 1998 and 2006 respectively.

The most recent approval (MS 914, issued on 18 October 2012) amalgamated the existing JC and JSE Ministerial Statements to a single set of contemporary conditions via s46B of the WA *Environmental Protection Act 1986* (EP Act), and included the incorporation of three new mine pits at JSW-A & C and Oxbow. The JSW and Oxbow approval was also subject to Commonwealth approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) via Decision notice 2011/5815.

1.5 Purpose and scope of this document

This Public Environmental Review (PER) document is required for the formal assessment of the Proposal under Part IV of the EP Act, administered by the WA Environmental Protection Authority (EPA). The Proposal was referred to the WA EPA on 4 July 2014 and the EPA determined that the Proposal required assessment at the level of PER.

The purpose of the PER is to present an environmental review of the principal components of the Proposal, including a detailed impact assessment and description of proposed environmental management measures for key environmental factors in accordance with the Environmental Scoping Document (ESD) prepared by the EPA (**Appendix 1**).

The preliminary key environmental factors relevant to the Proposal are (as outlined in the ESD):

- Flora and vegetation.
- Terrestrial fauna.
- Subterranean fauna.
- Hydrological processes and inland waters environmental quality.
- Rehabilitation and closure (integrating factor).
- Offsets (integrating factor).

During the assessment of proposals, other factors or matters may be identified as relevant to the proposal, but are not of significance to warrant further assessment by the EPA, or are impacts that can be regulated by other statutory processes to meet the EPA's objectives. However in some circumstances, other factors, while not being considered as preliminary key environmental factors or integrating factors, may require greater emphasis in the PER document. The preliminary other environmental factors relevant to the Proposal are (as outlined in the ESD):

- Aboriginal heritage.
- Air quality.
- Amenity.

The State environmental assessment process and the identification of key environmental factors for the Proposal are further described in Section 8 and Section 9 respectively.

The PER addresses all phases of the Proposal (construction, commissioning, operations and closure) and is structured as follows:

- **Part 1 Introduction**: A discussion of the purpose and scope of this document, the background to and development of the Proposal, the development alternatives considered, and details of the stakeholder engagement process undertaken.
- **Part 2 Description of Proposal**: A detailed description of the Proposal.
- **Part 3 Overview of Existing Environment**: An overview of the relevant features of the existing environment of the Revised Proposal Development Envelope and surrounding area.
- **Part 4 Approach to environmental factors**: A description of the State and Commonwealth environmental assessment processes, the applicable legislative and policy context and the approach taken for considering the potential environmental impacts of the Proposal.
- **Part 5 Assessment of environmental factors**: An assessment of key potential environmental impacts of the Proposal on the identified key environmental factors and the environmental management measures and predicted outcomes.
- **Part 6 Summary of cumulative impacts**: A summary of the cumulative impacts associated with the Proposal and nearby projects.
- **Part 7 Proposed environmental management program and environmental commitments**: A description of the environmental management framework and measures to offset any significant residual impacts that may arise from implementation of the Proposal, and proposed conditions of approval.

2. Development justification and alternatives considered

2.1 Proposal rationale and benefits

The Proposal is in close proximity to the existing Yandi Operations including ore processing plants and rail load-out facilities at JC, and will sustain mining as the existing deposits become depleted.

The Proposal will optimise Rio Tinto's existing infrastructure where possible, including railway, power, communications and road networks. This will reduce the extent of new infrastructure typically required for greenfield developments and result in a smaller disturbance footprint than would otherwise be required for a project of this scale.

These aspects make the Proposal a highly desirable option to contribute to the continued success of the WA Iron Ore industry, with consequent benefits for the wider economy.

New employment will be created during the mine construction phase of the Proposal. Further, the operating life of existing mine and rail transportation infrastructure will be extended resulting in the operational workforce being maintained beyond the lifespan of the existing Yandi Operations.

The Proposal will result in the continuation of economic benefits for WA and Australia through:

- contribution to the value of mineral exports;
- royalties and taxation payments;
- capital investment;
- increasing direct and indirect employment opportunities in the region;
- increasing demand for goods and services supporting the regional economy; and
- assisting to sustain the Pilbara Iron Ore industry.

The Banjima, Nyiyaparli and Yinhawangka people (the Traditional Owners) will also benefit under the terms of the Yandicoogina Land Use Agreement (YLUA). The YLUA was the first major land use agreement to be signed in Australia, and provides the basis for delivering social and economic benefits to Aboriginal stakeholders.

The ongoing activities of the Proponent, and more broadly Rio Tinto, in the Pilbara region will continue to support social and economic development projects, including:

- increasing the potential education, training, employment and business options for local Aboriginal people; and
- funding a range of organisations in the region, including sporting and cultural groups.

In connection with its existing and planned mining activities in the Pilbara, Rio Tinto also contributes to a range of research activities addressing regionally relevant environmental impacts. Examples of these projects include research into:

- Plant-water relationships in Pilbara vegetation, including:
    - the occurrence and nature of groundwater dependence in different tree species;
    - developing methods for measuring the effects of groundwater drawdown on vegetation; and
    - water use physiology of Mulga vegetation and strategies for maintaining surface flow regimes for Mulga conservation.
- The distribution and taxonomy of subterranean and short range endemic fauna, in collaboration with the Western Australian Museum (WAM) and in association with the Department of Parks and Wildlife (Parks and Wildlife).
- Predicting and managing water quality in pit voids.
- The palaeoclimatic history, geology and hydrology of the Fortescue Marsh.
- Recharge and hydrological process of Weeli Wolli Creek.
- Adaptive responses of fish to altered flow regimes and Pilbara regional study of bioaccumulation of metals in fish.

Key research collaborators in these projects include the University of Western Australia, Parks and Wildlife and WAM.

2.1.1 Demand for Iron Ore

Mining is an important component of the WA and national economies. The value of Western Australia's mineral and petroleum industry in 2014 reached just over $114 billion (DMP 2015). Iron Ore remained the State's highest value commodity, accounting for a $65 billion (75%) of total mineral sales in 2014. This represents a decrease of 6% from 2013, which can be attributed to the sharp drop in Iron Ore prices in the second half of the year. In total 697 million tonnes of Iron Ore were exported which was an increase of 25% on the previous calendar year (DMP 2015).

Mining and petroleum contributed approximately 91% of WA's merchandise exports in 2014. China remained the state's largest market, accounting for 51% of the state's total merchandise exports. As at March 2015, Western Australia had an estimated $179 billion worth of resource projects under construction or in the committed stage of development. A further $118 billion has been identified as being allocated to planned or possible projects in coming years (DMP 2015).

2.2 Evaluation of development alternatives

2.2.1 Evaluation of crusher and ore transport alternatives

A number of crusher and conveyor configurations were investigated based on varying saleable ore product tonnages to test crushing and conveying as an alternative to trucking to the plant. Some of the various conveyor routes and crusher locations examined are shown in **Figure 3**.

Two crusher locations were assessed; one to the east of the orebody, and one to the west, using a combination of trucking to the crushers and then conveying to the existing processing plant(s). From the analysis carried out, the crusher facilities at the existing

Yandi Operations will be utilised and trucking is the preferred ore transport option for the Proposal.

2.2.2 Evaluation of options for crossing Weeli Wolli Creek

A crossing at Weeli Wolli Creek is required to enable ore movement from the Proposal deposits to the various JSE and JC processing plants. As the Proposal deposit is entirely located east of Weeli Wolli Creek, a creek crossing via a culvert-floodway structure will be required to access facilities at the existing Yandi Operations, located entirely west of Weeli Wolli Creek. A number of locations for a creek crossing were identified, with the aim of minimising disturbance and water velocities and thus the potential impact to Weeli Wolli Creek and any heritage or environmentally sensitive areas.

The following three options for design of the crossing on Weeli Wolli Creek were considered:

- an engineered bridge;
- the existing Marillana-type floodway option; and
- a culvert-floodway consisting of cement stabilised base-course overlaid with a crushed rock wearing course, overlying eight 3.6 m corrugated steel pipes over the low-flow channel.

Following consultation with technical representatives on the study team for water, environment and heritage, the culvert-floodway concept was chosen as the option preferred. The culvert-floodway appears to be a more stable design than the existing Marillana-type floodway in a flooding situation, and is anticipated to cause less disruption to the flow of Weeli Wolli Creek during construction and operation.

2.2.3 Evaluation of water management options

Dewatering for the Proposal will be fully integrated with the existing Yandi Operations whole-of-site water demand; however, a substantial volume of surplus water is likely to be generated over the life of the Proposal, ranging from the existing approved approximately 16 GL/y[3] up to 78 GL/y. Some of the groundwater abstracted is expected to be used for on-site purposes such as dust control, camp usage and ore processing. The remainder will be discharged into the Marillana and Weeli Wolli Creek systems at controlled, release discharge points. Water discharge for the Proposal will tie in with the existing Yandi Operations water disposal infrastructure in the lower reaches of Marillana Creek towards the Weeli Wolli Creek confluence.

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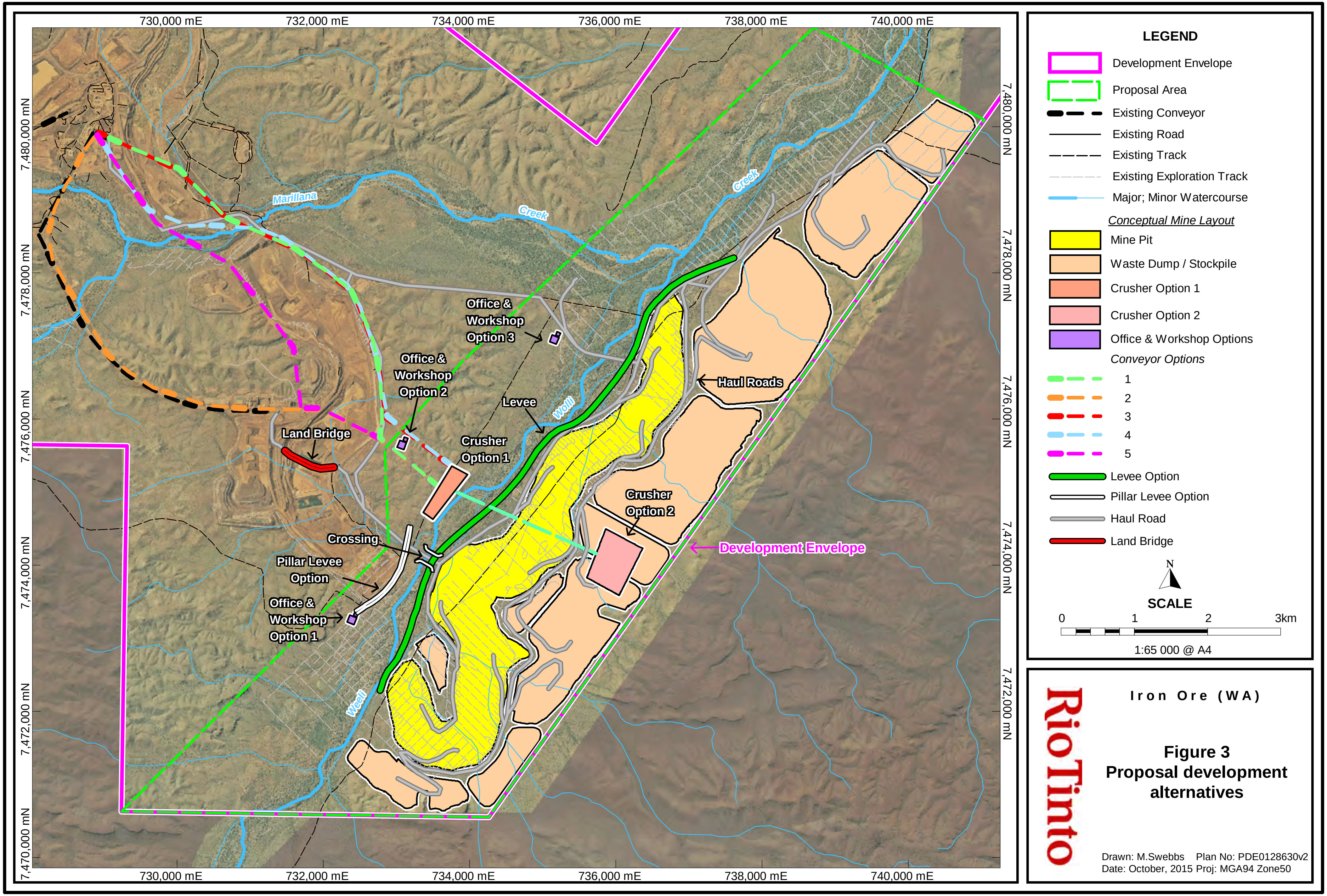
[3] Note that this limit relates to JSW and Oxbow, and does not include JC and JSE surplus water discharge. Total surplus water discharge is approximately 48 GL/y for existing Yandi Operations.



Geospatial Information and Mapping

Alternative options for the use of surplus water over and above the existing approved discharge limits for the Yandi Operation have been investigated during the pre-feasibility study, in line with the *Pilbara Water in Mining Guidelines* [Department of Water (DoW) 2009)] and *Strategic Policy 2.09: Use of mine dewatering surplus* (DoW 2013) including consideration of:

- reuse on-site;
- transfer to other current and future mining projects;
- aquifer recharge info aquifers;
- re-injection into aquifers;
- storage and evaporation;
- seasonal storage and release of water; and
- continuous surface release of water.

Additional options that have been investigated include the transfer of water to other sites such as Koodaideri and/or Hope Downs 1 and storage of water in the JC pit lake. These options and the rationale behind the selected option are described in detail in Section 13.3.4.

2.2.4 Evaluation of alternative office and workshop locations

A workshop for daily and weekly maintenance and potentially heavy vehicle refuelling facilities are proposed to be constructed, along with new office facilities consisting of an administration building for daily crew shift change meetings and a crib room with toilets. Three options were identified for the location of the workshop, refuelling and office facilities, taking into account considerations for minimal potential impact to heritage and environmental sites (**Figure 3**). An alternative location to the three options originally identified was selected due to optimisation of the location based on existing facilities.

2.2.5 No development option

The ‘do nothing’ alternative would result in the loss of opportunity to add value to Australia’s raw materials exports, the loss of economic, social and employment opportunities and the loss of potential for future developments in downstream processing of raw materials. If the Proposal does not proceed, the State of WA would forego substantial economic benefits, including:

- viable Iron Ore deposits at the Yandi Operations remaining undeveloped; and
- the decline and eventual end of production from the existing mines at Yandi Operations.

Not proceeding will prematurely reduce the existing workforce at the Yandi Operations and opportunities for supporting local communities and infrastructure would also be foregone. The ore quality within the Proposal deposits will maintain product quality specifications from the existing Yandi Operations and the Proposal will also prolong the use of the existing ore processing and transport infrastructure at Yandi.

If the Proposal did not proceed, the world’s demand for Iron Ore would then be met through the development of alternative ore deposits and processing facilities (which may have greater potential environmental impacts than the Proposal) or the development of equivalent projects located overseas with the resultant loss of benefits to the Pilbara, WA and Australia.

3. Stakeholder engagement

3.1 Key stakeholders

The following key stakeholders have been identified for the Proposal:

- Government agencies:
  - Office of the Environmental Protection Authority (OEPA).
  - Department of the Environment (DoE; Commonwealth).
  - Department of Aboriginal Affairs (DAA).
  - Department of Parks and Wildlife (Parks and Wildlife) – Pilbara regional office and Perth office Environmental Management Branch.
  - Department of Environment Regulation (DER).
  - Department of Mines and Petroleum (DMP).
  - Department of State Development (DSD).
  - Department of Water (DoW) – Pilbara regional office and Perth office.
  - Shire of East Pilbara.
- Non-government organisations:
  - Conservation Council of WA.
- Community:
  - Traditional Owners (Gumala Aboriginal Corporation).
  - Marillana Pastoral Station operators.
- Industry:
  - BHP Billiton Iron Ore (BHP).

3.2 Stakeholder engagement process

Discussions regarding the Proposal have been held with a number of stakeholders (**Table 2**).

The timing of the consultation program has enabled topics raised to be considered in the early design phase of the Proposal, during determination of management measures and as part of the preparation of the PER.

3.3 Stakeholder comments and Proponent responses

The main common topics/issues raised by stakeholders as part of the stakeholder engagement process were:

- impacts to vegetation and flora (particularly riparian vegetation and relationship to MS 914 clearing limits);
- surface and groundwater impacts, and water management;
- potential impacts to the Marillana and Weeli Wolli Creek systems;
- cumulative impacts (particularly to the creek systems);
- rehabilitation and closure (including the development of pit lakes); and
- employment opportunities for Traditional Owners.

These are outlined in more detail in **Table 3**, with the Proponent responses.

3.4 Ongoing consultation

The Proponent will continue consultation with relevant stakeholders during the environmental assessment process and through the implementation of the Proposal. In addition to the Traditional Owner groups represented by the Gumala Aboriginal Corporation and the pastoral station operators, the Proponent will consult with regulators including, but not limited to:

- DoW on the management of water resources and other matters related to the WA *Rights in Water and Irrigation Act 1914* (the RIWI Act) licensing requirements for the operations.
- DAA on the management of Aboriginal heritage sites and other matters related to the WA *Aboriginal Heritage Act 1972* requirements.
- Parks and Wildlife regarding Threatened and Priority flora and fauna species, and the Fortescue Marsh.
- DER regarding licensing matters (Part V of the EP Act).
- DSD regarding approval of the Proposal pursuant to the provisions of the *Iron Ore (Yandicoogina) Agreement Act 1996* (WA).
- OEPA regarding details of the Proposal and environmental offsets.
- DMP and other relevant stakeholders regarding closure objectives and indicative completion criteria for the Proposal.

Table 2: Stakeholder consultation relevant to the Proposal

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
OEPA		
21 March 2014	Proposal Pre-referral Presentation to OEPA. The Proponent discussed the Proposal being a Revised Proposal and provided a summary of the results of the biological surveys, potential impacts and preliminary key environmental factors for assessment. The OEPA queried why Billiard North was not included. Also queried why Billiard North was included in the Closure Plan update if not being included in the referral. Cumulative impacts – OEPA indicated that FMG's Nydinghu project and BHP's Jinidi project would need to be considered with the Proposal impacts. Queried if FMG had consulted with the Proponent on their Project. OEPA suggested that because this was a Revised Proposal that Rio would need to identify the key changes for this project in relation to the existing Yandi Operations as approved under MS 914. OEPA indicated that management of surplus water was a key focus, and recommended early consultation with the Department of Water. OEPA also queried disturbance in avoidance areas as delineated in MS 914 i.e. where/how the MS 914 avoidance area was delineated and what we were proposing in terms of disturbance. The Proponent also discussed the expected schedule for formal referral to the OEPA and a proposed Commonwealth referral.	The Billiard North project is not currently at a stage of evaluation where enough information is available to support an Environmental Impact Assessment. It was included in the Closure Plan to support a change in approach to the existing Closure Plan for JC and JSE, and to illustrate the broader life of mine closure objectives as required by DMP. A description of the Proposal and a comparison to the existing Yandi Operations is outlined in Sections 1 and 4 of this PER. The assessment process and referral timing is outlined in Section 8. Potential impacts to hydrological processes, and vegetation and flora are outlined in Sections 13 and 14 respectively. Cumulative impacts are discussed within the environmental factor sections.
21 March 2014	Presentation of the New Yandicoogina Life of Mine Closure Plan Including: • Yandicoogina project overview. • Closure objectives and criteria. • Preferred closure strategy. • Landform design.	Rehabilitation and closure associated with the Proposal is outlined in Section 17.

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	• Water management. • Habitat considerations for rehabilitation (and proposed wetland rehabilitation trial). • Unexpected closure. • Further study focus areas. • Compliance review. Key queries included salinity range of pit lakes, modelling undertaken, potential for metals to be released with increased salinity, interaction of saline pits and fresh water pits, and interactions with the creeklines, frequency of flushing of the pit lakes. Also access to pit lakes and safety issues. Discussion on development of completion criteria. Interest in wetland rehab trial and interest in rehabilitation success.	
21 April 2014	The Proponent provided detailed overview of Proposal, current/planned environmental studies, potential environmental impacts and proposed management. The preferred approvals pathway was discussed – existing management in place via MS914 – Level of Assessment will depend on significance of proposal. OEPA queried: • Closure - why Billiard North was not included in the referral if it is included in the Yandi life of mine Closure Plan. • Cumulative impacts – FMG Nyidinghu would need to be included in the cumulative impact assessment as well as Jinidi. • Avoidance areas in MS 914 – queried where they were derived from and what Hamersley Iron was proposing in terms of disturbance. • Referral – to focus on key changes for this Proposal in relation to the existing Yandi Operations.	The Proponent believes that existing conditions and management required under MS 914 for Yandi Operations would adequately address key potential impacts for the Proposal. An increase in disturbance, additional water management, and consideration of cumulative impacts are the key additional features for the Proposal. The Billiard North project is not currently at a stage of evaluation where enough information is available to support an Environmental Impact Assessment. It was included in the Closure Plan to support a change in approach to the existing Closure Plan for JC and JSE and to illustrate the broader life of mine closure objectives as required by the DMP.
21 April 2014	The Proponent provided detailed overview of the life of mine Closure Plan for the Revised Proposal. OEPA were interested in approach to wetland rehabilitation and also rehabilitation success /	The Proponent provided a copy of the presentation to the OEPA and submitted the Yandi life of mine Closure Plan to the OEPA on 31 March 2014.

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	monitoring. Discussion on pit lakes and potential for Oxbow to be saline.	Rehabilitation and closure associated with the Proposal is specifically outlined in Section 17.
12 June 2014	Updated hydrological information discussed with OEPA. Discussion on Proposal pit encroachment into Weeli Wolli Clearing Avoidance Area depicted on MS 914. Referral – to focus on key changes for this proposal in relation to the existing project (Flora and Vegetation, Fauna, hydrological processes, Closure and Rehabilitation). Context and justify impacts to environmental values identified in MS 914.	The referral document was updated to include further details on Proposal pit encroachment on the clearing avoidance zone depicted in MS 914, and focus on key changes from the existing Yandi Operations.
5 November 2014	Updated presentation on hydrogeological aspects of PBS Timing. Latest data. Surface water update – flood modelling and discharge extent modelling. Groundwater update – modelling and pump test data. Surplus water management – run through of all of the options investigated and discussion of discharge option into Marillana – Weeli Wolli creek as the only feasible option. Closure update. Other items discussed included details of the proposed levee including design, height, flood Annual Recurrence Interval (ARI) design, materials, changes to the low-flow line, and impacts on riparian vegetation from construction of the levee. Closure – stability of the pit lakes and how they will be designed and water quality.	Modelling results and predicted impacts to hydrological processes is outlined in Section 13. The Yandi life of mine Closure Plan has been updated to include the Proposal, with rehabilitation and closure of the Proposal specifically outlined in Section 17.
9 February 2015 4 March 2015	Brief update and discussion of aspects of the Proposal. Discussion of timeframes for PER and ESD. Details of the ESD discussed. Minor or Preliminary works discussion for element of the Proposal. Monitoring bores at the Tree Health monitoring sites discussed including number of sites, type of rig, clearing required and timelines.	Application for Minor or Preliminary works to be submitted. Notice for proposed monitoring works in Weeli Wolli submitted to compliance branch in June 2015.
21 April 2015	Update on Proposal Environmental Impact Assessment, including presentation of DVD's to	Information regarding hydrological processes is outlined in

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	convey: • Updated impact predictions from discharge. • Updated impact predictions from drawdown. • Timeframes. Discussion undertaken covering current altered environment and change from current to change from baseline. Discussion of any mitigation the Proponent was proposing to manage uncertainty on predictions, using an adaptive management approach, such as uncertainty of rate of change of water availability.	Section 13.
EPA		
9 June 2014	Discussed Proposal including Minor or Preliminary Works application and upcoming draft PER. Key queries raised by EPA included: *Closure.* • Details of pit lakes, including size, depth, water quality (metals and salinity), interactions with the creeklines, potential for plumes and impacts on Fortescue Marsh, long term implications. • Rehabilitation. • The Proponent's current understanding, science, results, gaps, timeframes.	Information regarding rehabilitation and closure is outlined in Section 17.
9-10 September (Site Visit: EPA / OEPA)	Site visit to Yandi Operations to specifically view and discuss the Proposal Presentation and DVD presentation of the project, predicted environmental impacts and current scientific knowledge Fly over of existing Yandicoogina Operations including review of Marillana and Weeli Wolli Creeks from Weeli Wolli Spring to the alluvial outwash fan near Fortescue Marsh Discussion of the environmental values of the Fortescue and Weeli Wolli Creek catchment and principles around operating in the Weeli Wolli Creek catchment Review of existing Yandicoogina Operations and the proposed PBS pit	Updates to the revised draft PER document including, but not limited to: articulate the Environmental Values Statement; and to clearly show the configuration of Weeli Wolli Creek and vegetation associations to more clearly present the impacts of the flood protection levee.

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	Review of wetland rehabilitation trial Discussion of closure aspects including pit depths, interactions of the pit lakes with groundwater and surface water. Discussion and look at the Weeli Wolli Creek Riparian zone and existing Clearing Avoidance Area – highlighted differences between the vegetation of the Major Creeks (the open riparian woodland around the low-flow line) and the broader floodplain (including the high flow lines). Discussion of the changes to the vegetation (augmentation) from upstream discharge An example of the existing Yandi Operations pit walls adjacent to Marillana Creek was viewed – showing the disconnect between the alluvial aquifer supporting the creek and the lower CID aquifer which had been drawn down to 60m bgl. The vegetation of Marillana Creek was sustained even with adjacent drawdown for over a decade. Discussion of existing environmental management on-site and how Yandi Operations was tracking against original impact predictions.	
Parks and Wildlife		
5 April 2014	The Proponent provided detailed overview of Proposal, current/planned environmental studies, potential environmental impacts and proposed management, with focus on biological issues. Updated details on Fortescue Marsh hydrogeology presented. The Yandi life of mine Closure Plan was presented. Key queries from Parks and Wildlife included how the 'avoidance areas' in MS 914 were developed, how water would be managed, interactions of surface water and groundwater in terms of riparian vegetation; results of biological surveys and significant flora, fauna; if the Proposal was a new assessment or would be amalgamated (as a Revised Proposal) with MS 914. Discussion of other projects in the vicinity.	The Proposal is considered a Revised Proposal of the existing Yandi Operations. The Proponent believes that existing conditions and management required under MS 914 for the existing Yandi Operations would adequately address key potential impacts for the Proposal. Results of investigations and discussion of potential impacts for key factors raised by Parks and Wildlife are outlined in Section 13 (Hydrological processes and inland waters environmental quality), Section 14 (Flora and vegetation) and Section 15 (Terrestrial fauna).
8 September 2014	Proposal update presentation including latest flora and vegetation, terrestrial fauna and hydrological investigations. Subterranean fauna also discussed.	Results of surveys/investigation, impact assessment and mitigation for key environmental factors is outlined in Section 13

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	Surplus water management options presented, including challenges of some options. Parks and Wildlife indicated that it did not require a further update on the Proposal unless any substantial changes or impacts predicted.	(Hydrological processes and inland waters environmental quality), Section 14 (Flora and vegetation), Section 15 (Terrestrial fauna) and Section 15 (Subterranean fauna).
16 April 2015	Update Presentation provided to Parks and Wildlife based on updated hydrological modelling and impact predictions. Proposal in final stages of completion to integrate the surface water and groundwater modelling and to assist with predictions of environmental impacts based on water availability in the alluvials. Discussed riparian vegetation in the Proposal Area is mostly sustained by surface water inputs, and very little dependency on groundwater. Predicted water availability changes in the alluvial aquifer as a result of drawdown from developing the Proposal deposit presented. Discussed that the key functioning elements of the system will be maintained to support longer term system function: alluvial substrate retained, which contains riparian seed bank and habitat for aquatic fauna (and subterranean fauna); flow paths (low-flow line) undisturbed; and water quality maintained. Flooding regime would still continue. System is expected over time to recover and return to pre-mining ecosystem – with some changes to the ecosystem communities upon closure. URS study has quantified this from a water availability perspective. Discussed extent of current wetting footprint in Weeli Wolli Creek remains within a 5-9 km extent from the Marillana – Weeli Wolli Creeks confluence since 2009. Modelling for the Proposal indicates that the range is still predicted to be within the existing approved 17 km limit. Options to address the environmental impacts as a result of the predicted change of water availability (and rate of change) are currently being investigated. However, the system is expected to return to that similar to pre-mining conditions (and water availability), hence the overall change in water availability to the end of mine life and closure is not proposed to be mitigated. Management plan updates: Updates to the existing Yandi Management Plans and Environmental Values Statement – values will be amended to specific environmental values, rather than broader factors e.g. hydrological processes.	Impacts to hydrological processes and, flora and vegetation is outlined in Sections 13 and 14 respectively.
14 September 2015	Brief Proposal update as part of a broader Rio Tinto Projects update.	Provide a copy of the updated EVS and MMP to Parks and Wildlife

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	Brief discussion of proposed changes (and rationale of the changes) to: • the Yandicoogina Weeli Wolli Catchment High level Environmental Values Statement (EVS; updated from 2012 version); and • the updated Yandicoogina Monitoring and Management Plan	Copy of the updated MMP and EVS sent 12/10/15 The MMP and EVS is attached in **Appendix 3**
DoE		
29-30 April 2014 (Site visit)	The Revised Proposal presented including a fly over of existing Yandi Operations and of the Proposal. DoE were interested in Matters of National Environmental Significance species found in the Revised Proposal Development Envelope. Northern Quoll not captured, however sightings at the warehouse near the camp have occurred on one occasion. Pilbara Olive Python found at the camp and sampled in Weeli Wolli Creek within the Proposal Area. No populations encountered. Significant species management procedures discussed. Outline of the Proposal presented and discussion of surveys completed and results. Discussion of proximity to Fortescue Marsh and water management. Discussion of proposal timing. Threatened Species Offset Plan for Revised Proposal discussed, including status.	A referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was proposed for the Proposal in Q3 2014, subsequent to the State referral. The Proposal was determined to be not a controlled action.
DER		
10 June 2014	Non-standard operation approval – Test pumping for Proposal. Test pumping requested for two bores, 3.8 GL over six months.	Approved by DER on 19 June 2014. Proponent notified DER on commencement (18 September 2014) and completion (24 November 2014) of test pumping regime
15 June 2015	Telephone discussion of Proposal including components relevant to DER: • additional discharge point (DO9A); • potential WWTP facilities; • potential mobile crushing and screening plants involved with construction works; and • potential workshop / washbay facilities with associated oily water treatment systems.	Presentation will be provided to DER. Awaiting confirmation of a suitable date.

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	Request to present broader Proposal.	
DoW		
21 March 2014	Presentation of the new Yandi life of mine Closure Plan.	No significant issues raised or outcomes.
10 April 2014	Pre-referral meeting to present the Proposal details and provide a high level summary of the groundwater and its abstraction and the proposed water management options including the hierarchy of use and the proposal to discharge into Marillana/Weeli Wolli Creeks. DoW queried what was in place for tree health monitoring and frequency of monitoring. Existing Yandi Operations management plan details discussed and provided. Discussed hydrological monitoring including the potential use of alluvial bores and nested bores to understand the interactions with tree health. EC and in situ loggers are currently used in the existing monitoring bores and at the discharge outlets. Flood protection levees discussed and surface water modelling associated with the location of the levees and other infrastructure. Levees would be backfilled into the Proposal pit upon closure. Discussion of what the Proponent had found in the way of stygofauna and troglofauna at the Proposal Area, and how habitat will be maintained in different areas as drawdown impacts across the entire operations variable at different times. Existing flood regime maintained to provide habitat connection.	Impacts to hydrological processes and inland waters environmental quality are outlined in Section 13; impacts to flora and vegetation are outlined in Section 14. Results of surveys and impacts to subterranean fauna are outlined in Section 15.
21 April 2014	Rio Tinto provided detailed overview of Yandi life of mine Closure Plan, including the Proposal. DoW queried the pit lakes and options if future deposits were not approved; likely salinity ranges; interactions for saline and fresh water pits; metals released in hypersaline conditions.	Rio Tinto has looked at 'early closure' contingencies and has addressed the possible options of future deposits not being approved. Further details regarding pit lakes are outlined in Section 17 (Rehabilitation and closure).
23 September 2014	An update was presented on the Proposal Environmental Impact Assessment including: • Timing. • Latest data. • Environmental Scoping requirements, including requirement for DoW endorsement of	Results of investigations and impacts to hydrological processes are outlined in Section 13.

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	consultants used for peer reviewers – selection discussed. DoW will discuss with OEPA. • Surface water update – flood modelling and discharge extent modelling. • Groundwater update – modelling and pump test data. • Surplus water management – run through of all of the options investigated and discussion of discharge option into Marillana – Weeli Wolli Creek system as the only feasible option. • Other items discussed included details of the proposed levee including design, height, flood ARI design, materials, base foundation conditions and control of subsurface water.	
26 November 2014 (site trip)	Site trip to Revised Proposal Development Envelope with DoW to present the existing Yandi Operations and specifically the Proposal. Discussed proposed plan for water management for the Proposal and discharge into Marillana/Weeli Wolli Creeks. Reviewed and discussed tree health monitoring data and limitations. Discussed existing hydrological monitoring - DoW indicated their interest in having monitoring bores located with tree health monitoring sites and if feasible to undertake with a Sonic rig. Infiltration testwork presented, discussing extremely high infiltration rates to the north of the Marillana - Weeli Wolli Creeks confluence and discussion on how this work supported Shawan Dogramaci's paper on the discharge from the existing Yandi Operations, as well as current observations of the wetting front from discharge (still in the range of 5-9 km past the confluence – similar since 2010). Discussed hydrological modelling, taking into account cumulative impacts. Discussed details of the recent hydrogeological pump test program, and future programs.	Results of investigations and impacts to hydrological processes are outlined in Section 13.
22 April 2015	The Proponent presented a series of DVD's to provide an environmental impact update and outline the baseline ecological regime, with a focus on riparian (phreatophytic) vegetation and water availability. • Discussed riparian vegetation in the Proposal Area is mostly sustained by surface water inputs, and very little dependency on groundwater. This is reflected in both current and historical riparian communities / species. No mature C1 vegetation (containing Melaleuca argentea,	Impacts to Flora and vegetation are outlined in Section 14.

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	which is the environmental value defined in the Environmental Value Statement) occurs in the Proposal Area. Vegetation community composition changes have occurred in Weeli Wolli Creek as a result of increased water availability including recruitment of Melaleuca argentea. • Discussed that the key functioning elements of the system will be maintained to support longer term system function: alluvial substrate retained, which contains riparian seed bank and habitat for aquatic fauna (and subterranean fauna); flow paths (low-flow line) undisturbed; and water quality maintained. Flooding regime would still continue. Ecosystem is robust and adaptive to changed conditions. • Significant ecosystem monitoring and management currently occurring (trees, water quality, aquatic fauna), and will continue to occur throughout the life of mine and through to closure. • Predicted water availability changes in the alluvial aquifer as a result of drawdown from developing the Proposal deposit presented. The likely result is increased drought stress (and some tree deaths) through this reach as a result of the Proposal. • System is expected over time to recover and return to pre-mining ecosystem – with some changes to the ecosystem communities upon closure. URS study has quantified this from a water availability perspective: A net reduction of about 10% in total water availability is expected upon closure. • Updates to the existing Yandi Operations management plans and Environmental Values Statement – values will be amended to specific environmental values, rather than broader factors e.g. hydrological processes. • DoW queried the Melaleuca recruitment and if this was a result of elevated water table from Hope Downs 1. • DoW queried the root morphology changes and about the rate of change of the phreatophytic root system in response to water availability. Also how this contexts with historical riparian communities in the catchment. Queried what would be the rate of change of water availability in the alluvials i.e. How long normal residence time was compared to changed (mining drawdown)	

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	conditions. Options to address the environmental impacts as a result of the predicted change of water availability (and rate of change) are currently being investigated. However, the system is expected to return to that similar to pre-mining conditions (and water availability), hence the overall change in water availability to the end of mine life and closure is not proposed to be mitigated.	
29 September	The Proponent discussed DoW comments on the draft PER document. • Design criteria for surface water infrastructure • Stygofauna habitat and cumulative impacts • Dewatering volumes and consistency between reports • Historical / baseline groundwater levels Boundary conditions used in modelling including in relation to Fortescue Marsh	Updates made to the Revised draft PER document.
DMP		
21 March 2014	Presentation of the new Yandi life of mine Closure Plan, including: • Yandicoogina project overview. • Closure objectives and criteria. • Preferred closure strategy. • Landform design. • Water management. • Habitat considerations for rehabilitation (and proposed wetland rehabilitation trial). • Unexpected closure. • Further study focus areas. • Compliance review. Key queries included salinity range of pit lakes, modelling undertaken, potential for metals to be released with increased salinity, interaction of saline pits and fresh water pits, and interactions with the creeklines, frequency of flushing of the pit lakes. Also access to pit lakes and safety issues.	Rehabilitation and closure is outlined in Section 17.

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	Discussion on development of completion criteria. Interest in wetland rehab trial and interest in rehabilitation success.	
21 April 2014	The Proponent provided a detailed overview of the Yandi life of mine Closure Plan for the Revised Proposal. DMP discussed that their guidelines are being changed so that Section 4 flows better. DMP commented about future unapproved projects in the Closure Plan. Discussed focus on rehabilitation in the Pilbara; access to pits and safety issues post-closure; completion criteria – want to target frames as "not to exceed" – need a way in which to measure/assess completion criteria.	Rehabilitation and closure is outlined in Section 17.
20 November 2014	Joint Yandi Operations site trip with DSD and DMP to Yandi to discuss rehabilitation and closure planning. Discussed the Closure Plan at a high level. DMP noted that the plan contained a lot of very technical information. Wetland rehabilitation trial area visited and discussed. DMP interested to see the outcomes. Progressive rehabilitation discussed including planning process and seed collection. Topsoil management, Tailing storage facility, Landfill, Turkey's nest management discussed.	No significant issues raised or outcomes.
27 May 2015	Brief update presentation and DVD's of updated Yandi life of mine Closure Plan to support the Proposal PER, including closure objectives and conceptual completion criteria. Aspects of closure discussed included the establishment of a wetland rehabilitation trial so as to better determine what plants will do best and how far away from the water table they need to be located in order to be sustained.	Rehabilitation and closure is outlined in Section 17.
3 August 2015	Presentation and DVD's of updated Yandicoogina life of mine Closure Plan to support the Proposal PER, including closure objectives and conceptual completion criteria. Items discussed included: Plan for backfill areas including sloped walls Impact of flood events and remedial work required	The Proponent acknowledged the importance of ongoing stakeholder consultation to developing the final land use and detailed completion criteria. The updated Closure Plan contains a risk assessment to identify gaps and support a process to address. The PER document will be updated to include further information

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	Wetland rehabilitation trial details Abandonment bunds Final land use & completion criteria – plan for developing details Water quality including salinity and other potential leachates Timing for closure DMP were interested if closure and waste management would be integrated with BHP's Yandicoogina Operations	from the updated Closure Plan.
DSD		
20 August 2014	Overview of 2015-2017 Pilbara mine plan including Proposal.	No significant issues raised or outcomes.
20 November 2014	Joint Yandi Operations site trip with DSD and DMP to discuss rehabilitation and closure planning. Discussed the Closure Plan at a high level. DMP noted that the plan contained a lot of very technical information. Wetland rehabilitation trial area visited and discussed. DMP interested to see the outcomes. Progressive rehabilitation discussed including planning process and seed collection. Topsoil management, Tailing storage facility, Landfill, Turkey's nest management discussed.	No significant issues raised or outcomes.
18 June 2015	High level overview of the Proposal provided.	DSD requested to be provided with further information in writing, which was provided on 25 June 2015.
31 August 2015 (Site visit)	Site visit to Yandicoogina Operations to present the Pocket and Billiard South Proposal The overall scope of the Proposal was presented Details of the Environmental Impact Assessment including predicted impacts and timing for the PER document discussed. Predicted impacts to Weeli Wolli Creek were discussed.	DSD requested to be provided with ongoing updates of the Proposal, including the PER timing.
DAA		
7 July 2014	The Proponent met with DAA and provided a high level overview of the Proposal.	The Proponent confirmed with DAA that a large portion of the Proposal Area has already been surveyed and that surveys will

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	DAA requested information on disturbance of sites when available.	be conducted prior to the commencement of any ground disturbance as per Rio Tinto's protocols. The Proponent is also reviewing designs to avoid areas of concern (including heritage sites) to avoid/minimise impact. The Proponent will continue to liaise with DAA and the Traditional Owners through its existing meeting forums to provide updates on the Proposal, the existing operations and where approvals may be required to disturb sites.
Gumula – Traditional Owners		
June 2013	Yandicoogina Land Use Agreement Monitoring and Liaison Committee meeting. An overview of the mine closure process was presented to the Gumala Aboriginal Corporation board members. It was agreed at the meeting to form a sub-committee/working group to address issues relating to closure and land management. The terms of reference for the sub-committee/working group are yet to be resolved.	The Proponent subsequently (October 2013) met with the Gumala Aboriginal Corporation Lore and Culture Committee to discuss participation of Elders in the closure working group. A decision on Elder's participation and representation is still pending.
4 February 2014 5 May 2014 12 August 2014 15 December 2014 15 April 2015 13 May 2015 16 July 2015	Monitoring and Liaison Committee Meeting update presentations of Yandicoogina Closure Plan. Topics discussed included: • Preservation of remaining ecosystems and protection for creek banks. • Lake water quality. • Ongoing importance of ethnographic and archaeological surveys. • Role of Gumala Aboriginal Corporation in closure planning. • Importance of including Elders and young people in consultation. • Management of artefacts at closure. • Potential community use of site infrastructure after closure. • Access through and around the mine and into the lake areas. Presentations and DVD presentations on the Proposal. Topics discussed included: • Overview of the Proposal including tie in with existing Yandi Operations.	A copy of the Draft PER will be provided to Gumala Aboriginal Corporation. Presentation of the Proposal was provided at the Hope Downs 1 Weeli Wolli Co-Management Board Forum.

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	• Timing of the Proposal. • Infrastructure requirements. • Outline of baseline biological surveys and findings. • Water related impacts presented and discussed, including drawdown and discharge into Marillana and Weeli Wolli Creeks and predicted environmental impacts on the system. Existing creeklines artificially altered from many years of discharge – especially Weeli Wolli and so currently look different to their original ephemeral state. Water availability after mining will revert back to pre-mining levels and therefore will not be able to sustain current water availability for trees and fish – some tree stress and death expected and less waterholes for fish/fishing. • Access to Weeli Wolli Creek will be permanently limited in the vicinity of the Proposal. • Discussion on cumulative impacts from the Proposal and other mines in the area and how this may change the water in the creeklines – query on Hope Downs 1 and if they will continue to discharge. • Presentations and discussion of tree health and water quality monitoring. Discussion of potential involvement of Traditional Owners in future monitoring. • Traditional Owners also expressed interest in the expected life of mine, water quality, water quality of pit lakes, ecosystems recovery, particularly along the creeklines, rehabilitation and involvement with rehabilitation.	
13 May 2015	An ethnographic survey was conducted with Gumula during which the focus was on: • Surface water management and discharge in relation to Weeli Wolli Creek. • Proposal dewatering requirements. • Ongoing management of Weeli Wolli Creek. • Hydrogeological drilling program.	The Proponent to consult Gumala Aboriginal Corporation about the potential for business and employment opportunities for the new Yandi developments. A number of archaeological sites identified to be avoided across the existing Yandi Operations.
Ongoing	Any issues relevant to the Gumula People are raised at quarterly Monitoring and Liaison meetings. It is a condition of the Agreements that notification of any activities is provided to Gumula prior to works	The Proponent will continue with regular consultation with Gumula through the Monitoring and Liaison meetings and through the pre-feasibility and feasibility studies.

Date	Topics/Issues Raised	Outcome and Proponent response where relevant
	taking place and effort is made to address any areas of concern raised by the group. Key concerns raised relate to potential impacts (including clearing, drawdown and discharge) within the Marillana and Weeli Wolli Creek systems, final life of mine closure landform, and future access.	Regular technical updates are provided including the approval process; Environmental Impact Assessment predictions and findings; and closure workshops.
Pastoral Station – Marillana Station		
20 April 2015	Informal discussion on upcoming Proposal and Closure Plan. Details of the Proposal requested to be provided, including key dates.	Updated presentation package including key dates provided to Marillana Station on 22 June 2015.
Shire of East Pilbara		
23 April 2015	Provided update of current Rio Tinto operations in the Pilbara with proposed projects for the Shire of East Pilbara. This included the Proposal and the proposed PER seeking feedback around September 2015.	Proposed to provide an update on the PER at next meeting (August 2015), and 'big picture' overview of clearing requests.
28 August 2015	Presentation of the Proposal details and estimated timing for Public Environmental Review.	No significant issues raised or outcomes.
BHP		
22 April 2015	Consultation on closure planning for BHP and the Proponent's Yandi Operations. Discussion to understand: • The Proponent's underlying strategy for closure; • the key driving assumptions; and • outcomes that are important for consideration in the upcoming revision of the BHP Closure Plan which may also have implications for the Proponent's Yandi Operations. Given the water focus for water and closure planning in the Fortescue Marsh area (particularly when considering the relationship between the closure strategies for the sites) and due to adjacent pits at Oxbow, a presentation and discussion on closure strategies and assumptions was undertaken. It was agreed that any presented materials would be publically available, but elaborated on through discussion.	Further discussion may be required at various stages of Closure planning to ensure closure model assumptions are understood and to avoid misalignment of adjacent (boundary) model predictions. Publically available material to be agreed on a case by case basis.

Part 2 – Description of the Proposal

This part describes the Proposal to be implemented, including information on the key characteristics, design, exclusions and scheduling of the Proposal.

4. Development overview

4.1 Key characteristics

The Proposal will involve construction and operation of a new mine pit, waste dumps and associated infrastructure. The Proposal deposits occur across the eastern extents of an 80 km long CID characterised by relatively continuous iron mineralisation along a palaeo-channel. Mining will consist of a single, below water table open cut pit along the CID palaeo-channel.

Key aspects of the Proposal include:

- **A new below water table open cut iron ore pit** to the east of the existing Yandi Operations within the CID.
- **Temporary surface waste dumps**, including mineral waste dumps, sub-grade dumps, low grade ore dumps and topsoil and subsoil stockpiles.
- **Major infrastructure, including:**
  - **A flood protection levee** along the western margin of the pit.
  - **A diversion drain** along the eastern margin of the new mine pit.
  - **A culvert-floodway** creekline crossing structure.
  - **Supporting mine infrastructure** – haul roads and ramps, mine access and internal road network, dewatering pumps and associated pipelines, discharge outlet(s), power and communications.

In addition, a number of the Yandi Operation's existing facilities and processes will be upgraded or integrated as part of the Proposal including:

- **Trucking ore** back to the existing Yandi Plant.
- **Yandi plant** including JC and JSE processing plants (including a wet plant), and associated conveyors, stackers, reclaimers, train load-out and other materials handling infrastructure.
- **A water management system** including on-site reuse of water abstracted from pit dewatering, and discharge of surplus volumes into creek systems. Discharge infrastructure servicing the existing Yandi Operations will be used where possible.
- **Mine support facilities** (e.g. power supply infrastructure, communications infrastructure, offices, explosives storage, waste water treatment plants etc.).

The Proposal is scheduled to be commissioned with first ore production from the first half of 2019, however these project schedules may change, depending on business priorities.

Rio Tinto's existing rail network will be used to transport mined and processed ore from the Revised Proposal to existing port operations at Dampier and Cape Lambert.

A preliminary summary of key features for the Proposal are described in **Table 3**.

Table 3: Summary of the Proposal

Component	Project Characteristic	Detail
General	Project life	~ 16 years
	Resources	The current resource consists of 452 million tonnes of CID ore
	Production rate	Up to 31 Mtpa
Development footprint	Approximate disturbance area – mining/waste stockpiles and infrastructure	Up to 1,800 ha (69 ha of riparian zone vegetation)
Mining	Ore type	Pisolite (Channel Iron Deposit)
	Mining in relation to the watertable	99% BWT mining
	Mineral waste disposal	Surface waste dumps, with progressive backfilling once individual pit stages are completed
Processing	Processing type	Both wet and dry processing using existing Yandi Operations facilities
	Residue disposal	Current Yandi Operations in pit and new WFSFs will be used for residue from wet processing
	Water demand	Peak demand (with wet processing) approximately up to 11 GL/y
	Roads	Existing and new access roads to approach/depart the Proposal and internal road system
	Ore transport	Haul road to transport ore from the Proposal to the existing Yandi Operations processing plants and use of existing rail
	Power spur	Connection into the existing Yandi Operations 220 kV power line

4.2 Development of the mining operation

4.2.1 Site plan

The existing Yandi Operations is outlined in **Figure 2**. A conceptual site plan for the Proposal is shown in **Figure 4**, which also shows the Proposal in relation to the Revised Proposal Development Envelope and existing roads.

4.2.2 Ground disturbance

The Proposal will result in up to 1,800 ha of new ground disturbance, within the Revised Proposal Development Envelope of 19,351 ha. The majority of the proposed 1,800 ha of disturbance will occur within the Proposal Area, with a small portion of this disturbance required for infrastructure tie-ins with the existing Yandi Operations.

As planning for the Proposal is ongoing, the exact locations of some ancillary infrastructure and tie-ins with the existing mines is dependent on final engineering design. The specifics of the infrastructure require flexibility in terms of siting once detailed designs are finalised. A conceptual site plan is indicated in **Figure 4**.

4.2.3 Vegetation clearing and topsoil

Topsoil is an important resource for rehabilitation as it contains a natural seed bank and, typically, contains organic material and nutrients. Topsoil layers in the Pilbara region are highly variable in thickness, ranging from very little soil development on rocky slopes to approximately 300 mm in valley areas.

The open pit, waste dumps, low grade dumps, haul roads and lay down areas will be cleared of all vegetation. Topsoil (approximately 200 mm) and subsoil (approximately 600 mm) will be collected prior to mining and stored in stockpiles for use in post-mining rehabilitation. Topsoil and subsoil will be collected from both the pit and dump areas, while only topsoil will be collected from the other areas (lay down areas and other infrastructure). The topsoil and subsoil will be cleared in a phased manner as and when the new pit and dumping areas come into operation.

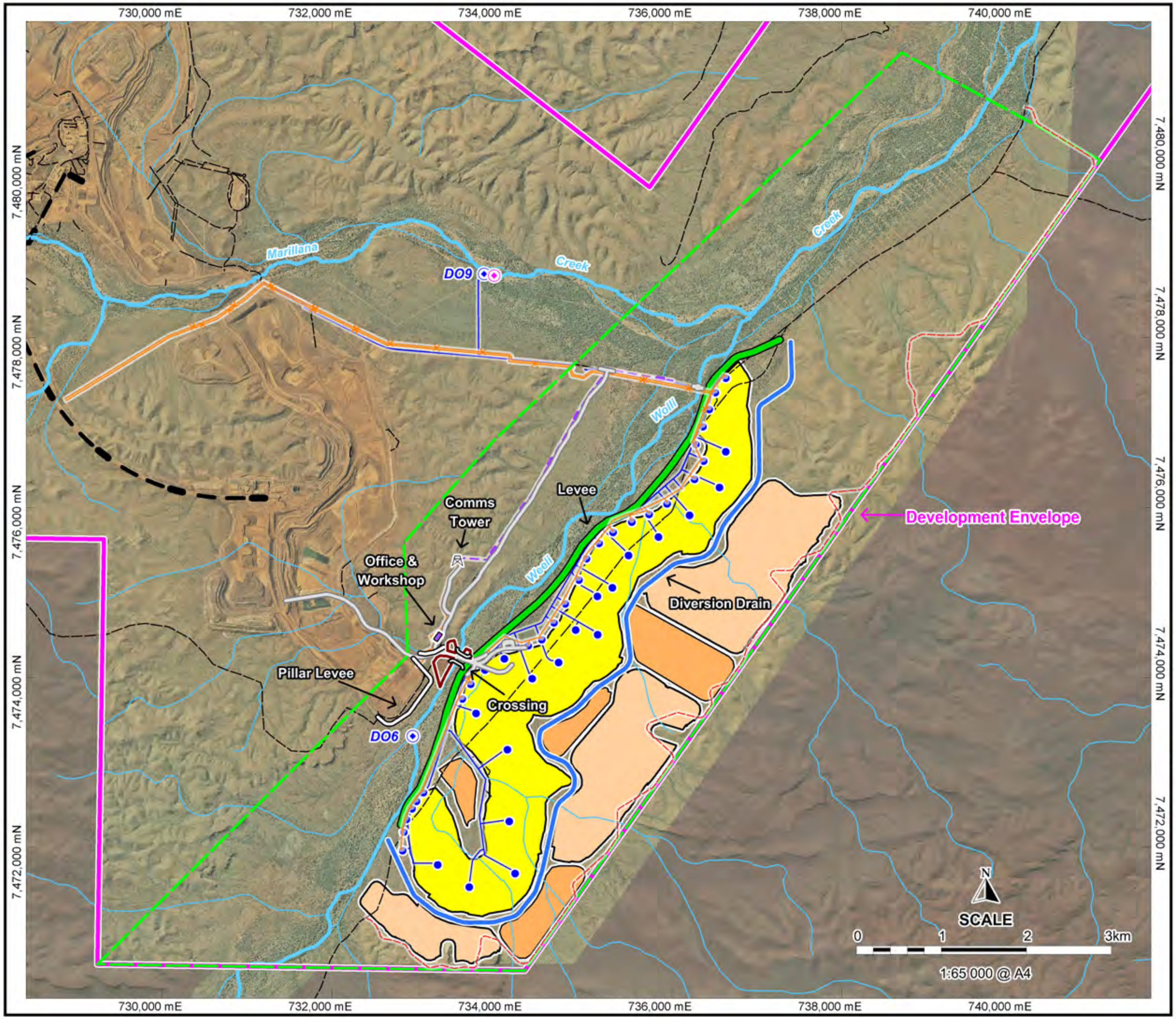
Throughout the life of the Proposal, an estimated 2.1 million m^3 of topsoil and 6.72 million m^3 of subsoil will be collected. All the topsoil and subsoil collected from pit and other areas will be stockpiled in line with the Proponent's standards. Cleared vegetation will also be stockpiled. This material will be used during rehabilitation (Section 17).

4.2.4 Mining

The scope of mining for the Proposal includes CID ore resources located within existing tenure ML274SA. The Proposal will involve developing a single pit, of which approximately 99% of the ore is below the water table. The pit will be approximately 10 km from end to end (~7 km strike length) and mining will involve conventional drill, blast, load and haul methods, as currently used at the existing Yandi Operations. For ore blending purposes, several faces within the mine pit will be worked simultaneously.

Based on current knowledge, the total quantity of extractable ore from the proposed pit is estimated to be ~452 Mt over the life of the Proposal. The maximum depth of mining is expected to be approximately 85 m below the surface.

Mining (pre-stripping) is proposed to start from 2018 and progress northwards and southwards consecutively from an initial mining area. The initial mining area location, rate and sequence of mining will ultimately be dictated by ore blending requirements to meet product specification from the Revised Proposal. A small portion of the proposed mine pit (approximately 17 ha) will encroach into the riparian woodland community of Weeli Wolli Creek to access the CID ore, which extends below the floodplain alluvials (see **Figure 55** in Section 14).



Rio Tinto

Iron Ore (WA)

Figure 4
Proposal conceptual site plan

Drawn: M.Swebbs
Date: Sept, 2015

Plan No: PDE0128514v3
Proj: MGA94 Zone50

Geospatial Information and Mapping

Overburden and waste will be used to progressively backfill the depleted pit, where possible. If the development sequence changes, temporary surface storage options will be required.

Mining is estimated to produce approximately 272 Mt of waste rock. Above ground stockpiles and mineral waste dumps have been provided for in the mine design. It is planned that all of the waste material will be used progressively to backfill the mine pit. However during development of the pit, temporary ex-pit waste dumps will be required and will be located in close proximity to the mine pit. The quantity of material to be placed in temporary storage areas will depend on the mine design, mining and dewatering sequence, and managed in line with the closure strategy.

A portion of the overburden from the initial mining area will be used as 'borrow material' for construction activities. As a result, the total area that would otherwise be disturbed during construction will be reduced.

Initial start-up mining crusher feed rates will be in the order of 28 Mtpa, which may increase up to 36 Mtpa, bringing the Revised Proposal crusher feed rates up to a total of 70 Mtpa.

4.2.5 Ore handling, processing and transport

The existing Yandi Operations are well established with central administration and workshop facilities at JC. Some new infrastructure will be required to accommodate the Proposal including:

- Civil infrastructure such as light and heavy vehicle road networks to connect the Proposal deposits to existing plant and facilities.
- The main workshop and storage areas will remain at JC. Heavy vehicle refuelling facilities and a workshop for daily and weekly maintenance may be constructed closer to the Proposal deposits.
- Small office facilities will be developed central to the Proposal Area. These facilities will consist of an administration building for daily crew shift change meetings and a crib room with toilets.
- A crossing at Weeli Wolli Creek is required to enable ore movement from the deposits to the various processing plants via heavy haulage trucks. As these deposits are entirely located on the east side of Weeli Wolli Creek, a creek crossing (via a culvert-floodway structure) will be required to access the facilities at the existing Yandi Operations, located entirely on the western side of Weeli Wolli creek.
- Local drainage and flood management protecting against stormwater runoff as well as water ingress into the pit adjacent to Weeli Wolli Creek.
- Electrical distribution via additional 33 MW installations will be required to support the Proposal.

Dewatering to enable mining of the Proposal wherein the orebody is essentially 99% below the water table. Based on initial hydrogeological modelling, dewatering of the pit will be required to occur at least a year prior to productive mining.

The existing capacity of the processing plants at JC (secondary and tertiary crushing and screening) with minor upgrades will accommodate all of the production from the Proposal. Any plant expansion requirements at JC will be subject to the provisions of the EP Act.

The existing waste fines cells at JSE in addition to new waste fines storage facilities (WFSF) in JSE will be used for the disposal of waste generated by wet processing. In accordance with existing operational practices, any water reclaimed through a decant process will be recycled back into the wet processing cycle.

Processed ore will be trucked from the Proposal to one of the existing operations wet or dry processing plants, where it will then be conveyed to the Loop Stockyard for rail loading and export. The existing capacity of the Loop Stockyard is expected to accommodate all of the production from Proposal. Upgrades or extensions to the existing Yandi Operations plants are a consideration, and would be managed under Part V of the EP Act.

4.2.6 Mineral waste

Overburden and waste rock will be used to backfill the depleted pit where mine pit sequencing and schedules allow. However, temporary surface storage options for waste and low grade ore stockpiles will be required over the life of the Proposal. The quantity of material to be placed in temporary storage areas will depend on the final mining and processing sequence selected.

Locations for waste dumps are presented in **Figure 4**, which provides for a conservative case should mine sequencing or dewatering sequencing change over the life of the operation. However, in line with the closure strategy, there will be sequential in pit disposal of waste, and stockpiling of low grade ore.

The existing Yandi JSE pit, which is adjacent to the Proposal Area, will serve as an in pit fines tailings storage facility (WFSF) for any material from the Proposal which is wet processed during the life of operations. The JC and JSE pits are currently used as a waste fines storage facility for the existing Yandi Operations.

Asbestiform minerals are not known from the CID orebody. However, there is a risk of encountering asbestiform material in the surrounding banded iron formation (BIF) and alluvium. Asbestiform fibres have been identified in the alluvium within the current mine operations at Yandi JC. Any fibrous waste encountered during construction or mining of the Proposal pit will be disposed of at the existing on-site facilities (store, encapsulate and record in the same waste dump), in accordance with the current Yandi Operations fibrous mineral protocols and procedures.

4.2.7 Dewatering and water management

The Proposal deposit is situated almost entirely (approximately 99%) below the water table and will require dewatering to commence approximately 12 months before mining activities start. Groundwater modelling has indicated that the dewatering required for the Proposal ranges from approximately 30 – 50 GL/y (cumulative peak of 83 GL/y when combined with existing Yandi Operations), of which up to 70% is not new dewatering; rather, it is the result of re-abstraction and discharge of upstream operations' surplus discharge water that has passively re-entered into the orebody (recirculation of water).

Dewatering will be undertaken using vertical bore holes completed in curtain or cluster arrangements within or adjacent to the mine pit; permanent bores will be placed along the western perimeter of the Proposal pit and permanent and sacrificial bores will be placed within and around the Proposal pit. The sacrificial bores will be decommissioned and replaced as the pit advances over time. Pumping of residual groundwater from in pit sumps will also be used when the mine pit reach final bench elevation.

Dewatering supply from the Proposal will be integrated with the existing Yandi Operations site water demand. It is estimated that approximately 5 GL/y will be used for on-site purposes (dust control, camp usage and ore processing) and approximately 48 GL/y to 78 GL/y will be discharged to Marillana and Weeli Wolli Creek systems over the life of the Revised Proposal, with a forecast average of 61 GL/y. Discharge will occur at controlled, release discharge points (refer to Section 13 for further details regarding surplus water management).

4.2.8 Surface water management

Two key surface water management structures will be required to protect the mine pit from accumulating water during large surface water flow events. This will result in localised disruptions to hydrological flow regimes. These structures include:

- An 8 km long flood protection levee along the western margin of the Proposal pit, adjacent to Weeli Wolli Creek. This will encroach into the Weeli Wolli Creek floodplain in some areas to facilitate the proposed pit extent.
- A diversion drain along the eastern edge of the pit, collecting rainfall runoff from hills to the east.

The preliminary design of the levee has been undertaken by a team of engineers who are familiar with the local conditions and have had experience with design and construction of levees at the existing Yandi Operations. The detailed design of the flood protection levee will be undertaken by experienced civil design engineers based on findings from geotechnical, geomorphological and hydraulic technical studies. The investigations and analysis undertaken to date are at a higher level than would normally be undertaken at the current stage of the Proposal in recognition of the importance of the levee and have been reviewed by the Proponent's engineers, consultant design engineers and independent third party geotechnical and hydrology experts.

The purpose of the levee is to prevent flooding of the open mine pit mine during high flow periods within Weeli Wolli Creek which is located adjacent to the proposed pit. The proposed levee is approximately 8 km in length; a crest width of 5 m, with a height ranging in the order of 2.5 to around 7 m (subject to final engineering designs) including a freeboard allowance of 0.5 m, and with upstream and downstream slopes of 1:3 (V:H; refer to **Figure 5**). The levee has been designed as a homogenous structure constructed from clayey gravels sourced from in situ materials along the alignment. Additional borrow material for the construction of levee and haul road embankments may be sourced from the proposed footprint of the Proposal pit (i.e. pre-strip waste). Laboratory analysis of samples collected during testing pitting activities for this study suggests that two thirds of the surficial soils in the pit footprint would be suitable for use. A potential source of dolerite rock for use in scour protection has also been identified.

A keyway is considered necessary to limit the risk of piping failure under the crossing structure and to key it in to the existing alluvial soils of the Weeli Wolli Creek. A minimal depth of 5 m depth and a minimum width of 2 m can be expected at this stage of design.

Risk assessments will be undertaken prior to construction, to ensure public safety is maintained and environmental risks are identified and managed. During operations, the levee will be subject to regular post-wet season inspections. The objective of the inspections is to ensure the long term stability of the levee and identify any deterioration in the condition of the levee before it becomes a risk to its integrity. If deterioration in the levee condition is identified, geotechnical engineers will assess the potential impact and identify any required remedial works.

Numerical slope stability analyses, using the limit equilibrium slope stability software package SLIDE Version 6.0, against the design acceptance criteria of a Factor of Safety (FOS) of greater than 1.5, was carried out at three critical sections. Relatively conservative effective stress (drained) shear strength parameters were attributed to each of the geological units based on correlations with field investigation, laboratory testing results and experience.

Three cases of levee stability analysis were assessed under static conditions based on a standoff distance of 30 m, 65 m and 100 m from the pit crest to the downstream toe of the levee. The analysis carried out under seismic loading only for dry conditions and for Peak Ground Accelerations (PGA) of 0.063 and 0.1g. The FOS for failure of the levee during either flood events or earthquakes exceed the required acceptance criteria (e. g. FOS=1.5 and FOS=1.1, respectively). The groundwater phreatic surface and location of the levee with respect to the pit crest has negligible effect on the stability of the levee.

A numerical analysis was also carried out using the finite element software package Plaxis, to assess the minimum offset required between the levee and the alluvial pit slope. The analysis indicates that the surcharge load from the levee structure has only marginal influence on the pit slope.

Limited potential for piping failure of fine dispersive materials in the levee and its foundation structure was determined in the engineering geotechnical study. As the levee will be constructed of compacted non-dispersive clayey gravel/gravelly clay materials and due to short duration of the flood events, the wetting front is not expected to penetrate more than 1-2 m into the levee materials. Therefore piping within the levee embankment is not expected and not considered a significant risk.

4.2.9 Water supply

Process water will be sourced from groundwater abstracted through the mine dewatering process. Potable water will be sourced from the borefields servicing the existing Yandi Operations.

4.2.10 Power supply

Power supply will be derived from the existing distribution system at the Yandi Operations, sourced from the Rio Tinto power grid network. Power connections to the Proposal will be largely aligned with other infrastructure corridors (e.g. roads).

Back-up power supply will be provided by the existing on-site 10 MW diesel-fired generator, currently servicing the existing Yandi Operations.

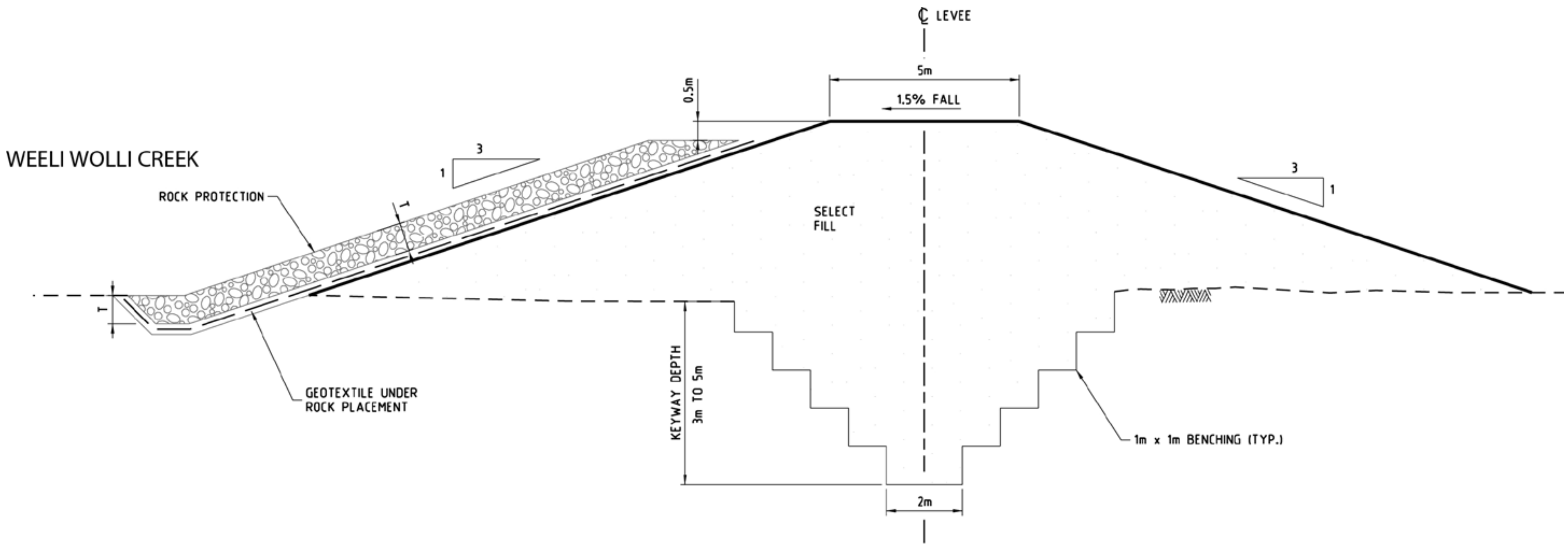


Figure 5: Typical levee cross section.

4.3 Mine support facilities and other infrastructure

4.3.1 Workforce and accommodation

The existing Yandi Operations currently employs around 1,400 people (including construction workforce and contractors) who are accommodated in a well established permanent village and a temporary construction camp. The workforce currently operates on a Fly In-Fly Out (FIFO) basis from Perth or other WA regional centres using the Barimunya airport.

The existing operational workforce is not expected to increase to support the Proposal and as such the existing accommodation village is expected to meet anticipated FIFO workforce requirements.

The recently re-commissioned construction camp for JSW and Oxbow operations comprises single and double storey rooms which will be maintained to accommodate the additional construction capacity (approximately 450 personnel) required for the Proposal.

The permanent village and construction camp are both part of the existing mining operation and approved under MS 914.

4.3.2 Wastewater treatment

Wastewater generated by the existing Yandi Operation is treated using the licensed wastewater treatment plants at the JC mine site and the recently expanded facility servicing the accommodation village. These will continue to be used over the life of the Proposal.

The Proposal mining areas are not anticipated to need new wastewater treatment facilities. However, existing facilities may need to be expanded for construction and future operations, and septic facilities will be required for offices and administration buildings. If any new facilities are required (to treat more than 20 m^3/day), appropriate licences will be obtained under Part V of the EP Act.

4.3.3 Non-mineral waste

Current systems servicing the existing Yandi Operations will be used to collect and recycle a number of waste streams including: hydrocarbon wastes (oil, drums, rags, filters etc.), tyres, batteries, scrap metal, printer cartridges, paper and cardboard, conveyor belting and computing equipment.

The licensed landfill facilities servicing the existing Yandi Operations will be used to dispose of putrescibles and inert materials, such as household waste, cardboard, furniture, fill and demolition material. Appropriate licences under the EP Act will be obtained if any new landfill facilities are required.

Hazardous wastes will be collected and sent off-site for treatment by licensed contractors. An existing land farm bioremediation facility used to treat hydrocarbon contaminated soils, will continue to be operated over the Proposal life. Contaminated soil is spread in a thin layer (approximately 300 mm) on an impermeable base. The soil is watered and tilled to stimulate aerobic microbial activity resulting in the degradation of hydrocarbon products into non-hazardous materials suitable for conventional disposal.

4.3.4 Fuel

The fuel storage and handling facilities at the existing Yandi Operations may be upgraded to service the Proposal mining operations. These are likely to be supplemented by local heavy vehicle refuelling facilities near the Proposal pit.

4.3.5 Road Access

Mine roads will be developed in and alongside the Proposal pit. The roads will provide access to mining areas, soil and waste stockpiles and supporting infrastructure. The mine road network is expected to change to some extent during the life of the Proposal, in accordance with the mine plan.

A bypass track around the Proposal will be constructed to allow for public access and to manage public safety as the current access track extending from Hope Downs 1 to Fortescue Marsh runs directly through the proposed borefield and mining area. This track will also ensure separation of the public from the construction work related to the Proposal.

Based on the current mine plan, the primary heavy vehicle access road for the Proposal will be aligned along the perimeters of the mine pit. A culvert-floodway crossing will be constructed across Weeli Wolli Creek, together with an upgrade to the existing Weeli Wolli Creek crossing (Greys' crossing) to create an engineered floodway with culverts to support heavy vehicle traffic and reduce ponding and upstream impoundment of flow. Larger rain events will continue to overtop the floodway as designed.

Road access from the Great Northern Highway is provided through the existing sealed Yandi Operations access road shared with BHP.

4.3.6 Other facilities/infrastructure

Other facilities that will be required for the Proposal include heavy/light vehicle maintenance workshops, offices and laydown areas. Locations of these facilities are depicted in **Figure 4**. Additional facilities may also include an ammonium nitrate storage facility and fabrication workshops.

4.4 Work excluded from the proposal

The scope of the Proposal subject to this Environmental Impact Assessment specifically excludes:

- Associated site offices, access roads, temporary concrete batch plant, borrow pit/quarry for suitable material, temporary services (communications, water supply, on-site power generation), upgrades to existing access roads/tracks and lay down areas and drilling/geotechnical/water investigation activities (to be subject to relevant provisions of Part V of the EP Act and DoW RIWI Act water licensing requirements).
- Low impact activities, including drilling activities associated with geology (including resource drilling), geotechnical and water investigations (including bore installation and test pumping) and power generation investigations (to be subject to relevant provisions of Part V of the EP Act and DoW RIWI Act water licensing requirements).

Iron Ore resources held by Rio Tinto (or its related companies) are present outside and proximate to the Proposal. These may be subject to future development proposals, but are outside the scope of the Proposal. Any proposals to develop these resources will be subject to separate environmental approval processes.

Part 3 – Overview of existing environment

This part provides an overview of relevant features of the existing environment. More detailed descriptions of the relevant existing environmental features of each of the preliminary key environmental factors are provided in Part 5.

5. Physical environment

5.1 Biogeographic region

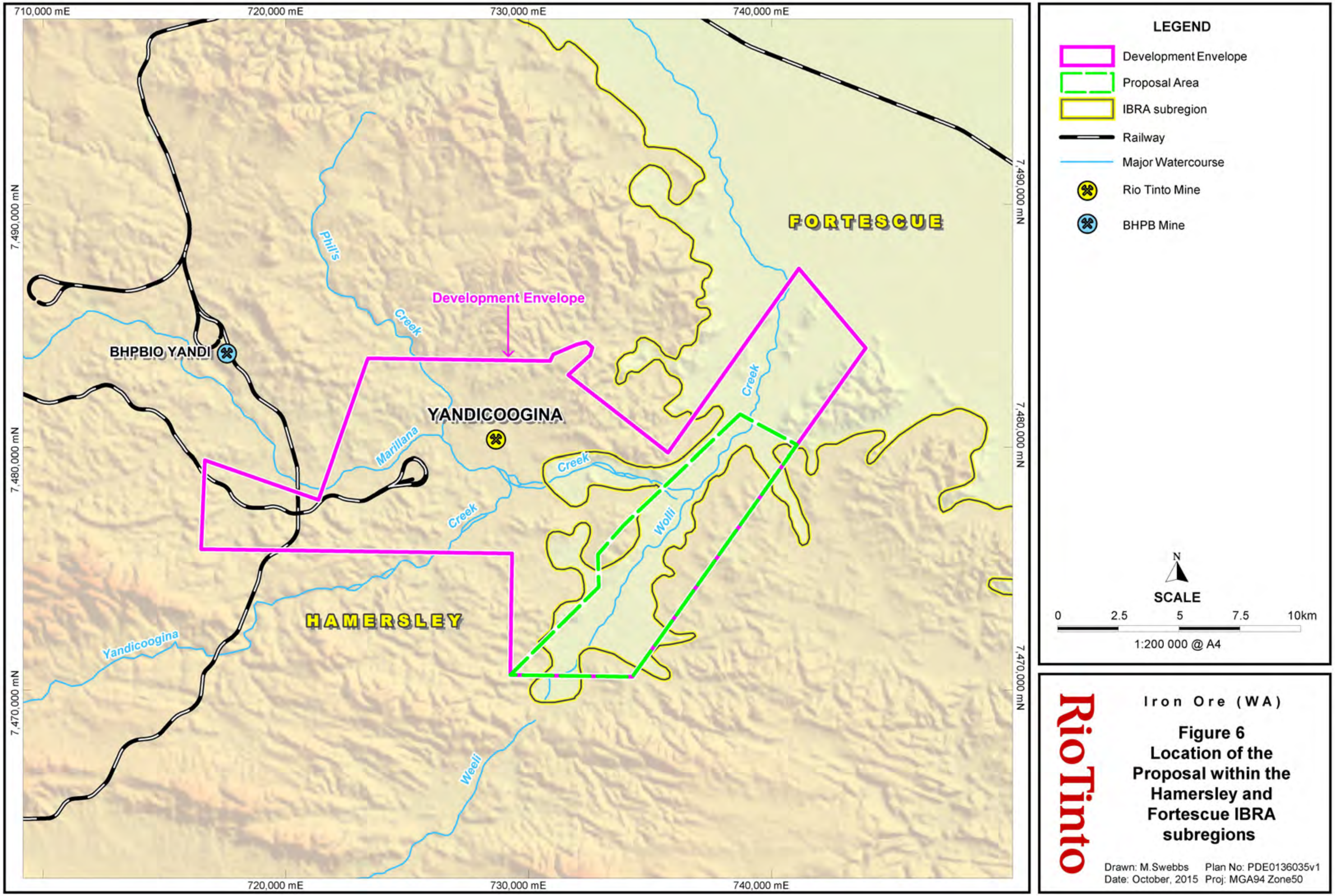
A biogeographic regionalisation of Australia has been developed collaboratively, in which bioregions (broad-scale regionalisations) are formally recognised and mapped in the Interim Biogeographic Regionalisation for Australia (IBRA), currently version 7. IBRA provides a landscape-based approach to the classification of the land surface of Australia, with bioregions being classified according to common climate, geology, landform, native vegetation and species information. Bioregions each reflect a unifying set of major environmental influences which shape the occurrence of flora and fauna and their interaction with the physical environment across Australia (DoE 2015a).

The Proposal Area lies within the Pilbara bioregion, which comprises four subregions: Hamersley, Fortescue, Chichester and Roebourne. Subregions are more localised and homogeneous geomorphological units within each bioregion. The Proposal Area is located within the Hamersley and Fortescue subregions (**Figure 6**). The majority of the landscape within the Proposal Area is considered to be typical of the Hamersley subregion, while the creek systems have affinities with the Fortescue subregion. A description of the major characteristics of the two subregions is provided in **Table 4**.

The Hamersley subregion is approximately 6.2 million hectares in area, with the dominant land uses being grazing of native pastures, unallocated Crown land and Crown reserves, urban settlements, conservation and mining (Kendrick 2003a). The main land uses of the smaller (approximately 2 million hectares) Fortescue subregion include grazing, unallocated Crown land and Crown reserves, conservation and Aboriginal land (Kendrick 2003b).

Table 4: Hamersley and Fortescue Subregions of the Pilbara bioregion

Pilbara Subregion	Description
Hamersley	Recognised as the southern section of the Pilbara Craton. The Hamersley subregion consists of mountainous areas of Proterozoic sedimentary ranges and plateaux, dissected with gorges (basalt, shale and dolerite; Kendrick 2003b).
Fortescue	Consists of alluvial plains and river frontages (Kendrick 2003a). There are calcrete aquifers and localised springs in sections of the Fortescue system. It is the northern limit of the *Acacia aneura* complex (mulga).



Rio Tinto

Iron Ore (WA)

Figure 6
Location of the Proposal within the Hamersley and Fortescue IBRA subregions

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0136035v1
Proj: MGA94 Zone50

Geospatial Information and Mapping

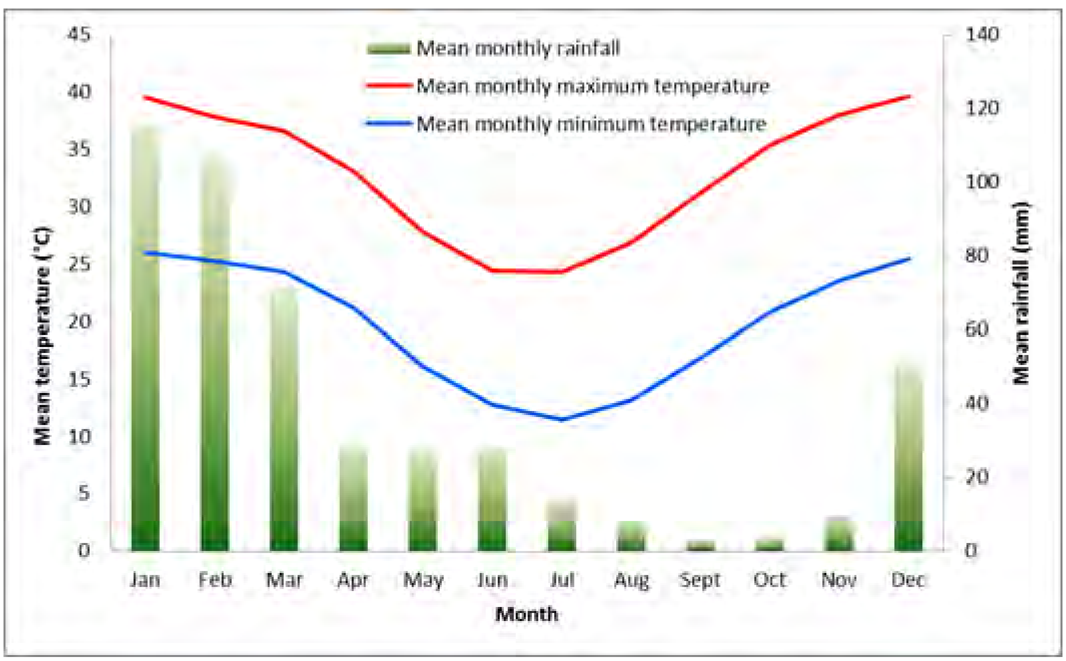
5.2 Climate

The Proposal Area is situated in the Pilbara bioregion of WA, which experiences a semi-arid to arid tropical climate that is characterised by hot humid summers (October to April) and relatively cool, dry winters (May to September). The mean monthly maximum temperature is approximately 40°C during the summer months (December/January), and drops to approximately 24°C in winter (June/July; BoM 2015). See **Figure 7** for further details.

The majority of the Pilbara has a bimodal rainfall distribution; from January to March rains result from tropical storms producing sporadic thunderstorms. Tropical cyclones moving south also bring heavy rains. From May to June, extensive cold fronts move eastwards across the state and sometimes reach the Pilbara. These fronts usually produce only light rains.

Long term, mean annual rainfall at the Yandicoogina locality is estimated to be approximately 400 mm, but is highly variable among years and over longer timescales. Annual evaporation is estimated to be between 3,200 mm to 3,600 mm and evaporation typically exceeds rainfall on a monthly basis throughout the year (MWH and Equinox Environmental 2011).

The closest operating meteorological station to the Proposal Area recording both temperature and rainfall data is the Wittenoom Weather Station (Station Number 005026), located approximately 95 km away. A summary of climate data recorded at the Bureau of Meteorology Wittenoom Weather Station is provided in **Figure 7**.



Source: BoM (2015)

Figure 7: Mean monthly rainfall, maximum and minimum temperatures recorded at the Wittenoom Weather Station between October 1951 to April 2015

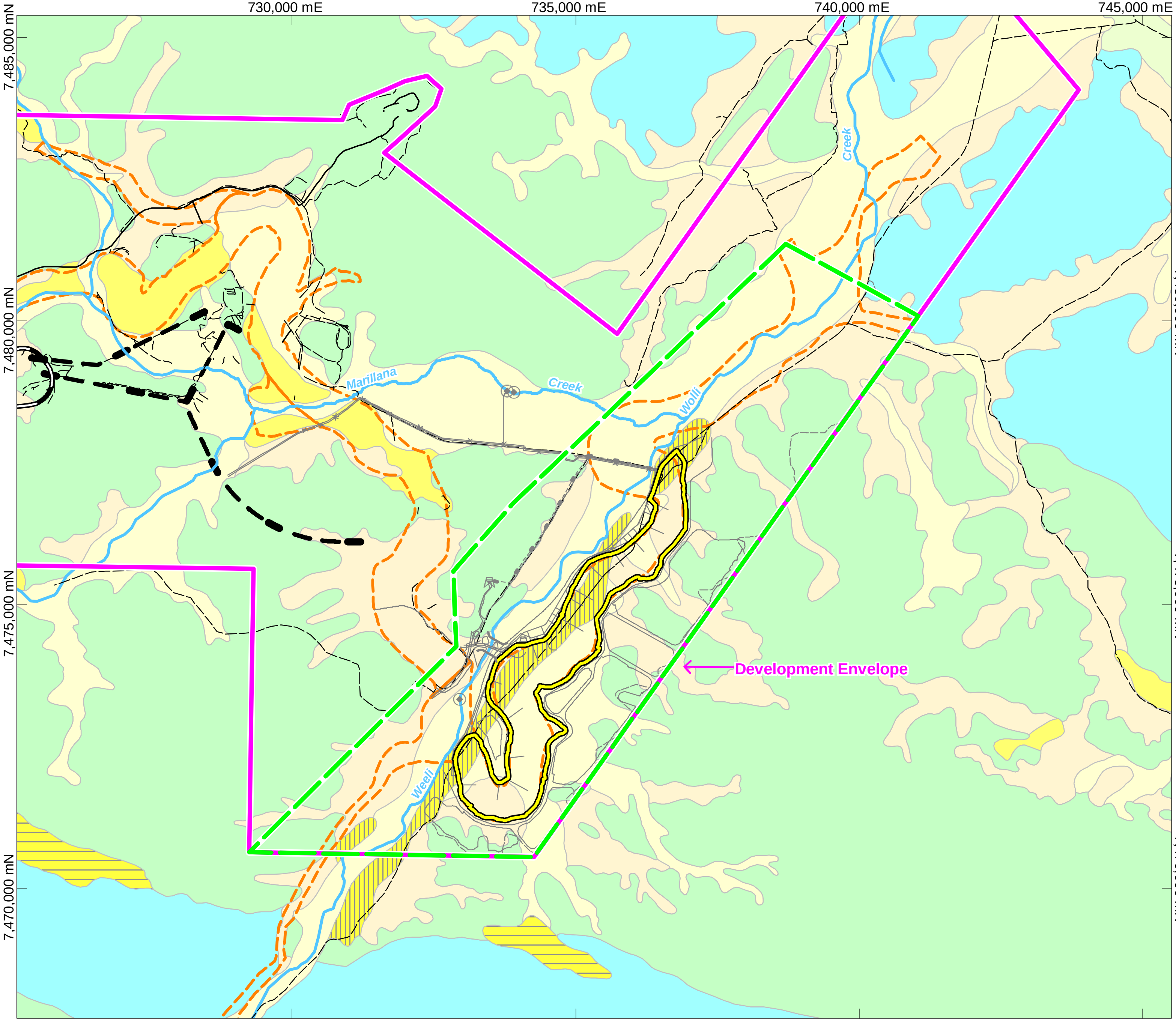
5.3 Geology

The Yandicoogina CIDs represent an accumulation of pisolitic iron that formed during the Tertiary Period. The CIDs are located in the Yandicoogina, Marillana and Weeli Wolli Creek regional catchments and comprise a palaeo-channel system that extends for a strike distance of approximately 80 km (Rio Tinto 2014a).

Most of the Yandicoogina area CID outcrops occur in association with Marillana Creek and its floodplain, or are covered by colluvium and alluvium up to 60 m thick. The palaeo-channel is between 450 and 750 m wide, with the main ore zone being 40-60 m thick in the centre of the channel and thinning out towards the channel margins, giving it a saucer-shape in cross-section. The top of the ore zone is generally weathered, silicified or clay rich due to infiltration of clays along joints, fractures, faults and tree roots (Rio Tinto 2014a). The stratigraphy of the CID includes six main material types:

- Eastern Clay Conglomerate/Laterite.
- Weathered Channel.
- Goethite Vitreous Upper.
- Goethite Vitreous Lower.
- Limonite Goethite Channel.
- Basal Conglomerate.

The proposal area marks the eastern extent of the CID palaeo-channel prior to entering and fanning out onto the Fortescue Plains. The palaeo-channel follows a north easterly course, located to the east of the JSE deposit, and continues along the borders of the Weeli Wolli valley before infiltrating the Fortescue Plains in the north. The Proposal deposit lies to the east and runs parallel to the floodplain of the current Weeli Wolli Creek for a total length of approximately 7 km (when measured in a straight line; Rio Tinto 2014a). The surface geology of the Proposal Area is presented in **Figure 8**.



LEGEND

Development Envelope
Proposal Area
Existing Conveyor
Existing Road
Existing Track
Major Watercourse

Conceptual Mine Layout

Mine Pit
Mine Layout/Infrastructure

Geology

Alluvuim
Eolian sand forming dunes and sheets
Colluvium
Pisolite and Limonite
Calcrete
Hematite and geothite
HAMERSLEY GROUP
Weeli Wolli
Brockman Iron
Extent of CID

N

SCALE

0 1 2 3 4 5km

1:100 000 @ A4

RioTinto

Iron Ore (WA)

Figure 8
Surface geology of the Proposal Area

Drawn: M.Swebbs
Date: Sept, 2015

Plan No: PDE0129377v2
Proj: MGA94 Zone50

Geospatial Information and Mapping

5.4 Landform and land systems

The Proposal Area is dominated by Weeli Wolli Creek and its associated floodplains and hill slopes (Biota 2014a). The Creek flows in a northeast direction and ends in an alluvial fan at the Fortescue Marsh, outside of the Revised Proposal Development Envelope. The confluence of Weeli Wolli Creek and Marillana Creek is located in the north west of the Proposal Area. Four major landforms occur within the Proposal Area:

- **Major creeklines and tributaries**: predominately *Eucalyptus victrix* open woodland over *Acacia* low woodland over tussock grassland, with some sections of *Eucalyptus camaldulensis* and *E. victrix* woodland over *Melaleuca* and *Acacia* open woodland.

- **Minor creeklines, floodplains and valleys**: Predominantly *Eucalyptus leucophloia*/*Corymbia hamersleyana* scattered low trees to low open woodland over *Acacia* shrubland, over *Triodia* hummock grassland.

- **Hills ridges and breakaways**: Predominantly *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Hakea chordophylla*, *Acacia inaequilatera*, *Grevillea wickhamii* tall open shrubland over *Triodia* sp. *Shovelanna Hill* (S.van Leeuwen 3835) hummock grassland.

- **Plains**: *Eucalyptus leucophloia* subsp. *Leucophloia* and *Corymbia hamersleyana* scattered low trees over *Acacia* low open woodland over open *Acacia*, *Eremophila* shrubland over *Triodia* open hummock grassland.

The physical resources of the Pilbara region have been characterised and mapped into a number of land system units based on landforms, soils, vegetation and drainage patterns (Van Vreeswyk et al. 2004). Four land systems as mapped by Van Vreeswyk et al. (2004) were identified as occurring within the Proposal Area (Biota 2014a). These land systems and their associated descriptions are presented in **Table 5** and spatially depicted in **Figure 9**. The River land system includes the major drainage lines of the area (Marillana, Yandicoogina and Weeli Wolli Creeks). All of the land systems are widely represented across the central Pilbara region.

Table 5: Major land systems within the Proposal Area

Land system	Description	Extent in Proposal Area (ha)	Proportion of Proposal Area (%)
Newman	Rugged ironstone ridges, plateaux and mountains; hard spinifex pastures in Good to Excellent condition; no erosion	1,161	26
Boolgeeda	Stony lower slopes and plains below hill systems; not degraded or eroded	1,491	33
River	Active flood plains and major rivers supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands	1,336	30
McKay	Hills, ridges, plateaux remnants and breakaways of metasedimentary and sedimentary rocks supporting hard spinifex grasslands	499	11

5.5 Hydrogeology

Conceptually, three main hydro-stratigraphic units are recognised in the Yandicoogina region. They are comprised of the:

- relatively impermeable basement of the Weeli Wolli Formation;
- overlying highly permeable fractured CID; and
- semi-permeable floodplain alluvium of the creeks.

The aquifers are recharged primarily by direct infiltration of rainfall and via creek bed alluvials as a result of surface water flows during and/or following heavy rainfall (Rio Tinto 2010).

The Yandicoogina Iron Ore deposits infill the dissected palaeo-river valley of the Marillana - Yandicoogina - Weeli Wolli Creek system to form the CID (Rio Tinto 2014a). The CID aquifer is characterised by a relatively high water yield associated with secondary porosity. The CID is overlain and flanked by both alluvium and unconsolidated materials, which are also relatively transmissive and variably connected with the CID aquifer (Rio Tinto 2014a). Together, the CID and alluvium aquifers range in width from 1,000 to 2,000 m. The overall groundwater system is bounded by low transmissivity parent rocks, and the depth of the CID channel diminishes towards the flanks of the flood plain (Rio Tinto 2014a).

The natural depth to groundwater at the existing Yandi Operations pre-mining varied from 3 - 20 m below ground level (Rio Tinto 2010). However, due to leakage into the CID aquifer from surplus water discharge associated with upstream operations, the depth to groundwater has decreased with the general flow direction to the east within the Marillana Creek catchment and to the northeast at the Proposal locations, along Weeli Wolli Creek (Kirkpatrick and Dogramaci 2010a, 2010b).

Groundwater values of the Proposal Area are described in further detail in Section 13.

5.6 Surface hydrology

The topography of the central Pilbara region generally supports well defined surface catchments. Most rivers in the Pilbara are ephemeral and flow only occasionally, usually after heavy rainfall events. Larger flows are correlated with storms or high intensity cyclonic events, which bring heavy rain over a large area of the catchment. The Revised Proposal is located in the Weeli Wolli Regional Catchment within the Upper Fortescue River Catchment, near the intersection of Marillana/Yandicoogina Creek, Phil's Creek and Weeli Wolli Creek (**Figure 10**).

Weeli Wolli Creek is the dominant drainage feature which enters the Proposal Area from south of the Proposal deposit. Weeli Wolli Creek is a major Pilbara drainage system, with a catchment area of 4,769 km^2, and length of approximately 71 km. Weeli Wolli Creek drains parallel to the Proposal deposit in a predominantly north easterly direction, which runs downstream of the deposit and the Marillana Creek confluence. It then drains into the fluvial outwash fan south of Fortescue Marsh, with Fortescue Marsh located approximately 40 km to the north of the Revised Proposal. As Weeli Wolli Creek approaches Fortescue Marsh, the creekline becomes increasingly braided and ill-defined within the fluvial outwash fan (Rio Tinto 2014b).

Weeli Wolli Creek and its tributaries are altered systems, receiving surplus water from existing mining projects specifically Yandi Operations, BHP's Marillana Creek (Yandi) operations and Hamersley HMS's Hope Downs 1 operation. The Hope Downs 1 surplus water release into Weeli Wolli Creek, which commenced in 2007, together with surplus water discharge from JSE into Weeli Wolli Creek (near the southern end of the Proposal deposit) during late 2006, has temporarily shifted the section of Weeli Wolli Creek adjacent to the Proposal from an ephemeral to a perennial system (Rio Tinto 2014a).

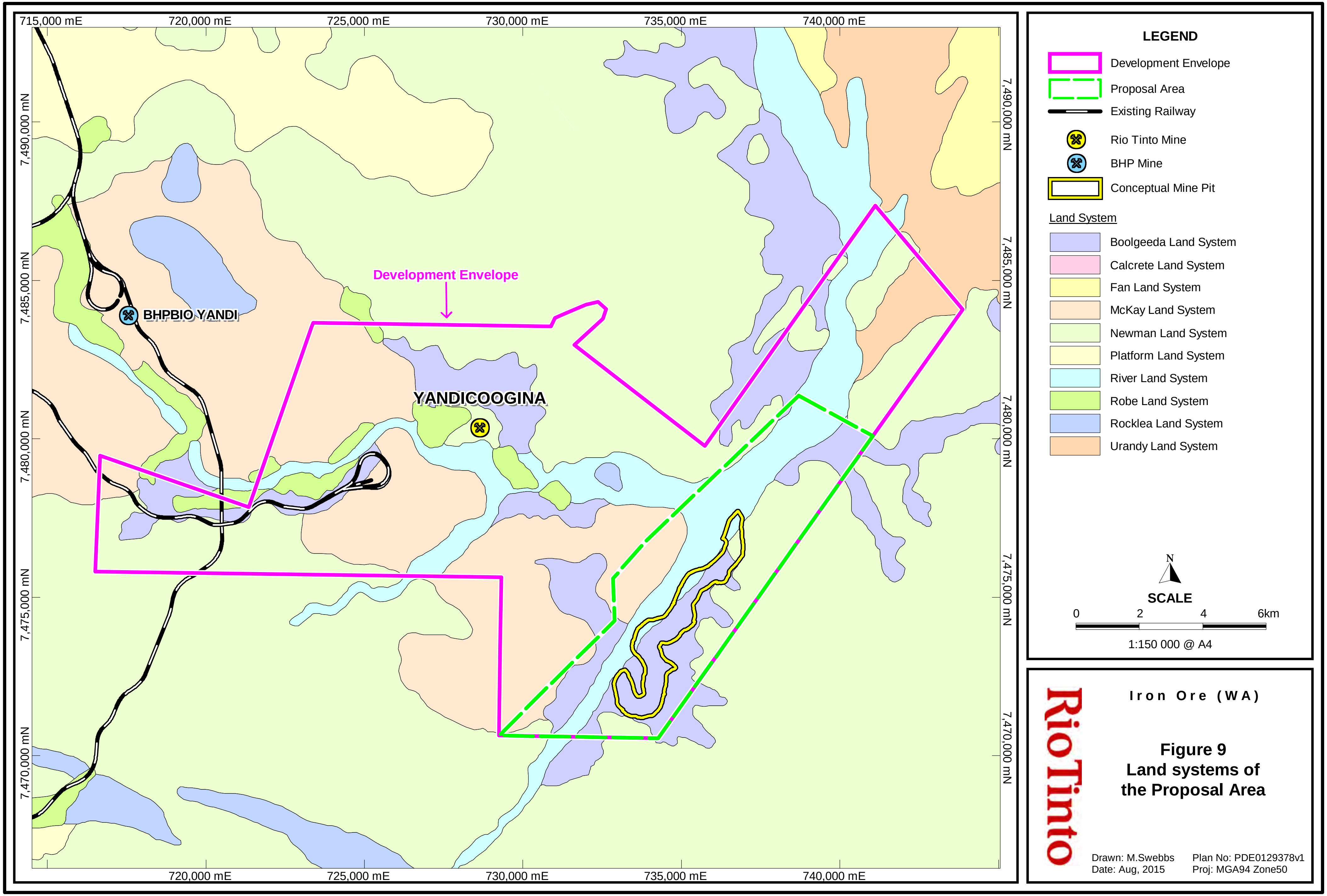
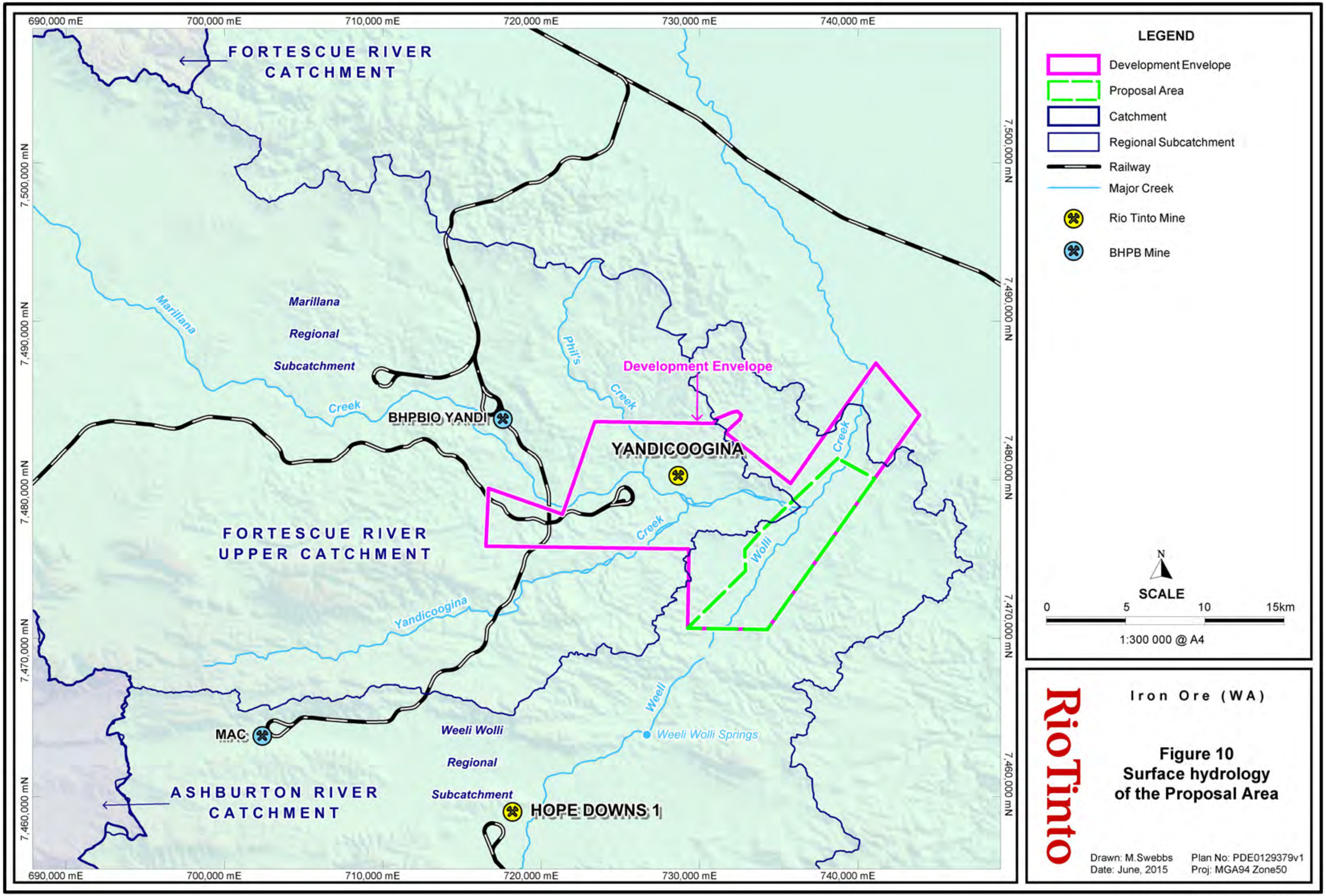


Figure 9
Land systems of the Proposal Area

Geospatial Information and Mapping



Geospatial Information and Mapping

6. Biological environment

6.1 Environmental Values Statement

As part of the approval for the existing Yandi Operations, under MS 914, an Environmental Values Statement (EVS) was required to be developed for Weeli Wolli Creek, as per condition 6-1 and 6-2:

- *Condition 6-1: The proponent shall ensure that the discharge of excess water from the Yandicoogina Iron Ore Project - Expansion to include Junction South West and Oxbow Deposits as a result of mining does not cause long term impacts to environmental values of the Weeli Wolli Creek System.*

- *Condition 6-2: To verify that condition 6-1 is being met, the proponent shall develop an Environmental Values Statement for the Weeli Wolli Creek System that defines the environmental values of the Weeli Wolli Creek System to the satisfaction of the CEO in consultation with the DEC.*

The high level values identified related to hydrology/hydrogeology, flora and vegetation, fauna, heritage and social aspects. This EVS was developed in consultation with the former Department of Environment and Conservation (DEC) and approved by the CEO of the OEPA on 14th October 2012 (**Table 6**).

Table 6: High level values statement for Weeli Wolli Creek catchment, October 2012

Value	Description
Hydrology/ hydrogeology	Marillana and Weeli Wolli Creeks are ephemeral watercourses supported by a combination of groundwater flows and surface run off. This system ultimately drains into Fortescue Marsh, approximately 40 km downstream of Yandicoogina.
Flora and vegetation	A number of populations of the DRF (Declared Rare Flora) *Lepidium catapycnon* occur within the Project Area. The species is listed as a DRF under the *Wildlife Conservation Act 1950* and as Vulnerable under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). Four main Riparian woodland vegetation communities exist along the Weeli Wolli and Marillana creekline areas within the Yandicoogina Project footprint. One community (open riparian woodland of *Eucalyptus victrix, Eucalyptus camaldulensis, Melaleuca argentea, M. glomerata*) is considered to have local significance due to its association with a major creekline in the area.
Fauna	The riparian woodland and ephemeral nature of the Weeli Wolli and Marillana Creeks, together with the underlying CID aquifer provide habitat for a range of fauna, including terrestrial, avian, aquatic and subterranean. Assemblages include aquatic fauna (micro and macroinvertebrates and fish), stygofauna, and animals of the hyporheic zone. The Project Area does not contain any permanent pools as refuge for aquatic fauna, and as a result there is no elevated conservation significance for aquatic fauna in the Project footprint. A number of stygofauna fauna species are known only from the Marillana-Weeli Wolli Catchment. In the wider catchment the Weeli Wolli Spring (upstream from the Project Area) is known to support a significant microbat species assemblage, which includes the most northerly population of the Chocolate Wattle Bat (*Chalinobolus morio*). No threatened fauna are known from the Weeli Wolli and Marillana creeklines in the Yandicoogina Project Area; however it may contain habitat for the Northern Quoll and the Pilbara Olive Python.
Heritage and social	Aboriginal culture is spiritually and physically connected to the landscape through *Jukurppa* (Dreaming) stories, ceremony, and physical places such as ethnographic and archaeological heritage sites. Weeli Wolli Creek is an important ephemeral water source, food source, camping and meeting place and has been visited by the Traditional Owners of the area for many thousands of years. Significant ethnographic and archaeological heritage sites are also associated with the Marillana and Weeli Wolli water courses. Weeli Wolli Creek is significant for tourism in the region.

These original values are proposed to be amended to reflect specific identified environmental values (rather than processes). This alteration is being undertaken in consultation with Parks and Wildlife. The updated EVS for the Weeli Wolli Creek catchment, included in the revision to the Yandicoogina Monitoring and Management Plan (**Appendix 4**), is described in **Table 7**.

Table 7: High level values statement for Weeli Wolli Creek catchment, October 2015

High Level Values	**Description**
Fortescue Marsh	The Fortescue Marsh is the largest ephemeral wetland in the Pilbara region and is listed on the Directory of Important Wetlands of Australia as a wetland of national significance. The diverse ecosystem includes endemic flora, fauna and supports a rich diversity of restricted aquatic and terrestrial invertebrates. The Fortescue Marsh is classified as a Priority Ecological Community (PEC). Marillana and Weeli Wolli Creeks are ephemeral watercourses supported by a combination of groundwater flows and surface run off. This system ultimately drains into Fortescue Marsh, approximately 40 km downstream of Yandicoogina.
Flora and vegetation	A number of populations of the DRF (Declared Rare Flora) *Lepidium catapycnon* occur within the Yandicoogina Development Envelope. The species is listed as a DRF under the Wildlife Conservation Act and as Vulnerable under the EPBC Act. Five broad riparian woodland vegetation communities exist along the Weeli Wolli and Marillana creekline areas within the Yandicoogina Development Envelope. One community (C1A - open riparian *eucalypt* woodland containing a mature and co-dominant *Melaleuca argentea* component) is considered to have local conservation significance due to its groundwater dependency, associated values, somewhat restricted distribution, and association with a major creekline in the area. This community is similar but of different structure and reduced significance to the vegetation community of Weeli Wolli Spring (significant *Melaleuca argentea* woodlands).
Stygofauna	A number of subterranean fauna species are known only from the Marillana-Weeli Wolli Catchment. The riparian woodland and ephemeral nature of the Weeli Wolli and Marillana Creeks, together with the underlying CID aquifer provide habitat for a range of fauna, including terrestrial, avian, aquatic and subterranean. Assemblages include aquatic fauna (micro and macroinvertebrates and fish), stygofauna, and animals of the hyporheic zone. The Development Envelope does not contain any permanent pools as refuge for aquatic fauna, and as a result there is no elevated conservation significance for aquatic fauna in the Development Envelope.
Other Recognised Values	**Description**
Fauna	In the wider catchment, the Weeli Wolli Spring (upstream from the Development Envelope) is known to support a significant microbat species assemblage, which includes the most northerly population of the Chocolate Wattle Bat (*Chalinobolus morio*). This bat species has been recorded in the south west corner of the Development Envelope. The Pilbara Olive Python (*Liasis olivaceus barroni*) has been recorded within Weeli Wolli Creek within the southern area of the Development Envelope, and the Development Envelope may contain habitat for the Northern Quoll (*Dasyurus hallucatus*). The Weeli Wolli Creek catchment also contains records of listed migratory birds and Priority species.
Heritage and Social	Aboriginal culture is spiritually and physically connected to the landscape through Jukurppa (Dreaming) stories, ceremony, and physical places such as ethnographic and archaeological heritage sites. Weeli Wolli Creek is an important ephemeral water source, food source, camping and meeting place and has been visited by the Traditional Owners of the area for many thousands of years. Significant ethnographic and archaeological heritage sites are also associated with the Marillana and Weeli Wolli water courses. Heritage and social values are recognised and are addressed by the Heritage of Western Australia Act 1990. Weeli Wolli Creek is also a significant tourism destination in the region.

6.2 Vegetation and flora

6.2.1 Context

6.2.1.1 Surveys in the region

Numerous flora and vegetation surveys have been conducted in the wider Yandicoogina locality, with surveys commencing in 1994 (refer to Section 14.2 for further details), to varying levels of detail. Within the Revised Proposal Development Envelope, 30 vegetation units (**Figure 11** to **Figure 19**) have been identified within the following broad landscape categories (Biota 2015a):

- Major creeklines and tributaries - A total of five vegetation types were associated with creeklines that supported true riparian vegetation, as characterised by the presence of the tree species *Eucalyptus camaldulensis* (River Red Gum), *E. victrix* (Coolibah) and/or scattered stands of *Melaleuca argentea* (Cadjeput).
- Minor creeklines, floodplains and valleys - A total of five vegetation types were associated with minor creeklines, floodplains and valleys.
- Hills, ridges, gorges and breakaways - A total of 11 vegetation types were associated with hills, ridges, gorges or breakaways.
- Plains - A total of nine vegetation types were associated with stony plains.

A total of 548 native vascular flora taxa from 173 genera and 53 families have been recorded within the Revised Proposal Development Envelope, based on all survey in the area to date. This includes one Threatened species (*Lepidium catapycnon*) and five Priority flora species. A total of 36 introduced flora species were also recorded (Biota 2015a).

6.2.1.2 Establishment of Clearing Avoidance Area

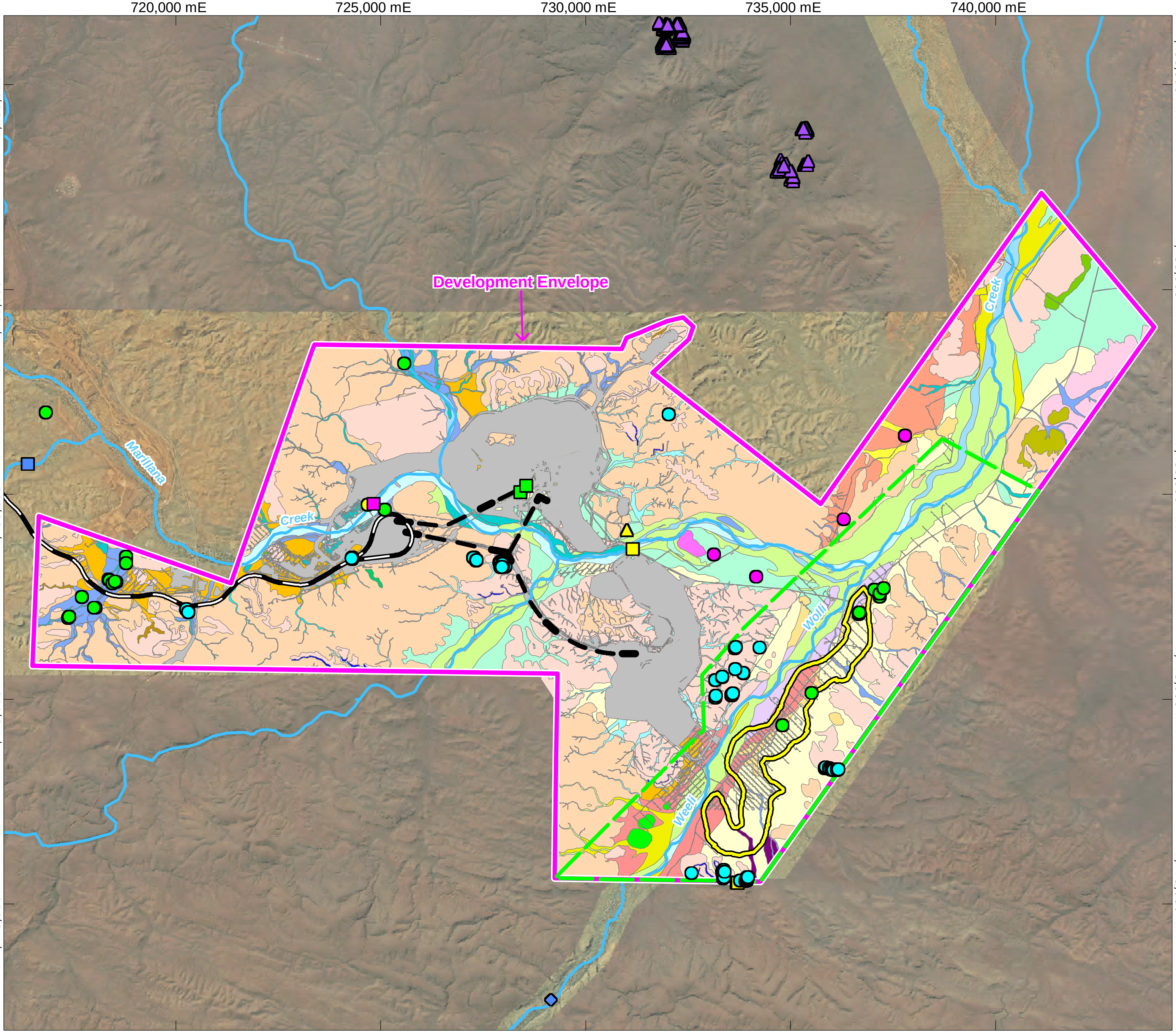
During assessment and approval of the existing Yandi Operations, a Clearing Avoidance Area (CAA) was defined as part of MS 914. The CAA was developed in recognition of the local conservation significance of the creeklines (as described in detail in the original EVS) and their ecological function. The boundary of the CAA was based on vegetation mapping specifically delineating riparian vegetation and encompassing creekline vegetation communities representing the broader floodplain.

The CAA was originally developed for the JSW and Oxbow environmental assessment whereby a Development Envelope was defined and key areas for reduced or limited clearing were delineated along Marillana Creek. This included delineating areas of the creekline not proposed to have any clearing undertaken during implementation of the proposal. However, during a subsequent s46B amendment under the EP Act to include the existing operations (JC and JSE), the boundary of the CAA was extended from Marillana Creek to also include Weeli Wolli Creek to match the expanded Development Envelope, and delineated areas which were not intended to have any clearing associated with implementation of the operations which were included and approved in MS 914.

The applicability of the CAA delineated in MS914 was therefore related to implementation of the JSW, Oxbow, JC and JSE deposits only, and not intended to apply to potential future developments (such as this Proposal). To avoid confusion, the CAA and Restricted Clearing Area polygons have been revised to an overall Restricted Clearing Area as depicted in **Figure 79**, Section 24.

6.2.1.3 Riparian vegetation trends

Riparian vegetation along Pilbara watercourses are often dominated by dense, tall, large trees of *Melaleuca argentea, Eucalyptus camaldulensis* and *E. victrix*. These species occur in an environment subject to ecological shifts that can be quite large and dynamic, with episodic occurrences of drought, defoliating wildfire, severe flood and stand replacement by regeneration, even when in a "natural and protected" condition. Shifts in species composition and in tree health are inevitable over time.



LEGEND

Development Envelope
Proposal Area
Existing Railway
Existing Conveyor
Major Watercourse
Conceptual Mine Pit

Priority 1 Flora
Synostemon hamersleyensis

Priority 2 Flora
Rhodanthe frenchii
Stylidium weeliwolli

Priority 3 Flora
Rostellularia adscendens var. latifolia
Sida sp. Barlee Range (S. van Leeuwen 1642)
Themeda sp. Hamersley Station (M.E. Trudgen 11431)

Priority 4 Flora
Goodenia nuda
Rhynchosia bungarensis

Species of Interest
Eulalia sp. (Three Rivers Station, B.Forsyth AQ6789133)
Glycine sp. aff. arenaria

Rare Species
Lepidium catapycnon

N

SCALE
0 2 4 6km
1:140 000 @ A4

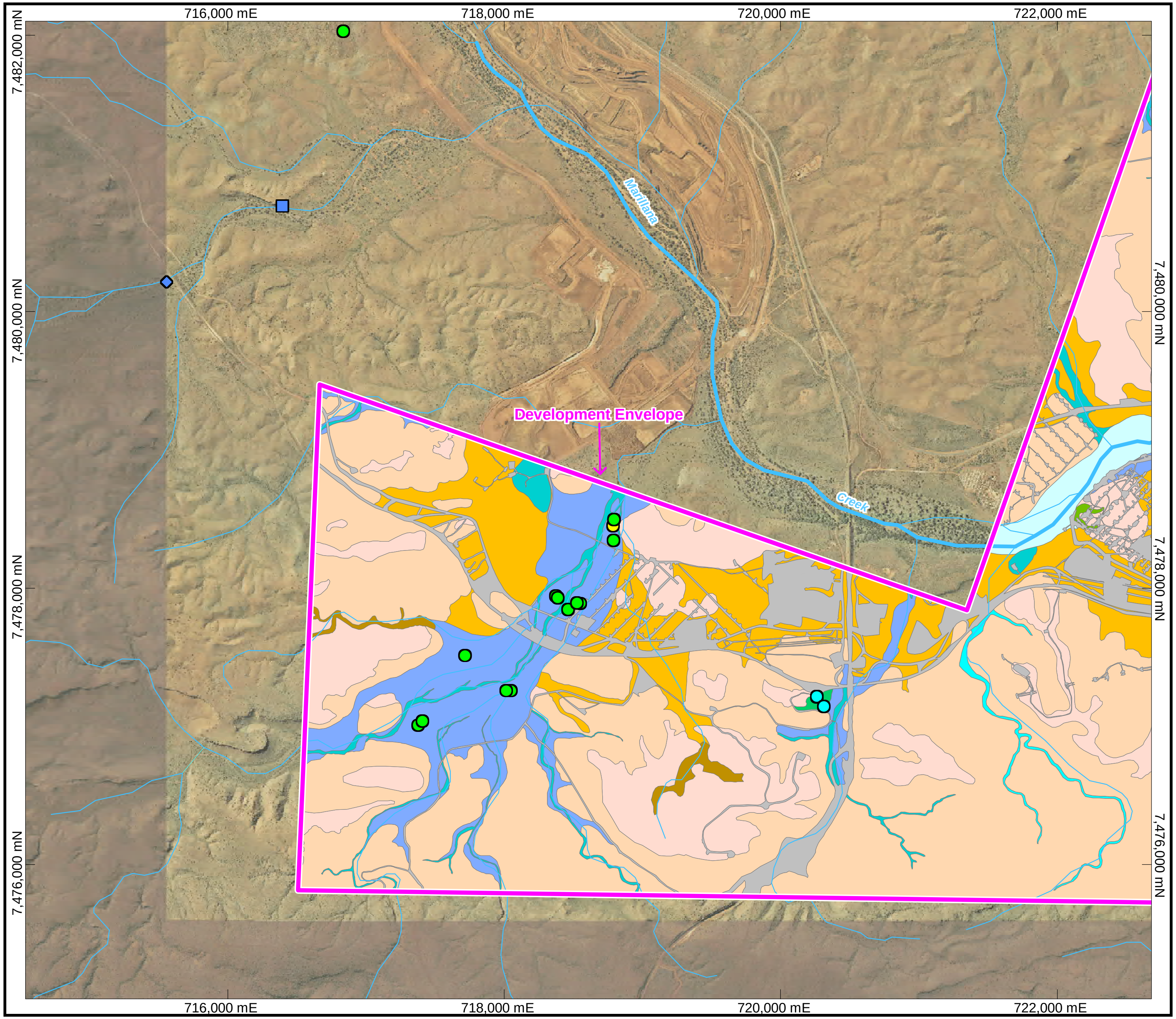
RioTinto

Iron Ore (WA)

Figure 11
Vegetation units in the Revised Proposal Development Envelope (Overall Map)

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0131734v3
Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

Development Envelope

Rare Species

Lepidium catapycnon

Priority 2 Flora

Rhodanthe frenchii

Stylidium weeliwolli

Priority 3 Flora

Rostellularia adscendens* var. *latifolia

Priority 4 Flora

Goodenia nuda

N

SCALE

0 0.5 1 1.5 2km

1:40 000 @ A4

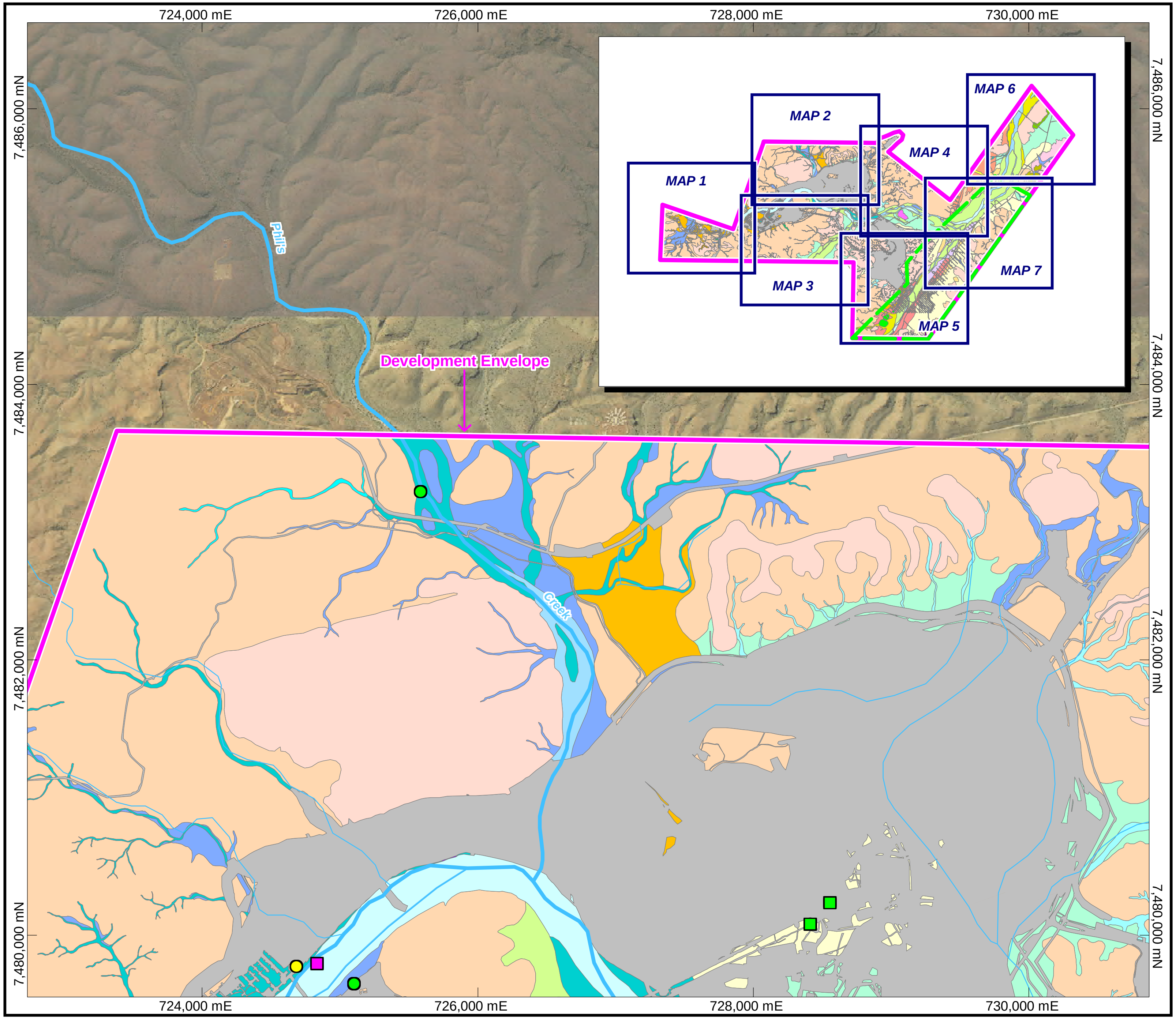
RioTinto

Iron Ore (WA)

Figure 12
Vegetation units in the Revised Proposal Development Envelope (Map 1)

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0131734v2
Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

Development Envelope

Priority 3 Flora

Rostellularia adscendens var. ***latifolia***

Priority 4 Flora

Goodenia nuda

Rhynchosia bungarensis

Species of Interest

Glycine sp. aff. ***arenaria***

N

SCALE

0 0.5 1 1.5 2km

1:40 000 @ A4

Rio Tinto

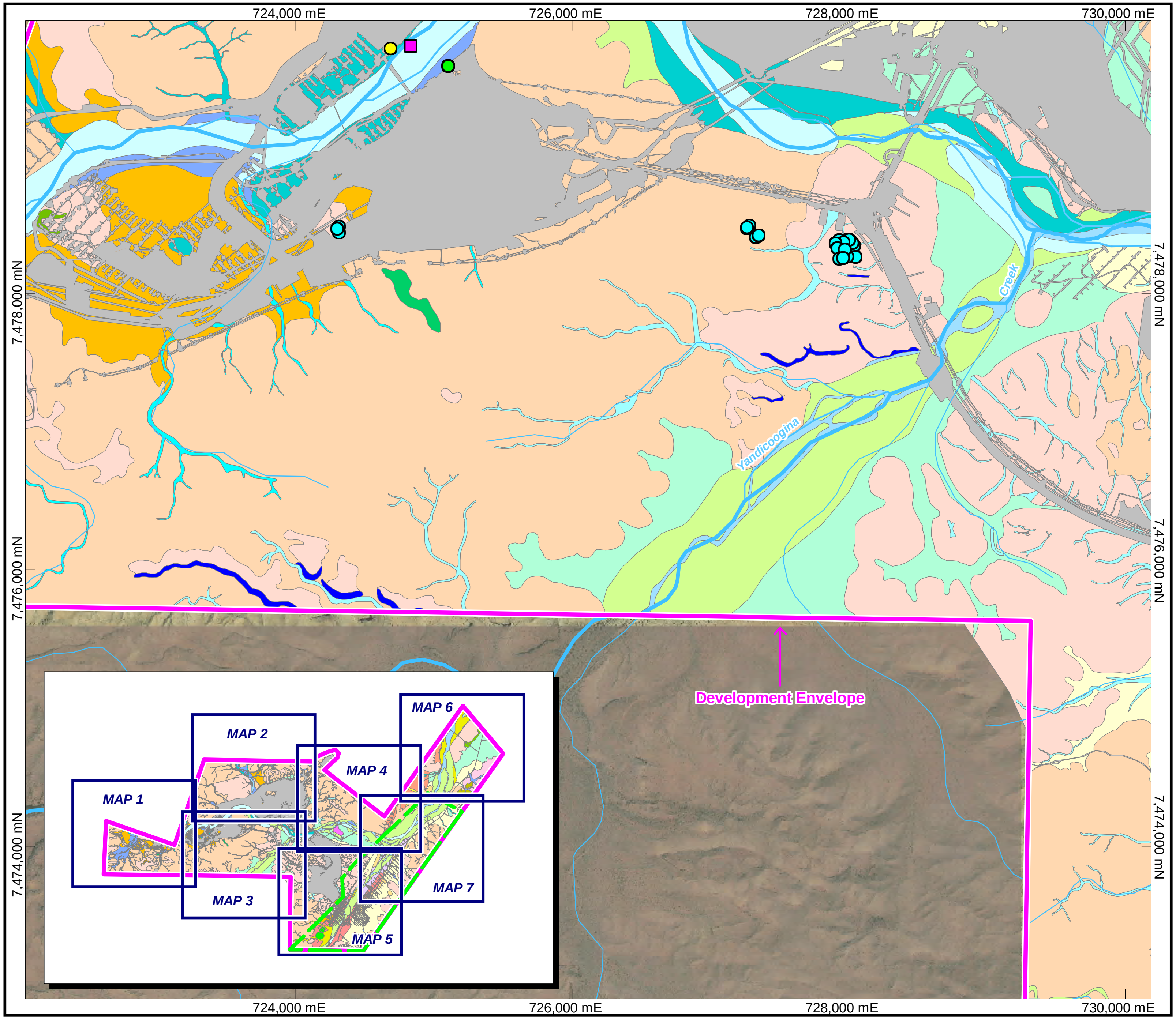
Iron Ore (WA)

Figure 13
Vegetation units in the Revised Proposal Development Envelope (Map 2)

Drawn: M.Swebbs
Date: October, 2015

Plan No: PDE0131734v2
Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

Development Envelope

Rare Species

Lepidium catapycnon

Priority 3 Flora

Rostellularia adscendens var. *latifolia*

Priority 4 Flora

Goodenia nuda

Species of Interest

Glycine sp. aff. *arenaria*

N

SCALE

0 0.5 1 1.5 2km

1:40 000 @ A4

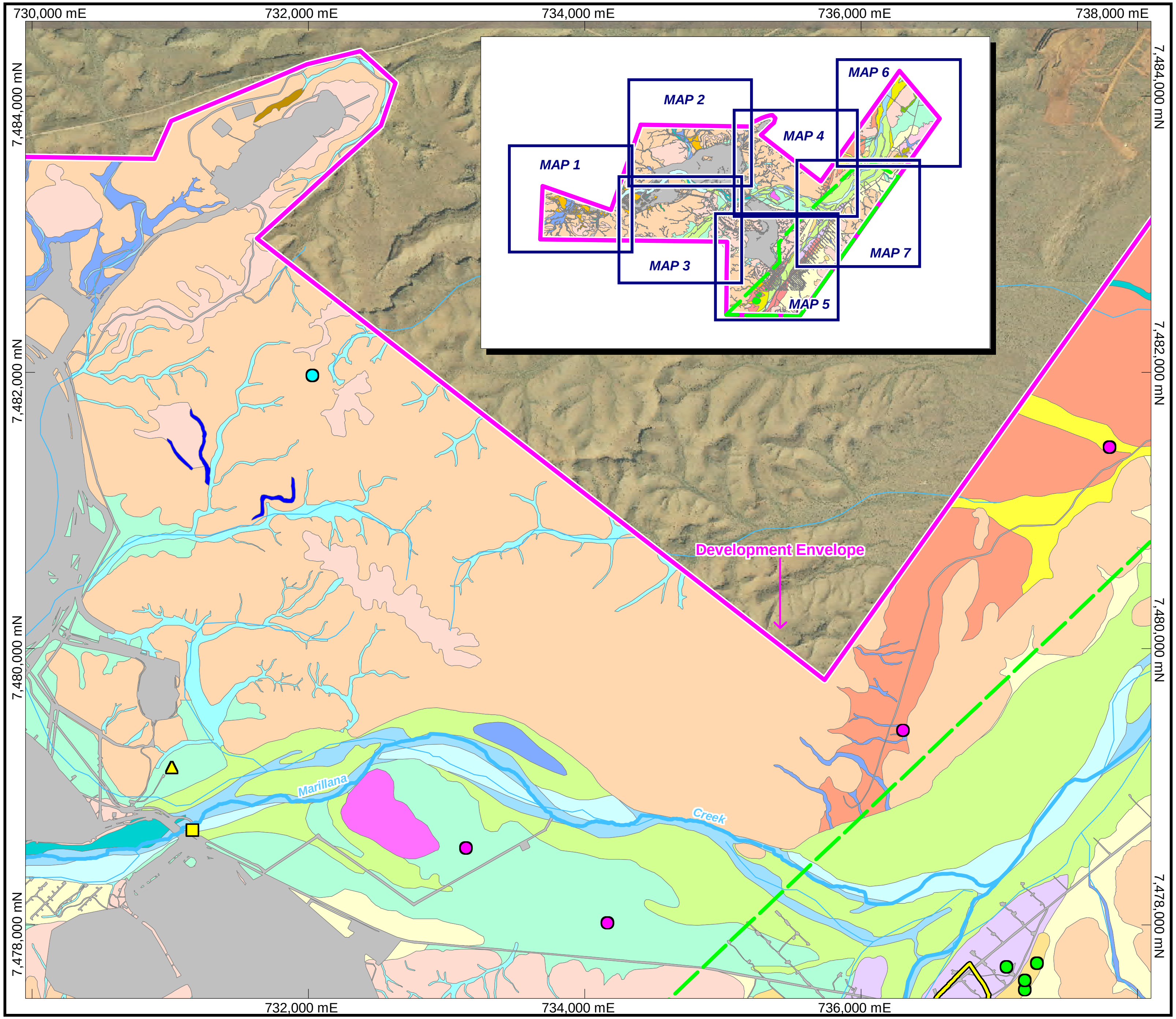
Rio Tinto

Iron Ore (WA)

Figure 14
Vegetation units in the Revised Proposal Development Envelope (Map 3)

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0131734v2
Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

Development Envelope
Proposal Area
Conceptual Mine Pit
Conceptual Waste Dump

Rare Species
Lepidium catapycnon

Priority 3 Flora
Sida sp. Barlee Range (S. van Leeuwen 1642)
Themeda sp. Hamersley Station (M.E. Trudgen 11431)

Priority 4 Flora
Goodenia nuda

Species of Interest
Eulalia sp. (Three Rivers Station, B.Forsyth AQ6789133)

N

SCALE
0 0.5 1 1.5 2km
1:40 000 @ A4

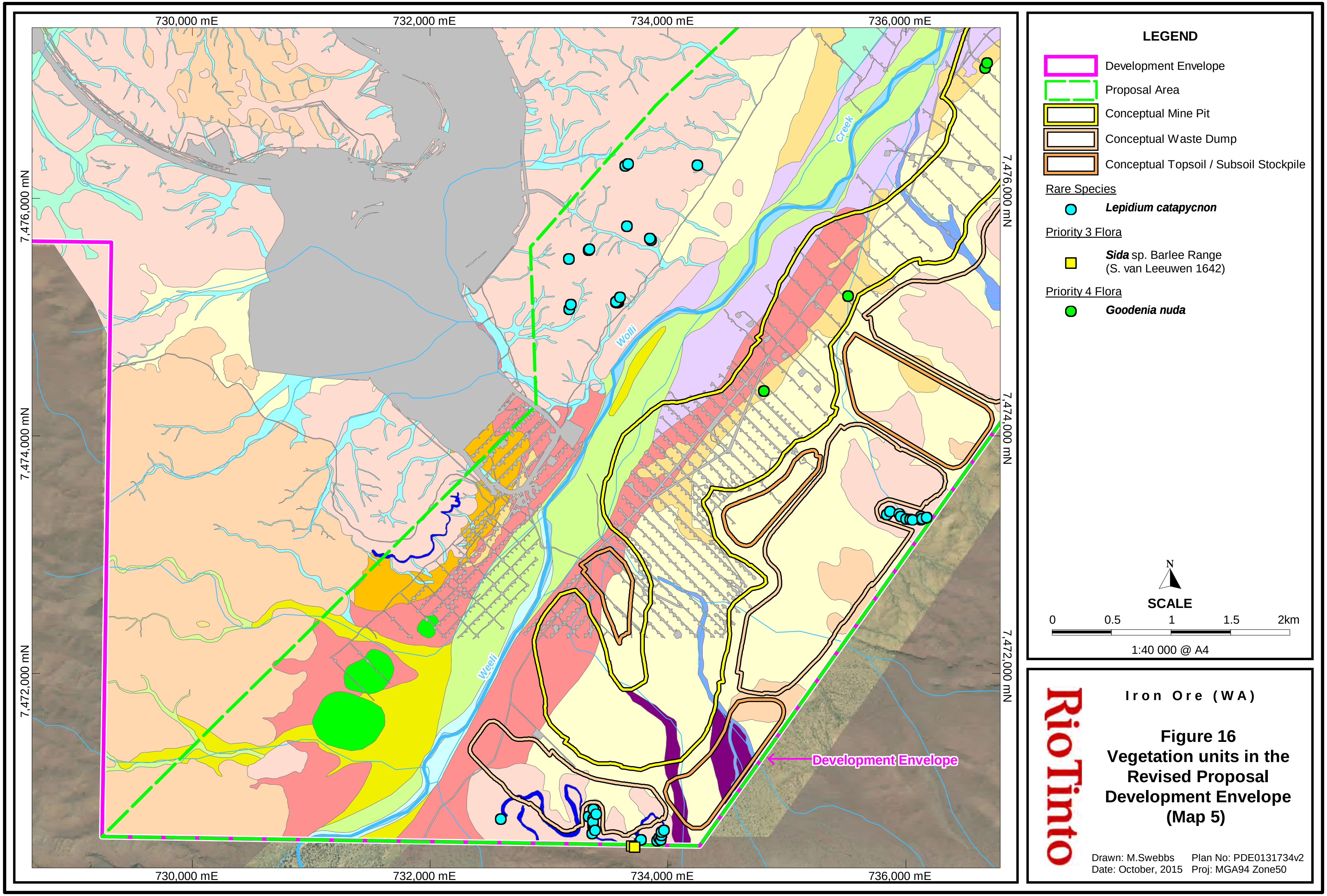
RioTinto

Iron Ore (WA)

Figure 15
Vegetation units in the Revised Proposal Development Envelope (Map 4)

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0131734v2
Proj: MGA94 Zone50

Geospatial Information and Mapping



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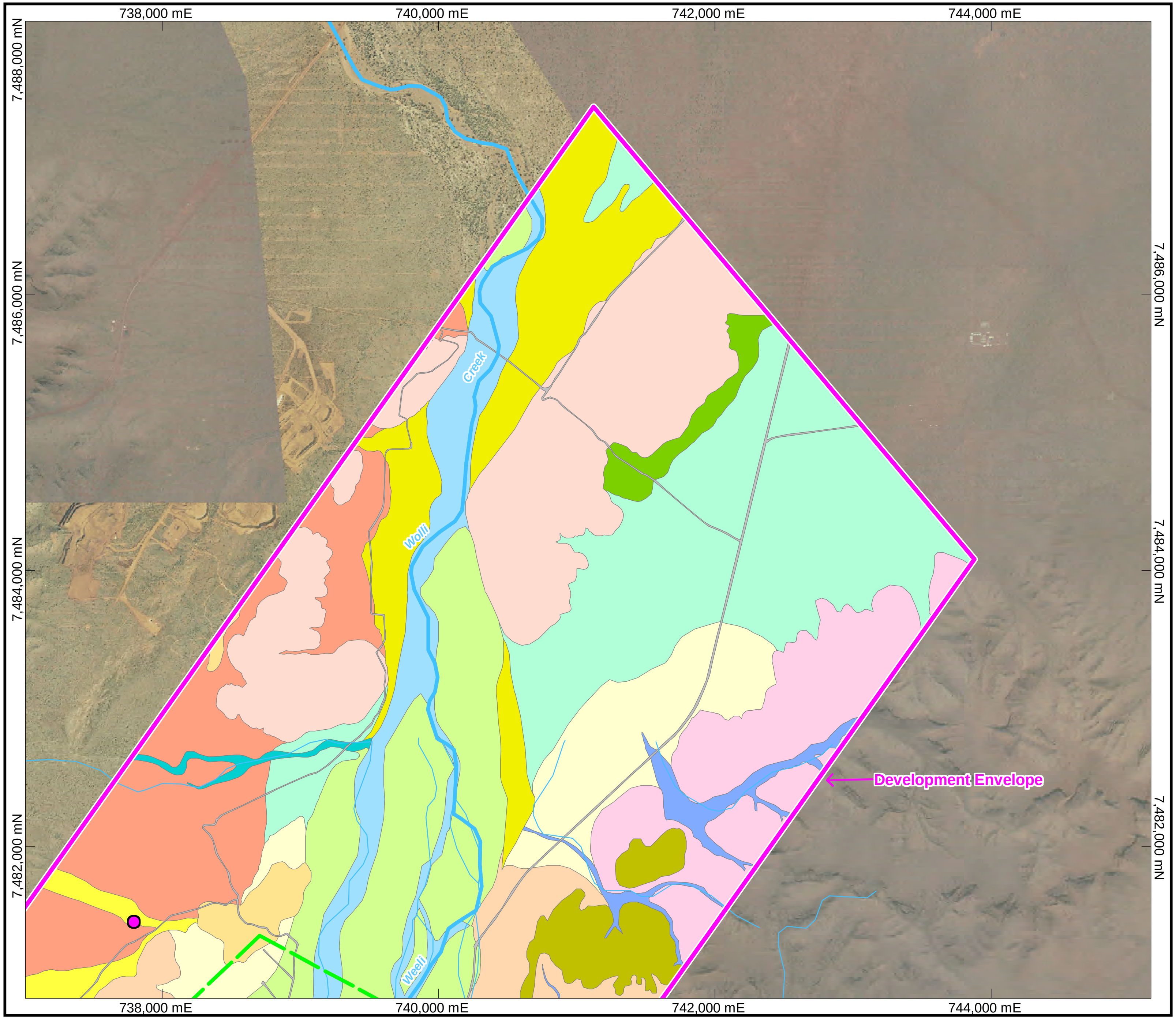


LEGEND

Development Envelope

Proposal Area

Species of Interest

Eulalia sp. (Three Rivers Station, B.Forsyth AQ6789133)

N

SCALE

0 0.5 1 1.5 2km

1:40 000 @ A4

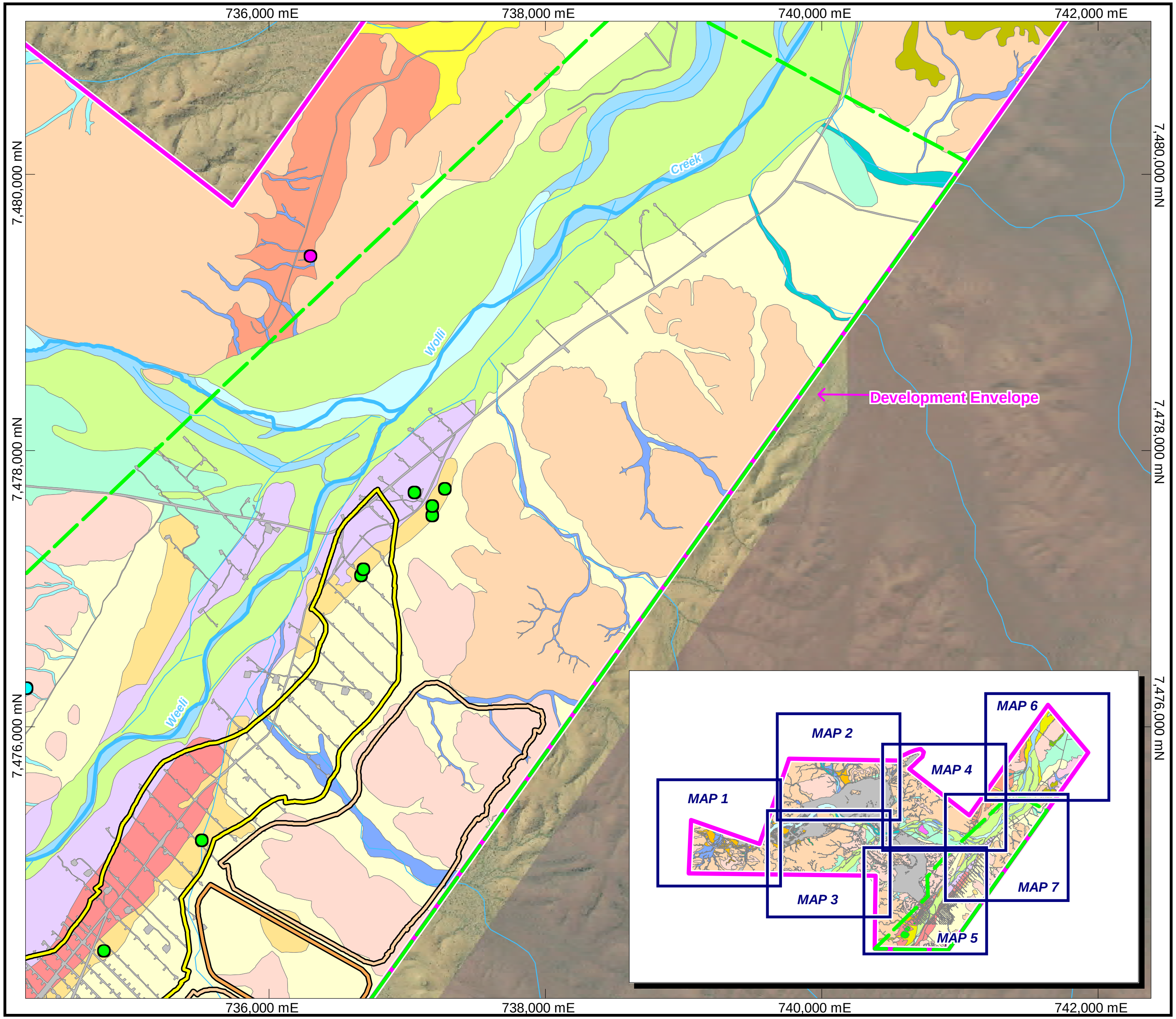
Rio Tinto

Iron Ore (WA)

Figure 17 Vegetation units in the Revised Proposal Development Envelope (Map 6)

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0131734v2
Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

- Development Envelope
- Proposal Area
- Conceptual Mine Pit
- Conceptual Waste Dump
- Conceptual Topsoil / Subsoil Stockpile

Rare Species

- ***Lepidium catapycnon***

Priority 4 Flora

- ***Goodenia nuda***

Species of Interest

- ***Eulalia*** sp. (Three Rivers Station, B.Forsyth AQ6789133)

N

SCALE

0 0.5 1 1.5 2km

1:40 000 @ A4

Rio Tinto

Iron Ore (WA)

Figure 18
Vegetation units in the Revised Proposal Development Envelope (Map 7)

Drawn: M.Swebbs
Date: October, 2015

Plan No: PDE0131734v2
Proj: MGA94 Zone50

Figure 19 - Vegetation units in the Revised Proposal Development Envelope

Vegetation of Major Creeklines and Tributaries

C1: EcEvMaMgAc
Eucalyptus camaldulensis subsp. refulgens, E. victrix woodland over Melaleuca argentea, M. glomerata, Acacia coriacea subsp. pendens low open woodland

C2: EvChAtuGwTErCYpERItTHt
Eucalyptus victrix, (Corymbia hamersleyana) scattered low trees over Acacia tumida var. pilbarensis, Grevillea wickhamii tall shrubland over Tephrosia rosea var. Fortescue Creeks (M.I.H. Brooker 2186) low shrubland over Cymbopogon ambiguus, C. procerus Eriachne tenuiculmis, Themeda triandra very open tussock grassland

C3: EvAciAcMgCEc
Eucalyptus victrix scattered trees over Acacia citrinoviridis, A. coriacea subsp. pendens, Melaleuca glomerata tall open shrubland over *Cenchrus ciliaris scattered tussock grasses

C4: EvAciAprAThCEc
Eucalyptus victrix open woodland over Acacia citrinoviridis, A. pruinocarpa, Atalaya hemiglauca low woodland over *Cenchrus ciliaris tussock grassland

C5: EvAbAaAmERItTHt
Eucalyptus victrix scattered low trees over Acacia bivenosa, A. ancistrocarpa, A. maitlandii tall open shrubland over Eriachne tenuiculmis, Themeda triandra very open tussock grassland

Vegetation of Minor Creeklines, Floodplains and Valleys

F1: ChAtuGwTp
Corymbia hamersleyana scattered low trees to low open woodland over Acacia tumida var. pilbarensis, Grevillea wickhamii tall open shrubland over Triodia pungens hummock grassland

F2: AprAciCEc
Acacia pruinocarpa, A. citrinoviridis tall open shrubland over *Cenchrus ciliaris tussock grassland

F3: ElChAtuAaAbGwTspp
Eucalyptus leucophloia, Corymbia hamersleyana low open woodland over Acacia tumida var. pilbarensis, A. ancistrocarpa, A. bivenosa, Grevillea wickhamii tall open scrub over mixed Triodia hummock grassland

F4: ChAtuAaPcAtenBONeARhPAmTp
Corymbia hamersleyana scattered low trees over Acacia tumida var. pilbarensis tall open shrubland over A. ancistrocarpa, Petalostylis cassioides, A. tenuissima open shrubland over Bonamia erecta very open herbland over Aristida holathera var. holathera var. holathera, Paraneurachne muelleri very open tussock grassland and Triodia pungens very open hummock grassland

Vegetation of Hills, Ridges and Breakaways

F5: ChAciAaAiSENsppTp
Corymbia hamersleyana scattered low trees over Acacia citrinoviridis, A. ancistrocarpa, A. inaequilatera tall open shrubland over Senna spp. open shrubland over Triodia pungens open hummock grassland.

H1: ElHcAiGwTsps
Eucalyptus leucophloia subsp. leucophloia scattered low trees over Hakea chordophylla, Acacia inaequilatera, Grevillea wickhamii tall open shrubland over Triodia sp. Shovelanna Hill (S. van Leeuwen 3835) hummock grassland

H2: ElAiTwTsps
Eucalyptus leucophloia subsp. leucophloia scattered low trees over Acacia inaequilatera scattered tall shrubs over Triodia wiseana, (T. sp. Shovelanna Hill (S. van Leeuwen 3835)) open hummock grassland

H3: ElGwAarTsps
Eucalyptus leucophloia subsp. leucophloia scattered low trees over Grevillea wickhamii tall open shrubland over Acacia arida shrubland over Triodia sp. Shovelanna Hill (S. van Leeuwen 3835) open hummock grassland

H4: ChAarTspsTw
Corymbia hamersleyana scattered low trees over Acacia arida open shrubland over Triodia sp. Shovelanna Hill (S. van Leeuwen 3835), T. wiseana hummock grassland

H5: ElCfERlmTHspp
Eucalyptus leucophloia subsp. leucophloia, Corymbia ferriticola scattered low trees over Eremophila latrobei subsp. filiformis, Senna spp. scattered shrubs over Cymbopogon ambiguus, Eriachne mucronata, Themeda sp. Mt Barricade (M.E. Trudgen 2471), T. triandra open tussock grassland

H6: ElAbTw
Eucalyptus leucophloia scattered low trees over Acacia bivenosa open shrubland over Triodia wiseana hummock grassland

H7: ElAprTwTp
Eucalyptus leucophloia scattered low trees over Acacia pruinocarpa tall open shrubland over Triodia wiseana, T. pungens open hummock grassland

H8: AmoTspsTw
Acacia monticola tall shrubland over Triodia sp. Shovelanna Hill (S. van Leeuwen 3835), T. wiseana closed hummock grassland

H9: ChGOrANlAtuGwTHtCYa
Corymbia hamersleyana scattered low trees over Gossypium robinsonii, Androcalva luteiflora, Acacia tumida var. pilbarensis, Grevillea wickhamii shrubland over Themeda triandra, Cymbopogon ambiguus open tussock grassland

H10: AiERfTp
Acacia inaequilatera scattered tall shrubs over Eremophila fraseri subsp. fraseri scattered shrubs over Triodia pungens very open hummock grassland

H11: GpERfTp
Grevillea pyramidalis subsp. leucodendron, Eremophila fraseri tall open shrubland over Triodia pungens hummock grassland

Vegetation of Plains

P1: ElEgAprAbAaAdTwTpTsps
Eucalyptus leucophloia subsp. leucophloia scattered low trees over E. gamophylla scattered low mallees over Acacia pruinocarpa scattered tall shrubs over A. bivenosa, A. ancistrocarpa, A. dictyophleba shrubland over Triodia wiseana, T. pungens, T. sp. Shovelanna Hill (S. van Leeuwen 3835) hummock grassland

P2: ChAprAiAsclApaTp
Corymbia hamersleyana, Acacia pruinocarpa scattered low trees over A. inaequilatera, A. sclerosperma subsp. sclerosperma, A. pachyacra tall open shrubland over Triodia pungens hummock grassland

P3: AprAciAiAsclTlo
Acacia pruinocarpa low open woodland over A. citrinoviridis, A. inaequilatera, A. sclerosperma subsp. sclerosperma open shrubland over Triodia longiceps hummock grassland

P4: AprAsyAiTw
Acacia pruinocarpa low open woodland over A. synchronicia, A. inaequilatera scattered tall shrubs over Triodia wiseana open hummock grassland

P5: ElEgAbAaTb
Eucalyptus leucophloia subsp. leucophloia scattered low trees over E. gamophylla scattered low mallees over Acacia bivenosa, A. ancistrocarpa open shrubland over Triodia basedowii open hummock grassland

P6: AapERfoERl/g
Acacia aptaneura low open forest over Eremophila forrestii subsp. forrestii open shrubland over E. lanceolata low open shrubland over mixed very open grassland

P7: ERf/G
Eremophila fraseri subsp. fraseri open shrubland over mixed very open grassland

P8: EgAiTs
Eucalyptus gamophylla scattered low mallees over Acacia inaequilatera scattered tall shrubs over Triodia schinzii hummock grassland

P9: ChEgAiAaAprPcTb
Corymbia hamersleyana scattered low trees over Eucalyptus gamophylla scattered low mallees over Acacia inaequilatera, A. ancistrocarpa, A. pruinocarpa tall open shrubland over Petalostylis cassioides open shrubland over Triodia basedowii open hummock

Disturbed
Disturbed

The Proponent monitors riparian tree health utilising a variety of methods, specifically ground transects (record flora present, structure and visual rating of crown health condition), Digital Cover Photography, and aerial photography. Monitoring results show varying changes to riparian vegetation (when comparing reference and impact sites). Some areas show increased health, others decreased (including dead trees) and others that have changed little (Eastham 2015). These results indicate that the vegetation even at reference sites in the Pilbara is not static, but is highly dynamic in its responses to altered environmental conditions.

The hydrology of the Weeli Wolli Creek system is complex. In addition to a high level of natural variation in rainfall and surface water flow, the creek is also influenced by dewatering, spur irrigation, discharge and re-injection associated with mines operating in the catchment. Ecological changes are inevitable where an ephemeral creek system is altered to a perennial system for a number of years. **Plate 1** shows the extent and density of vegetation associated with the Weeli Wolli Creek system prior to hydrological alterations by mining operations, when the system was ephemeral. The vegetation is much sparser in comparison to **Plate 2**, which shows the extent and density of vegetation subsequent to hydrological alterations where the system is now perennial and natural regeneration from local seed sources is occurring.

Plate 1: Vegetation associated with portion of Weeli Wolli Creek system in 2006

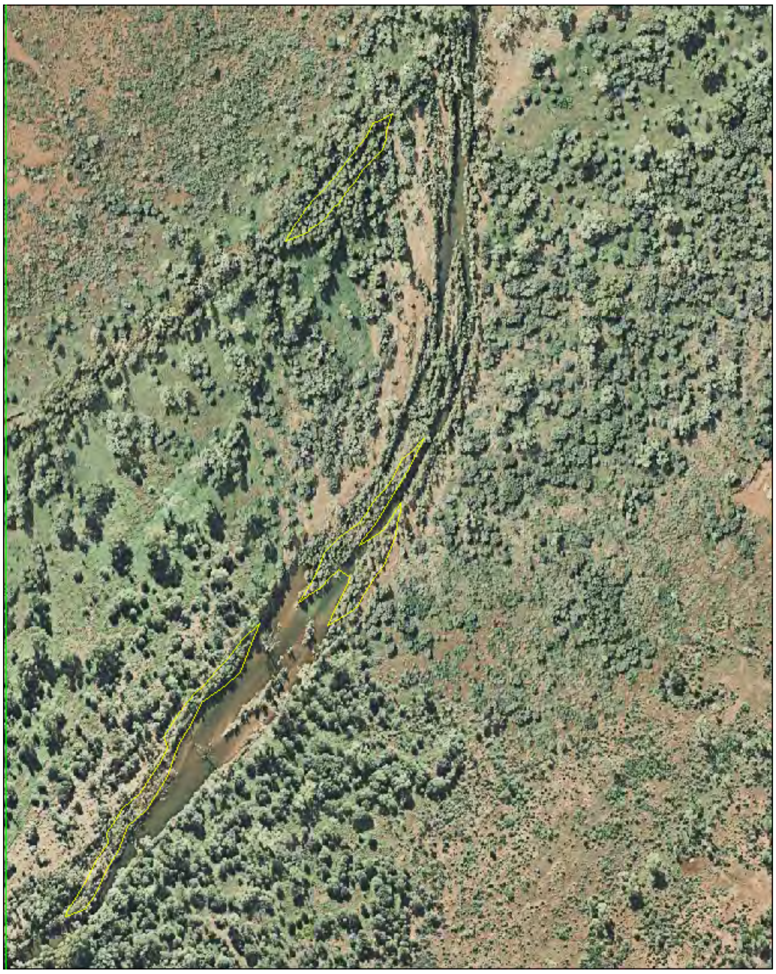


Plate 2: Vegetation associated with portion of Weeli Wolli Creek system in 2014

Tree responses to drought and waterlogging (associated with dewatering and surplus water discharge) will differ between the three dominant riparian species (*M. argentea, E. camaldulensis* and *E. victrix*), as well as being influenced by the proximity of the trees to the disturbance (dewatering or discharge), the ecological niche occupied by individual trees (especially elevation above water table), valley shape and soil type.

6.2.2 Vegetation

The Proposal Area lies within the Fortescue Botanical District of the Eremaean Botanical Province as defined by Beard (1975a). Vegetation of this province is typically open and frequently dominated by spinifex, wattles and scattered eucalypts. The Proposal Area intersects two of the vegetation units defined by Beard (1975b), all of which have the majority of their pre-European extent remaining. These vegetation units are described in

Table 8: Broad vegetation of the Proposal Area

Beard Vegetation Association	Description
Fortescue Valley_29	Sparse low woodland; mulga, discontinuous in scattered groups
Fortescue Valley_82	Hummock grasslands, low tree steppe; Snappy Gum over *Triodia wiseana* (equivalent to Hamersley_82)

Source: Beard (1975b)

Biota Environmental Sciences (Biota) has mapped and described vegetation sub-associations (referred to herein as vegetation units) within the Proposal Area (Biota 2014a); and additional refined riparian vegetation mapping has been undertaken along Marillana and Weeli Wolli Creek (Rio Tinto 2015a). The vegetation units have been grouped according to major landform, with the following relevant to the Proposal Area:

- Vegetation of Major Creeklines and Tributaries.
- Vegetation of Minor Creeklines, Floodplains and Valleys.
- Vegetation of Hills, Ridges and Breakaways.
- Vegetation of Plains.

Most of the vegetation was in Excellent or Good condition (utilising the scale by Trudgen 1988), however the creekline and floodplain vegetation ranged from Good to Very Poor condition. This was due to dense weed invasion (particularly by *Cenchrus ciliaris*) and disturbance from cattle in the form of tracks, grazing, trampled vegetation and scats (Biota 2014a).

Details of the vegetation recorded within the Proposal Area, including the conservation significance of vegetation communities and vegetation condition, are described further in Section 14.

6.2.3 Flora

A total of 455 native vascular flora taxa from 147 genera and 47 families have been recorded from the Proposal Area, based on all survey effort to date (Biota 2014a). This includes one Threatened species and two Priority flora species, with an additional three Priority species potentially occurring in the Study area. When compared to other studies within the region, the total number of native flora taxa recorded from the Proposal Area is in the range that would be expected and does not contain a particularly high level of vegetation or plant species diversity for the Pilbara bioregion (Biota 2014b). Eighteen introduced flora species have also been recorded.

The flora recorded in the Proposal Area, including conservation significant flora, are described further in Section 14.

6.3 Terrestrial fauna

6.3.1 Terrestrial fauna habitats

Five fauna habitat types have been categorised in the Proposal Area, classified on the basis of landform, substrate and vegetation (Biota 2014c). In addition, disturbed areas were identified. The fauna habitats included:

- Alluvial Plain (Flood Plain).
- Mulga woodland.
- Hilltops and Slopes.
- Pediment Slope.
- Major Drainage Line.

The major drainage channels of the Marillana and Weeli Wolli Creeks provide suitable habitat for conservation significant fauna species such as the Pilbara Olive Python (*Liasis olivaceus barroni*). Habitat for the conservation significant Northern Quoll (*Dasyurus hallucatus*) is limited, but some small areas of rocky breakaway habitat do exist throughout the Proposal Area (Biota 2014d).

Terrestrial fauna habitats are described further in Section 15.

6.3.2 Terrestrial vertebrate fauna

A total of 147 vertebrate fauna species have been recorded in the Proposal Area, including five conservation listed species under the EPBC Act, the *Wildlife Conservation Act 1950* (WC Act) and/or the Parks and Wildlife Priority List. An additional species, the Chocolate Wattled Bat (*Chalinolobus morio*), while currently not listed under Commonwealth or State legislation, was also identified to be of significance. A further 11 conservation listed species have been identified as likely or potentially occurring within the Proposal Area (Biota 2015b; 2014c).

The terrestrial vertebrate fauna of the Proposal Area, including conservation listed species, are described further in Section 15.

6.3.3 Short range endemic terrestrial invertebrate fauna

Species are identified as potential short range endemics (SREs) if they have a known distribution less than 10,000 km^2 (Harvey 2002). SRE invertebrate fauna were targeted during recent fauna surveys of the Proposal Area. Genetic analysis from collected specimens determined four potential SRE putative species from two families of mygalomorph spiders (Biota 2014c, 2015b). The SREs of the Proposal Area are described further in Section 15.

6.3.4 Aquatic fauna

Aquatic fauna surveys have been conducted biannually (wet and dry seasons) since September 2007 by Wetland Research and Management (WRM 2015a, b) in Marillana Creek and Weeli Wolli Creek. The most recent survey in September/October 2013 (late dry) and April/May 2014 (late wet) found the following number of taxa in the Proposal Area:

- 108 microinvertebrate taxa.
- 141 macroinvertebrate taxa.

- 34 hyporheic fauna taxa: 15 taxa classified as occasional hyporheos stygophiles, 7 taxa as stygobites, and 12 were possible hyporheic taxa.
- 3 fish species.

Several undescribed hyporheic taxa were considered to be new species, and five stygobitic amphipod/isopod species were considered to be potential SREs, with *Maarrka weeliwolli* and *Pygolabis weeliwolli* appearing to be restricted to Marillana Creek and Weeli Wolli Creek. The aquatic fauna sampled within the Proposal Area are described further in Section 15.

6.4 Subterranean fauna

Subterranean fauna can be classified into two main groups:

- Stygofauna which are obligate groundwater-dwelling aquatic fauna that spend their entire life cycle below ground, occasionally occurring very close to surface waters as well as deep aquifers; and
- Troglofauna which are obligate subterranean terrestrial fauna that inhabit caves and the many small voids and tunnels that occur within some unconsolidated and rocky substrates above the water table.

Subterranean fauna in WA are generally invertebrates and often exhibit high levels of endemism. The absence of light in subterranean ecosystems results in limited energy resources originating from surface environments. As a consequence, subterranean fauna have evolved to survive in unique environments, often being highly specialised with morphological, physiological and biological adaptations that reflect severe environmental constraints (Gibert & Deharveng 2002 as cited in EPA 2013b). WA's subterranean fauna is recognised as being globally significant because of its extraordinarily high species richness and high levels of endemism (EPA 2013b).

In total there were 2,761 stygofauna specimens from 62 taxa found in the Proposal Area to date. There is limited troglofauna habitat within the Proposal Area, and the CID formation proposed for excavation (known to provide habitat for troglofauna in other areas of the Pilbara) is located 99% below the water table. Three troglofauna specimens (three taxa) have been recorded within the Proposal Area.

Subterranean fauna of the Proposal Area are described in further detail in Section 15.

7. Social environment

7.1 Socio-economic setting

The Pilbara is one of the largest regions in WA, encompassing 507,896 km^2 (Pilbara Development Commission 2015). In June 2014, the estimated resident population of the Pilbara region was 67,503 people, with almost 60% of the population aged between 20 and 49 years. The mining and construction industries account for 60% of all jobs in the region. In 2014, the gross regional product for the Pilbara was almost $35 billion (REMPLAN 2015).

The Proposal Area lies within the Shire of East Pilbara, which has an estimated population of 25,000 people, including FIFO workers. The East Pilbara economy is primarily based on mining and associated supporting industries, tourism and pastoral activities. The main regional centres of the East Pilbara are Newman, Marble Bar and Nullagine. There are a number of Aboriginal Communities within the Shire, including Jigalong, Punmu, Parngurr, Irrungadgi and Parnpajinya (Shire of East Pilbara 2014).

Newman, with a population of 9,000 people, is the nearest significant population centre to the Proposal Area, located approximately 90 km to the south east. Newman is an important regional centre due to its proximity to mining and mineral exploration sites, and airport that supports the FIFO mine workforces. The 54 km bitumen access road into Yandicoogina, shared by the Proponent and BHP, is located 135 km north west of Newman on the Great Northern Highway.

7.1.1 Land use

The principal land use in the region is pastoral cattle production. The Proposal Area co-exists with Pastoral Lease N50368 which is currently held by a BHP subsidiary and operated as Marillana Station (**Figure 20**). A number of the Proponent's existing Yandi Operations deposits (JC, JSE, and part of JSW) also co-exist with this pastoral lease. Marillana Station has a long history of cattle grazing and is still used for this purpose.

There are a number of other mining projects that occur in the vicinity of the Proposal and existing Yandi Operations. These are operated by Rio Tinto (or its subsidiaries) or a number of other third party operators (**Figure 21**).

Other regional land uses include tourism and conservation. The Proposal Area is located approximately 70 km from the nearest boundary of the Karijini National Park, approximately 200 km from the Millstream Chichester National Park and approximately 115 km from the Mungaroona Range Nature Reserve (**Figure 22**).

Additionally, the Proposal Area is located in the catchment of the Fortescue Marsh, which has regionally and nationally important conservation values and is listed in the Directory of Important Wetlands of Australia (Environment Australia 2001; EPA 2013a). Fortescue Marsh is almost 1,050 km^2 in size, the largest ephemeral wetland in the Pilbara, within a larger management area of over 5,800 km^2 (EPA 2013a). The northern section of the Revised Proposal Development Envelope is located in this broader management area, Zone 2b Poonda Plain, which has a medium environmental significance (EPA 2013a). However, the Proposal Area is primarily located outside this zone and the only potential impact from the Proposal is related to the surplus discharge wetting front (see Section 13). The highly diverse ecosystem of the Fortescue Marsh is an important regional conservation asset and supports populations of restricted aquatic and terrestrial invertebrates, threatened vertebrate fauna and Priority flora (DPaW 2014).

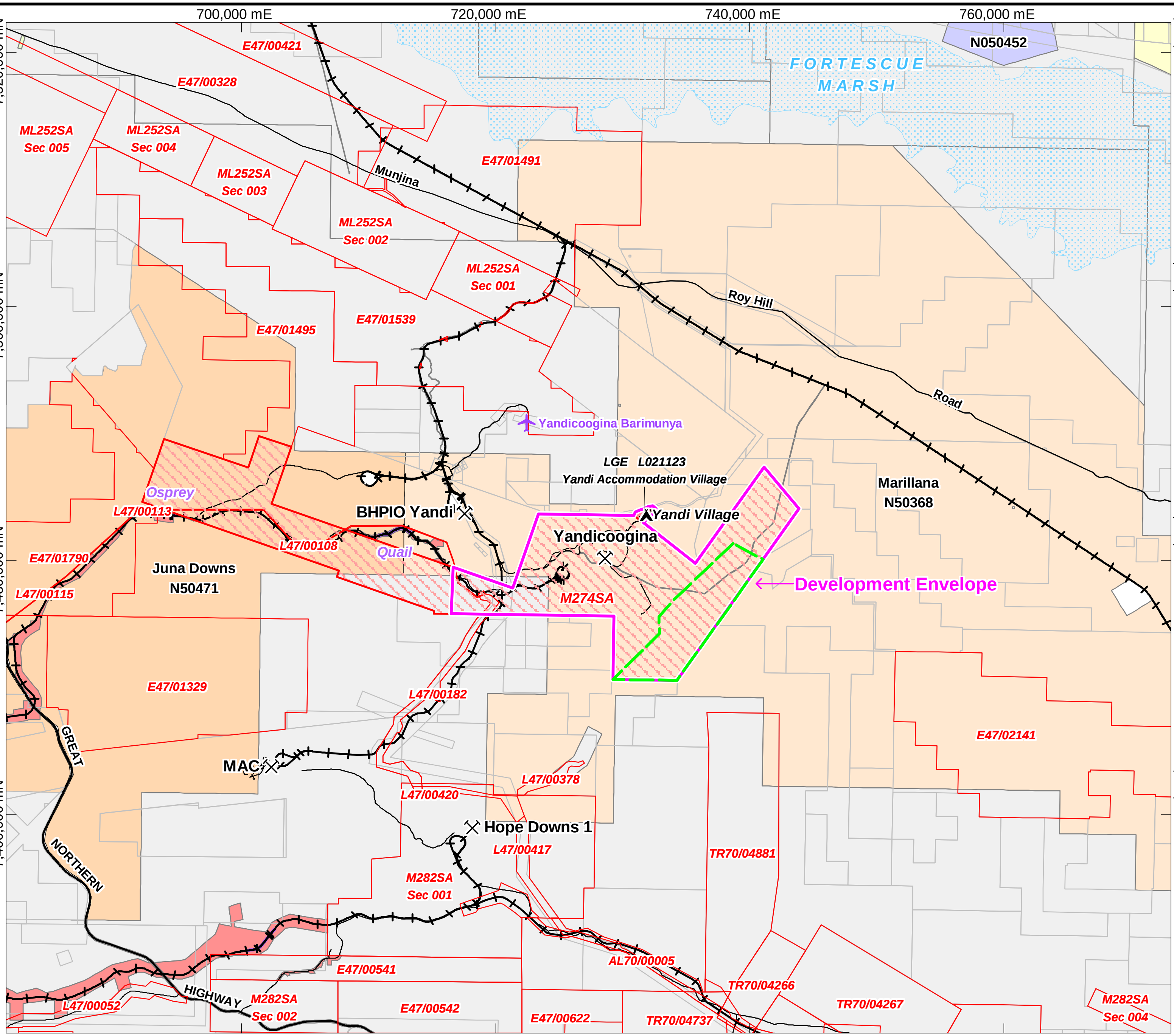
7.1.2 Tenure

The Revised Proposal is located on mining lease 274SA (ML274SA) held by Hamersley Iron – Yandi Pty Ltd established under the *Iron Ore (Yandicoogina) Agreement Act 1996* (**Figure 20**).

The Proponent operates a railway corridor that runs in a west, and then north westerly direction, extending from the rail load-out facility located near JC. Part of this railway runs through BHP's Yandicoogina Operation to the west of the existing Yandi Operations on Mining Lease 270SA. The Proponent has been granted Lease L21124 under the *Land Administration Act 1997* for this section of the railway. The railway corridor connects with existing Rio Tinto port facilities at Dampier and Cape Lambert.

The Proponent's workforce for the existing Yandi Operations is accommodated in the village/camp facilities located on Lease L21123 under the *Land Administration Act 1997,* which abuts the northern boundary of ML274SA.

BHP operates a railway line and power transmission corridor which crosses ML274SA in a north south direction immediately east of the Oxbow deposit.



LEGEND

- Development Envelope
- Proposal Area
- M274SA
- RTIO Live Mining Act Tenure
- Other Live Mining Act Tenure
- RTIO General Lease
- Unallocated Crown Land
- Juna Downs Pastoral Station
- Marillana Pastoral Station
- Hillside Pastoral Station
- Roy Hill Pastoral Station
- Land Subject to Inundation
- Existing Mine
- Yandi Village
- Airport
- Railway
- Rail Siding
- Highway
- Major Road
- Minor Road

N

SCALE

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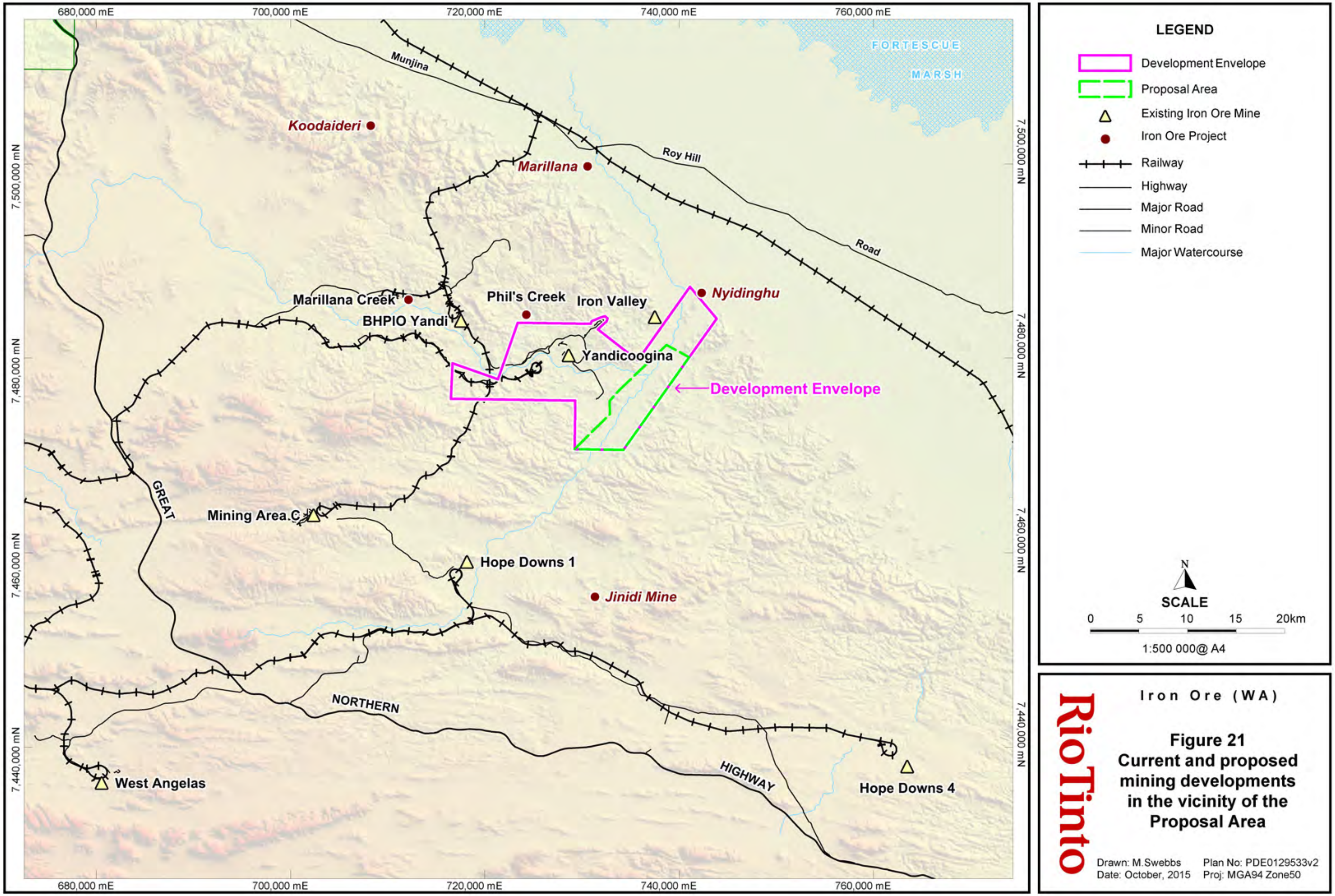
1:450 000@ A4

RioTinto

Iron Ore (WA)

Figure 20
Land use and tenure in the vicinity of Proposal Area

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0129380v2
Proj: MGA94 Zone50

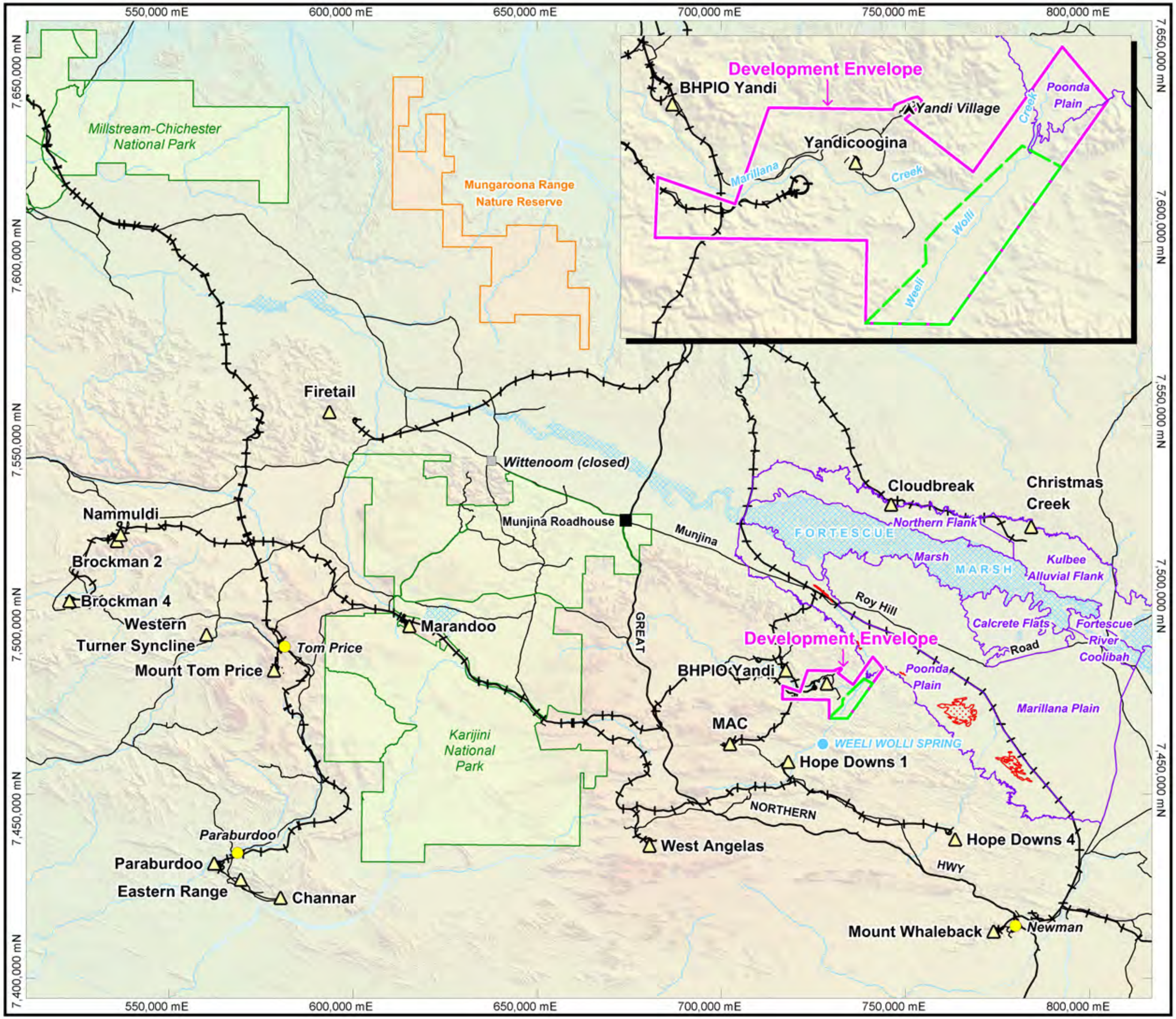


RioTinto

Iron Ore (WA)

Figure 21
Current and proposed mining developments in the vicinity of the Proposal Area

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0129533v2
Proj: MGA94 Zone50



LEGEND

- Development Envelope
- Proposal Area

Regional Conservation Areas

- Fortescue Valley Sand Dunes
- Fortescue Marsh
- Fortescue Marsh Management Zone
- National Park
- Nature Reserve
- Weeli Wolli Spring

- Existing Mine
- Town
- Yandi Village
- Railway
- Highway
- Major Road
- Minor Road
- Major Watercourse

N

SCALE

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1:1 500 000@ A4

RioTinto

Iron Ore (WA)

Figure 22 Conservation areas in the vicinity of the Proposal Area

Drawn: M.Swebbs
Date: October, 2015

Plan No: PDE0129529v2
Proj: MGA94 Zone50

7.2 Aboriginal heritage, culture and Native Title

7.2.1 Native Title

There are more than 31 Aboriginal cultural groups (socio-linguistic groups) recognised in the Pilbara region (Pilbara Development Commission 2015). In the Shire of East Pilbara, over 16% of the population identify as Aboriginal (REMPLAN 2015).

Rio Tinto's Yandi Operations are covered by the YLUA, which has been in place since 1997 and was negotiated with Gumala Aboriginal Corporation, a representative body for the Traditional Owners of the Yandicoogina area.

At the time the YLUA was entered into, the Innawonga (now 'Yinhawangka'), Bunjima (now 'Banjima') and Niapaili (now 'Nyiyaparli') claimant application (NNTT number: WC 96/61, Federal Court number: WAD 6096/98; "IBN Claim") was registered over the Revised Proposal Development Envelope in its entirety.

Since 1998, native title claims for the area have undergone some significant changes, namely Yinhawangka and Banjima have separated out their claims and Martu Idja Banyjima and Bunjima are now native title holders as part of a single 'Banjima' language group. Both Nyiyaparli and Yinhawangka have separate Claim Wide Participation Agreements with Rio Tinto in their own right, however, the YLUA is not superseded by the existence of these newer commercial agreements.

Rio Tinto works with Gumala Aboriginal Corporation as the representative body for these claimant groups in relation to Hamersley Iron's Yandicoogina mining lease area (ML274SA). The Agreement provides financial and other benefits to the Aboriginal parties over the life of the mining operations for education, training, employment, business and community development.

7.2.2 Heritage sites

Archaeological and ethnographic heritage surveys have been completed across the Proposal footprint and for the majority of the Proposal Area. These surveys have documented artefact scatters, rock shelters and engravings (Rio Tinto 2014a). Extensive surveys have also been undertaken within the Revised Proposal Development Envelope; these surveys have identified numerous Aboriginal archaeological sites in addition to those listed above, including quarries, stone structures and scarred trees. These sites range from low to high archaeological and cultural significance. Possible burial sites (high significance) have also been identified within the area.

Weeli Wolli Creek and Marillana Creek have been identified as ethnographic sites. These creeks have important associations with camping, ceremonies and cultural activities.

Aboriginal heritage values in the Proposal Area are described further in Section 19.1.

Part 4 – Approach to Environmental Impact Assessment

Part 4 of the PER outlines the State and Commonwealth environmental assessment processes and the applicable legislative context. This part also describes the approach taken in considering the potential environmental impact of the Proposal and the environmental studies conducted to support the assessment of impacts.

8. Environmental assessment process

8.1 State environmental assessment process

The Proposal was referred to the WA EPA under Section 38 of the EP Act on 4 July 2014. The EPA determined that the Proposal required environmental assessment at the level of PER (with a six week public review period), whereby the Proponent must fulfil the requirements of the *Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2012* (EPA 2012b) for environmental assessment prescribed under the EP Act.

The EPA issued an Environmental Scoping Document (ESD; **Appendix 1**) for the Proposal on 31 December 2014. The ESD provides an outline of the key environmental factors, a description of the scope of the assessment of the Proposal and an indicative timeline for the assessment process.

The key aim of the PER is to present an assessment of impacts to environmental factors relevant to the Proposal in accordance with the ESD. The Environmental Impact Assessment uses various EPA guidance documents to determine the significance of the environmental effects of the Proposal (Section 8.2).

The EPA will need to confirm the PER document as suitable for a public review period on the basis that it adequately addresses the expectations of the EPA set out in the ESD. Following the public review period, the EPA will provide to the Proponent copies (and a summary) of all submissions received. The Proponent will respond to matters raised in the submissions to the satisfaction of the EPA.

The EPA will then assess the PER document, submissions received, the Proponent's response to submissions, and obtain advice from any other persons it considers appropriate before submitting its assessment report on the Proposal to the Minister for Environment.

The Minister will then publish the EPA report. Any person may lodge an appeal to the Minister for Environment against the content of, or recommendations in the EPA assessment report within 14 days of its publication. Subsequent to the determination of appeals (if any), the Minister then decides whether or not the Proposal should be implemented and if so, under what conditions.

The environmental assessment process for a PER is depicted diagrammatically in **Figure 23**.

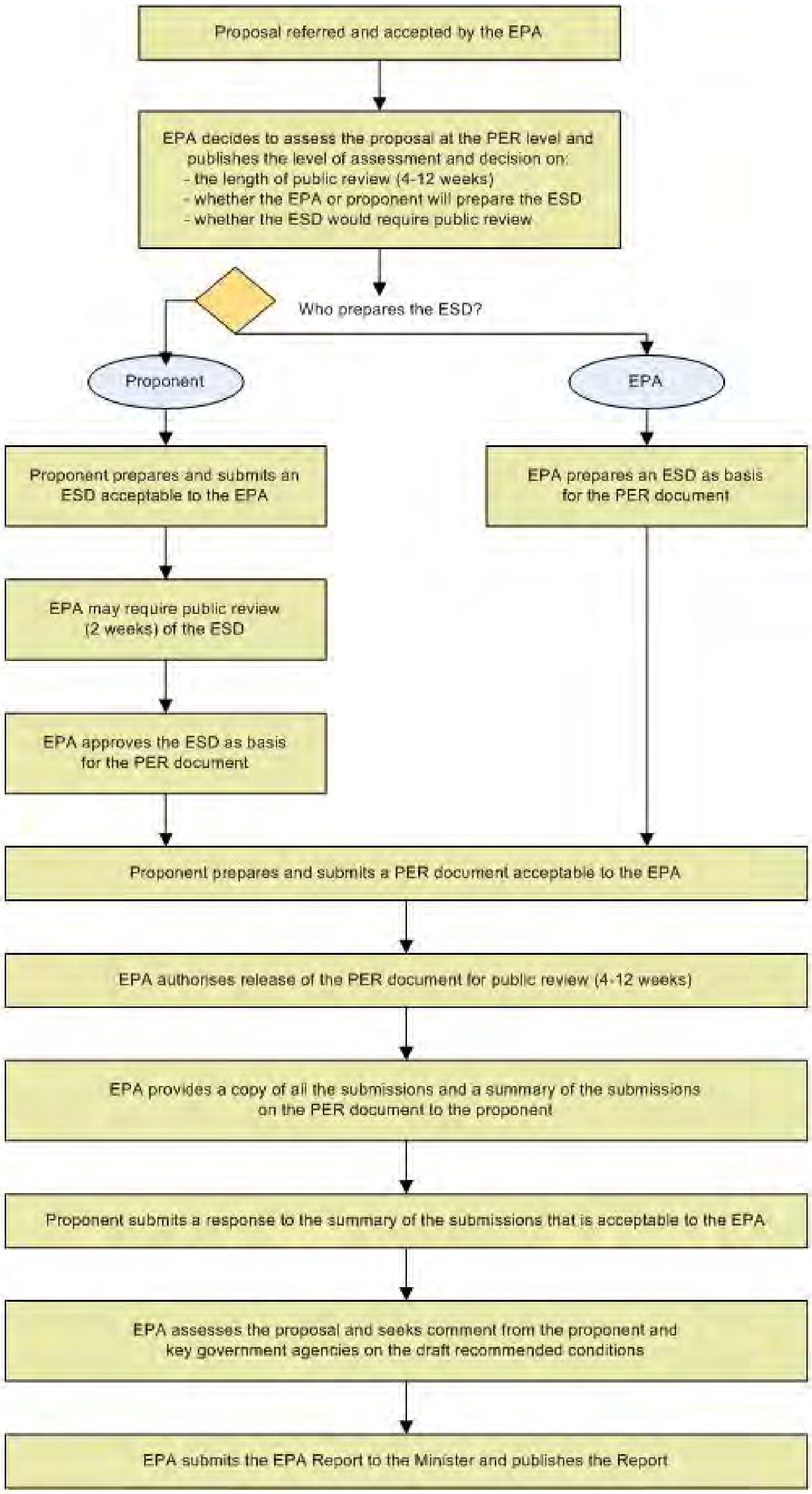


Figure 23: Public Environmental Review assessment process

8.2 State legislation, policy and guidance

The Proposal is subject to compliance with relevant state legislation and regulations and is guided by relevant key over-arching state policies and strategies. In addition, there are EPA Position Statements and Guidance Statements that have been used to determine the significance of the environmental effects of the Proposal. The relevant state legislation/regulations, policies, strategies, EPA Position Statements and Guidance Statements, and other guidance documents, are listed in Section 8.2.1 to Section 8.2.5.

8.2.1 State legislation and any subsidiary regulations

- *Aboriginal Heritage Act 1972*.
- *Biosecurity and Agricultural Management Act 2007.*
- *Bush Fires Act 1954.*
- *Contaminated Sites Act 2003.*
- *Country Areas Water Supply Act 1947.*
- *Dangerous Goods Safety Act 2004.*
- *Electricity Act 1945.*
- *Environmental Protection Act 1986.*
- *Health Act 1911.*
- *Heritage of Western Australia Act 1990.*
- *Iron Ore (Yandicoogina) Agreement Act 1996.*
- *Land Administration Act 1997.*
- *Local Government Act 1995.*
- *Main Roads Act 1930.*
- *Mines Safety and Inspection Act 1994.*
- *Mining Act 1978.*
- *Native Title (State Provisions) Act 1999.*
- *Occupational Health and Safety Act 1984.*
- *Poisons Act 1964.*
- *Public Works Act 1902.*
- *Rights in Water and Irrigation Act 1914.*
- *Soil and Land Conservation Act 1945.*
- *Waste Avoidance and Resource Recovery Act 2007.*
- *Waterways Conservation Act 1976.*
- *Wildlife Conservation Act 1950.*

8.2.2 State policies and strategies

- State Water Quality Management Strategy Document No. 6 – Implementation Framework for Western Australia for the Australian and New Zealand Guidelines for Fresh and Marine Water Quality and Water Quality Monitoring and Reporting (Government of Western Australia 2001).
- Hope for the Future: The Western Australian State Sustainability Strategy (Government of Western Australia 2003).
- Western Australian Greenhouse Strategy (Government of Western Australia 2004).
- Pilbara water in mining guideline (Government of Western Australia 2009).
- WA Environmental Offsets Policy (Government of Western Australia 2011).
- WA Environmental Offsets Guidelines (Government of Western Australia 2014).
- Western Australian Water in Mining Guideline (Government of Western Australia 2013a).

8.2.3 EPA Position Statements

- Environmental Protection Bulletin No. 1 – Environmental Offsets (EPA 2014a).
- Position Statement No. 2 – Environmental Protection of Native Vegetation in WA (EPA 2000).
- Position Statement No. 3 – Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002).
- Position Statement No. 7 – Principles of Environmental Protection (EPA 2004a).

8.2.4 EPA Guidance Statements

- No. 6 – Rehabilitation of Terrestrial Ecosystems (EPA 2006).
- No. 20 – Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in WA (EPA 2009a).
- No. 33 – Environmental Guidance for Planning and Development (EPA 2008).
- No. 41 – Assessment of Aboriginal Heritage (EPA 2004b).
- No. 51 – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in WA (EPA 2004c).
- No. 54a – (Draft) Sampling Methods and Survey Considerations for Subterranean Fauna in WA (EPA 2007).
- No. 56 – Terrestrial Fauna Surveys for Environmental Impact Assessment in WA (EPA 2004d).

8.2.5 Other guidance documents

- Environmental Assessment Guideline (EAG) 8 – Environmental Factors and Objectives (EPA 2013a).
- Environmental Assessment Guideline (EAG) 12 – Consideration of subterranean fauna in Environmental Impact Assessment in Western Australia (EPA 2013b).
- Cumulative environmental impacts of development in the Pilbara region (EPA 2014b).

- Guidelines for Preparing Mine Closure Plans (DMP and EPA 2015).
- EPA and DEC Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA and DEC 2010).
- DoW – Water Quality Protection Notes.

8.3 Commonwealth environmental assessment process

The Proposal was referred to the DoE under the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 26 September 2014. DoE determined that the Proposal is 'not a controlled action' on 25 October 2014, which means the Proposal does not require assessment and approval under the EPBC Act.

8.4 Principles of environmental protection

The Proponent acknowledges the environmental protection principles listed in Section 4a of the EP Act and presented in EPA Position Statement No. 7 (EPA 2004a). These environmental principles are:

- The precautionary principle.
- The principle of intergenerational equity.
- The principle of the conservation of biological diversity and ecological integrity.
- Principles relating to improved valuation, pricing and incentive mechanisms.
- The principle of waste minimisation.

Consideration has been given to these principles in the assessment of the potential environmental impacts associated with the Proposal. These principles are addressed in Part 7.

8.5 Principles of EIA

The *Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2012* (EPA 2012b) outlines the principles of Environmental Impact Assessment (EIA) for the Proponent, as follows:

1. Consult with all stakeholders, including the EPA, decision making authorities (DMAs), other relevant government agencies and the local community as early as possible in the planning of their proposal, during the environmental review and assessment of their proposal, and where necessary during the life of the project.

2. Ensure the public is provided with sufficient information relevant to the EIA of a proposal to be able to make informed comment, prior to the EPA completing the assessment report.

3. Use best practicable measures and genuine evaluation of options or alternatives in locating, planning and designing their proposal to mitigate detrimental environmental impacts and to facilitate positive environmental outcomes and a continuous improvement approach to environmental management.

4. Identify the environmental factors likely to be impacted and the aspects likely to cause impacts in the early stages of planning for their proposal. The onus is on the Proponent through the EIA process to demonstrate that the unavoidable impacts will meet the EPA objectives for environmental factors and therefore their proposal is environmentally acceptable.

5. Consider the following, during project planning and discussions with the EPA, regarding the form, content and timing of their environmental review:

(a) The activities, investigations (and consequent authorisations) required to undertake the environmental review.

(b) The efficacy of the investigations to produce sound scientific baseline data about the receiving environment.

(c) The documentation and reporting of investigations.

(d) The likely timeframes in which to complete the environmental review; and use best endeavours to meet assessment timelines.

6. Identify in their environmental review, subject to the EPA's guidance:

(a) Best practicable measures to avoid, where possible, and otherwise minimise, rectify, reduce, monitor and manage impacts on the environment.

(b) Responsible corporate environmental policies, strategies and management practices, which demonstrate how the proposal can be implemented to meet the EPA's environmental objectives for environmental factors.

The Proponent has considered these principles of EIA throughout the PER process for the Proposal.

9. Identification of key environmental factors

Scoping of relevant environmental factors was completed as part of the EPA process in preparing and finalising the ESD for the Proposal. The ESD was prepared with input from other WA DMAs and the Proponent (**Appendix 1**).

The EPA identified seven preliminary key environmental factors relevant to the Proposal that require detailed consideration by the Proponent. These preliminary key environmental factors are:

- flora and vegetation;
- terrestrial fauna;
- subterranean fauna;
- hydrological processes;
- inland waters environmental quality;
- rehabilitation and closure (integrating factor); and
- offsets (integrating factor).

Table 2 of the ESD sets out for each preliminary environmental factor:

- the EPA objective;
- the relevant aspects;
- the identified potential impacts;
- the work required to be undertaken; and
- the relevant policy/guidance documents.

The EPA identified other environmental factors that it considers relevant to the Proposal; air quality, amenity and (indigenous) heritage. These other environmental factors also warrant attention as part of the environmental review of the Proposal to the extent that the PER must demonstrate how these factors will be mitigated and the extent to which other statutory decision making processes can regulate the potential effects to meet EPA objectives and principles of Environmental Impact Assessment.

A compliance table has been developed (**Appendix 2**) showing where the ESD listed work requirements for each of the preliminary key environmental factor (and the other environmental factors) have been addressed or presented in the PER.

10. Cumulative impact assessment approach

10.1 Cumulative impact assessment overview

Cumulative impact assessment (CIA) is the process of assessing the impacts from all relevant historical, current and reasonably foreseeable future activities that may affect one or more specific components of the environment. This is in contrast to conventional 'project specific' EIA, which typically focuses on the impacts caused by a single development within a limited temporal or spatial boundary. CIA provides a spatial and temporal extension to conventional EIA and considers both direct and indirect impacts that may combine over time and/or space. Assessment of cumulative impacts can provide a means to identify potentially significant effects that may not be evident in conventional EIA, such as the potential for multiple mining projects to incrementally affect environmental values.

In its advice to the Minister for Environment under Section 16(e) of the EP Act (EPA 2014b), the EPA expressed concerns about cumulative environmental impacts to key environmental values in the Pilbara region, due to current and future mining developments in the region, combined with threatening processes of other land uses such as pastoralism and tourism. Consequently, CIA is an important consideration for Pilbara mining developments. The EPA identified cumulative impacts as a key issue for the Proposal in the ESD and specified the following required work:

- Flora and vegetation: "Provide a detailed description of the cumulative impacts associated with the proposal, including direct impacts from clearing, and indirect impacts such as groundwater drawdown, surface discharge of excess groundwater, altered drainage, changes in water quality, dust emissions and fragmentation of vegetation".
- Flora and vegetation: "Discuss potential direct and indirect (including downstream) and cumulative impacts to flora and vegetation as a result of the proposal, and provide quantitative data on impacts of the proposal to species of conservation significance".
- Terrestrial fauna: "Discuss potential direct/indirect (including downstream) and cumulative impacts to fauna as a result of the proposal, and provide quantitative data on impacts of the proposal to species of conservation significance".
- Hydrological processes: "Investigate groundwater drawdown due to groundwater abstraction associated with the proposal. Analyse and discuss any impacts to groundwater levels and flows taking into consideration the cumulative impacts with other proposals. Analyse, discuss and assess surface water and groundwater impacts, including changes in groundwater levels and changes to surface water flows associated with the proposal together with cumulative impacts with other projects and referred proposals (including the BHP strategic proposal) for which relevant information is publicly available".
- Inland waters environmental quality: "Model cumulative impacts with other mines in the catchment (currently operating and referred proposed mines, including the BHP strategic proposal, where information is publicly available). Develop strategies and controls to minimise the impacts".

The scope of the CIA conducted for the Proposal was defined with regard to the spatial boundary (Section 10.2), the key environmental receptors considered for each preliminary key environmental factor (Section 10.3) and the mining projects and referred proposals considered (Section 10.4). The outcomes of the CIA are provided in *Part 5 – Assessment of Environmental Values* of this document for each of the individual factors and is also summarised in *Part 6 – Summary of cumulative impacts*.

10.2 Spatial boundary

When approaching a CIA, decisions are required to be made regarding the spatial boundary; it is seldom practical or appropriate to include everything in the assessment. A balance needs to be found between the practical constraints (e.g. publically available data) and the rigour of the analysis. Including too little will lead to insufficient insight in the analysis, while including too much has the potential to overwhelm and obscure insight into meaningful trends.

The spatial boundary defined for the Proposal CIA was the Upper Fortescue River Catchment, which is approximately 30,000 km^2 (EPA 2013c), surrounds the Fortescue Marsh area and extends to the south of the Great Northern Highway (**Figure 24**). The proposed disturbance footprint of the Proposal is wholly contained within this catchment.

The Upper Fortescue River Catchment was regarded as the largest extent of potential cumulative impacts from the Proposal. For some receptors (Section 10.3), a smaller boundary within the Upper Fortescue River Catchment was defined where appropriate; for example, where the receptor was spatially restricted and/or not expected to be significantly affected by projects or referred proposals outside this boundary, for which or where available information (e.g. mapping) was restricted.

The distribution of some of the key environmental receptors considered extends beyond the spatial boundary used for the Proposal CIA. This assessment may therefore overstate the potential impacts to these receptors. The results of the assessment should be considered in the context of the spatial boundary used and are not necessarily applicable to the full extent or distribution of the receptor, where it extends beyond the catchment in question.

10.3 Key environmental receptors

Unlike conventional EIA, in which a single project is typically the focus of the assessment, CIA requires the identification of environmental receptors that provide the investigative focal point for the assessment (Hegmann et al. 1999). Environmental receptors tend to be at the end of ecological pathways and are therefore the ultimate recipients of impacts; they integrate the cumulative effects of different pressures and activities (IFC 2013).

Key environmental receptors relevant to the Proposal CIA were identified from the requirements of the ESD and findings of ecological surveys undertaken in the Proposal Area. They are outlined in Sections 10.3.1 for flora and vegetation receptors, Section 10.3.2 for terrestrial fauna receptors, and Section 10.3.3 for receptors related to hydrological processes and inland waters environmental quality.

10.3.1 Flora and vegetation

Flora and vegetation receptors considered for assessment in the Proposal CIA were those that have been recorded, or are considered likely to occur, in the proposed disturbance footprint of the Proposal and that meet one of the following criteria:

- Threatened flora species – species listed as Specially Protected under the WC Act and published under Schedule 1 of the Wildlife Conservation (Rare Flora) Notice and/or listed as Critically Endangered, Endangered or Vulnerable under the EPBC Act.
- Threatened Ecological Communities (TECs) – communities endorsed by the Western Australian Minister for Environment as Presumed Destroyed, Critically Endangered, Endangered or Vulnerable and/or listed as Critically Endangered, Endangered or Vulnerable under the EPBC Act.
- Any other flora species or vegetation community identified in the Proposal ESD and/or from findings of ecological surveys undertaken in the Revised Proposal Development Envelope as being of confirmed or potential elevated significance at the local level.

Flora and vegetation receptors that met one of the aforementioned criteria and were therefore included in the Proposal CIA were:

- Riparian vegetation along Weeli Wolli and Marillana Creeks, characterised by the presence of the tree species *Eucalyptus camaldulensis* (River Red Gum) and/or *E. victrix* (Coolibah) and/or *Melaleuca argentea* (Cadjeput). In the Revised Proposal Development Envelope, Biota (2014a, 2015a) mapped riparian vegetation as vegetation types C1, C2, C3, C4 and C5. These communities have been further refined by the Proponent (Rio Tinto 2015a) into 13 riparian sub-associations.

Lepidium catapycnon (Vulnerable, WC Act and EPBC Act) has been recorded in the Revised Proposal Development Envelope (Biota 2014a), including in the Proposal Area; however, this species has been avoided and does not occur within the proposed disturbance footprint of the Proposal. All known and recorded populations are avoided and therefore this species was not included in the CIA.

10.3.2 Terrestrial fauna

Terrestrial fauna receptors considered for assessment in the Proposal CIA were those that have been recorded, or are considered likely to occur, in the proposed disturbance footprint of the Proposal and that meet one of the following criteria:

- Threatened fauna species – species listed as Specially Protected under the WC Act and published under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice and/or listed as Critically Endangered, Endangered or Vulnerable under the EPBC Act.
- Migratory birds – species listed as Specially Protected under the WC Act and published under Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice, and/or listed as Migratory under the EPBC Act.
- Other Specially Protected fauna species – species declared to be in need of special protection other than for the reasons for Schedules 1 (Threatened), 2 (Presumed Extinct), or 3 (Migratory) and listed as Specially Protected under the WC Act and published under Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice.

- Any other fauna species identified in the Proposal ESD and/or from findings of ecological surveys undertaken in the Revised Proposal Development Envelope as being of confirmed or potential elevated significance at the local level.

Terrestrial fauna receptors that met one of the aforementioned criteria and were therefore included in the Proposal CIA were:

- Pilbara Olive Python – listed as Vulnerable under the WC Act and EPBC Act. This species has been recorded in the Proposal Area (Biota 2015b) and may utilise habitats in the proposed disturbance footprint of the Proposal.
- Chocolate Wattled Bat – not listed under the WC Act or EPBC Act, but locally restricted within the Pilbara region, being recorded only in Marillana and Weeli Wolli Creeks. This species has been recorded in the Proposal Area (Biota 2015b) and may utilise habitats in the proposed disturbance footprint of the Proposal.
- Potential SRE invertebrate fauna recorded from the Proposal Area, comprising four mygalomorph spiders: Idiopidae sp. I1, Idiopidae sp. I9, Nemesiidae sp. N42 and Nemesiidae sp. N44.

The following terrestrial fauna receptors met one of the criteria for consideration in the Proposal CIA, but were excluded from the CIA:

- Pilbara Leaf-nosed Bat – listed as Vulnerable under the WC Act and EPBC Act. Weeli Wolli Creek is considered to be potential foraging habitat for the Pilbara Leaf-nosed Bat and the species is considered likely to occur in the Proposal Area; however, the species has not been recorded in the Revised Proposal Development Envelope (Biota 2014c). There was no evidence of roost caves suitable for the species despite extensive searches along the ridgelines of the Proposal Area. Consequently, while the Proposal Area as a whole could be considered dispersal habitat for the species, it was not considered core habitat as there was no evidence that a roost occurs within 15 km (the maximum foraging distance of individuals; Biota 2013).
- Peregrine Falcon – listed under Schedule 4 of the WC Act. One individual of this species has been recorded from the Robe land system in the Yandicoogina Junction Central Project area; however, it was considered likely to be a transitory or foraging individual (Biota 2015b). The species has not been recorded in the Proposal Area (Biota 2015b).
- Rainbow Bee-eater – listed under Schedule 3 of the WC Act and as Migratory under the EPBC Act. This species has been recorded in the Revised Proposal Development Envelope. The Rainbow Bee-eater is widespread throughout much of Australia and typically occurs in open country in most vegetation and landform types; however, the habitats in the Revised Proposal Development Envelope are not considered core habitat for this species (Biota 2015b).
- Fork-tailed Swift – listed under Schedule 3 of the WC Act and as Migratory under the EPBC Act. This species has been recorded in the Revised Proposal Development Envelope. The Fork-tailed Swift would not rely on any terrestrial habitats in the Revised Proposal Development Envelope since it is an aerial species and the habitats in this area are not considered core habitat for this species (Biota 2015b).
- Eastern Great Egret – listed under Schedule 3 of the WC Act and as Migratory under the EPBC Act. One individual Eastern Great Egret was observed flying

over Weeli Wolli Creek; however, this species is considered either uncommon or not a regular visitor in the Revised Proposal Development Envelope (Biota 2015b).

- Common Greenshank – listed under Schedule 3 of the WC Act and as Migratory under the EPBC Act. This species has been recorded previously within 10 km of the Revised Proposal Development Envelope and may be present on occasion in drainage line habitats with water in this area (Biota 2015b). This species is not considered to be a regular visitor.

10.3.3 Hydrological processes and inland waters environmental quality

The key hydrological receptors near the Proposal are Marillana Creek, Weeli Wolli Creek and Fortescue Marsh. Of these, an assessment of potential cumulative impacts has been conducted for Marillana and Weeli Wolli Creeks (Section 13.4). Fortescue Marsh will not be affected by the Proposal and therefore has been excluded from the CIA. The wetting front of surplus water discharge from the Proposal is expected to be contained within the current MS 914 limit of 17 km downstream of the confluence of Marillana and Weeli Wolli Creeks. Therefore, there is no additional impact proposed as a result of the Proposal.

10.4 Mining projects considered

At the scoping stage of a CIA, current and future actions with potential cumulative impacts need to be identified. Firm boundaries need to be drawn around the extent of future actions to be included. Best practice is to include actions determined to be certain and those actions that are reasonably foreseeable (and can be reasonably considered to contribute to significant cumulative impacts). Deciding how long into the past and the future (temporal boundaries) to examine and assess impacts is also a critical part of the scoping phase. It is rarely practical for the temporal boundaries to extend back in time to a pre-impact condition or to a time into the future when, for example, a sensitive receptor has recovered. In practice, CIA’s typically commence with current conditions and extend to a point in time when there is meaningful certainty in the key inputs such as future activities.

Publically available information was reviewed to determine existing and reasonably foreseeable future mining projects located within each spatial boundary defined for this CIA. From this review:

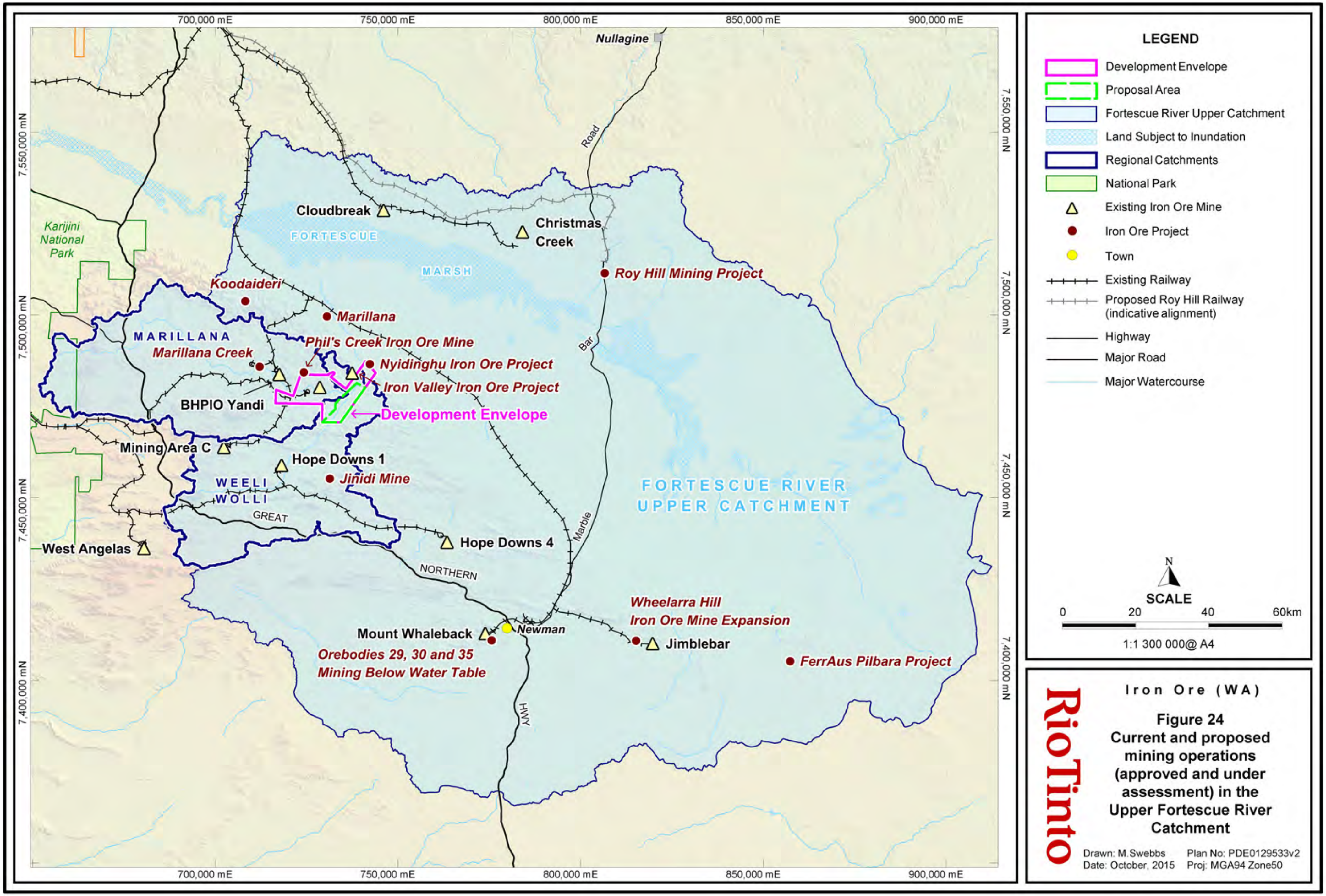
- 23 existing mining projects were identified within the Upper Fortescue River Catchment. These mining projects were operational and/or approved under the EP Act at the time of writing. Of the 23 identified projects, five were excluded as they are a significant distance from the Proposal Area and/or from key environmental receptors within the catchment, such as Fortescue Marsh. These were Atlas Iron’s FerrAus Pilbara Project and BHP’s Jimblebar, Mt Whaleback, Orebodies 29, 30 and 35, and Wheelarra Hill Expansion projects. Five of the remaining 18 projects were also located within the Weeli Wolli Creek regional catchment (**Table 9**; **Figure 24**).
- Two reasonably foreseeable future projects were identified within the Upper Fortescue River Catchment (excluding Proposal). Of these, none were located within the Weeli Wolli Creek regional catchment (**Table 9**; **Figure 24**). These mining projects had been referred under the EP Act at the time of writing. The BHP Strategic Assessment was also identified and is specifically referred to in the

ESD for the Proposal; however, at the time of writing, only the scoping document was publically available and information on potential impacts of the BHP Strategic Assessment was not included (or publically available). The BHP Strategic Assessment was therefore excluded from the Proposal CIA. The Proposal (this assessment) is also included as a reasonably foreseeable future project in **Table 9** and shown in **Figure 24**.

Table 9: Existing and reasonably foreseeable future mining projects considered for inclusion in the Proposal cumulative impact assessment

Project	**EP Act Assessment No.**	**EPBC Act Ref.**	**Proponent/ Operator**
Existing projects – included in CIA			
Christmas Creek Mine - Water Management Scheme	1873	2010/5706	FMG
Cloudbreak Iron Ore Mine	1577	2005/2205	FMG
Cloudbreak Life of Mine	1848	2010/5696	FMG
Hope Downs 1 Iron Ore Mine Expansion	1308	-	Hamersley HMS (Rio Tinto managed)
Hope Downs 4 Iron Ore Mine	1738	2008/4636	Hamersley HMS (Rio Tinto managed)
IO Direct Shipping Iron Ore Project	Not Assessed - Public Advice Given	N/A	FMG
Iron Valley Iron Ore Project	1905	2012/6458	Iron Ore Holdings
Jinidi Iron Ore Mine	1904	2012/6299	BHP
Koodaideri Iron Ore Mine	1933	2012/6422	Mount Bruce Mining (Rio Tinto managed)
Marillana Creek (Yandi)	1555	-	BHP
Marillana Iron Ore Project	1781	2011/5892	Brockman
Mining Area C	1108	-	BHP
Phil's Creek Iron Ore Mine	Not Assessed – Managed Under Part V of EP Act	2009/5107	Mineral Resources
Pilbara Iron Ore and Infrastructure Project - Railway Stage A	1505	-	FMG
Pilbara Iron Ore and Infrastructure Project - Railway Stage B	1520	2004/1897	FMG
Roy Hill 1 Iron Ore Mining Project Stage 1	1589	2008/4624	Roy Hill
Roy Hill 1 Iron Ore Mining Project Stage 2	1822	2008/4624	Roy Hill

Project	EP Act Assessment No.	EPBC Act Ref.	Proponent/ Operator
Rio Tinto Yandi Operations	809, 946, 1590 & 1726	2011/5815	Hamersley Iron – Yandi (Rio Tinto managed)
Existing projects – excluded from CIA due to distance			
FerrAus Pilbara Project	1908	2011/6036	Atlas Iron
Jimblebar Iron Ore Project	1847	-	BHP
Mt Whaleback	N/A	N/A	BHP
Orebodies 29, 30 and 35 Mining Below Water Table	1982	-	BHP
Wheelarra Hill Iron Ore Mine Expansion	1558	-	BHP
Future projects			
Proposal (this assessment)	2017	2014-7343	Hamersley Iron – Yandi (Rio Tinto managed)
Christmas Creek Expansion Project (under assessment)	1989	2013/7055	FMG
Nyidinghu Iron Ore Project (under assessment)	1068	2013/6945	FMG



700,000 mE
750,000 mE
800,000 mE
850,000 mE
900,000 mE
7,550,000 mN
7,500,000 mN
7,450,000 mN
7,400,000 mN
Nullagine
Road
Bar
Marble
HWY
GREAT
NORTHERN
Karijini National Park
Cloudbreak
Christmas Creek
FORTESCUE
MARSH
Roy Hill Mining Project
Koodaideri
Marillana
MARILLANA
Marillana Creek
Phil's Creek Iron Ore Mine
Nyidinghu Iron Ore Project
Iron Valley Iron Ore Project
Development Envelope
BHPIO Yandi
Mining Area C
Hope Downs 1
Jinidi Mine
WEELI WOLLI
West Angelas
Hope Downs 4
FORTESCUE RIVER UPPER CATCHMENT
Wheelarra Hill Iron Ore Mine Expansion
Newman
Mount Whaleback
Jimblebar
Orebodies 29, 30 and 35 Mining Below Water Table
FerrAus Pilbara Project
LEGEND
Development Envelope
Proposal Area
Fortescue River Upper Catchment
Land Subject to Inundation
Regional Catchments
National Park
Existing Iron Ore Mine
Iron Ore Project
Town
Existing Railway
Proposed Roy Hill Railway (indicative alignment)
Highway
Major Road
Major Watercourse
N
SCALE
0
20
40
60km
1:1 300 000@ A4
RioTinto
Iron Ore (WA)
Figure 24
Current and proposed mining operations (approved and under assessment) in the Upper Fortescue River Catchment
Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0129533v2
Proj: MGA94 Zone50

11. Environmental studies

The Proponent conducted a number of environmental studies as part of the Environmental Impact Assessment (EIA) process for the Proposal. Previous studies have also been undertaken as part of the approvals process for the original Yandicoogina mine (JC) and the previous Yandicoogina mine developments (Yandi JC Expansion, JSE, JSW and Oxbow Deposits), some of which overlap the Proposal Area. The requirement and scope of the environmental studies was defined through the preliminary risk assessment, sustainable development assessment, stakeholder consultation and scoping of the Proposal as part of the ESD. The studies provided the basis for assessing the significance of the potential environmental impacts for each key environmental factor identified in the ESD. Where applicable, the studies were undertaken using commonly accepted methodologies and in accordance with relevant EPA Guidance Statements.

Key reports generated by these studies are listed in **Table 10** (many are also attached in **Appendix 3**). All environmental studies applicable to the Proposal, as well as other supporting studies and documentation, are referenced as appropriate throughout the PER. A number of the studies form part of an ongoing monitoring and survey effort to establish a baseline for ongoing environmental management.

Table 10: Studies and investigations supporting the PER

Environmental factor	Studies, investigations and/or reports
Hydrological Processes and Inland Waters Environmental Quality	• Environmental risk assessment for riparian zones on Weeli Wolli Creek (URS 2015; **Appendix 3**). • Revised discharge extent modelling in Weeli Wolli Creek based on measured channel loss rates (Rio Tinto 2014c; **Appendix 3**). • Peer review of surface water modelling (WorleyParsons 2015; **Appendix 3**). • Groundwater model setup, calibration and estimation of dewatering requirements (Rio Tinto 2014d; **Appendix 3**). • Peer review of groundwater modelling (Hydrogeologic 2015; **Appendix 3**). • Geomorphological assessment of Weeli Wolli Creek (MWH 2015; **Appendix 3**). • Weeli Wolli Creek Ecohydrology (Rio Tinto 2015b; **Appendix 3**). • Hydrogeology and groundwater dynamics of Weeli Wolli and Marillana Creeks and Fortescue Marsh (Fellman et al. 2011; Dogramaci et al. 2012; Dogramaci and Skrzypek 2015; Dogramaci et al. 2015; Burke et al. 2014a; Burke et al. 2014b; Burke et al. 2015; Skrzypek et al. 2013; Skrzypek et al. 2015 Roullard et al. 2015).
Flora and Vegetation	• March 2014 and July 2014 flora and vegetation survey of Yandi Pocket and Billiards South Deposits Phase 1 and 2 (Biota 2014a; **Appendix 3**). • Riparian vegetation of Marillana and Weeli Wolli Creeks: Mapping refinement and assessment of values and significance (Rio Tinto 2015a; **Appendix 3**). • Yandi Vegetation and Flora Integration Report (Biota 2015a; **Appendix 3**). • Environmental risk assessment for riparian zones on Weeli Wolli Creek (URS 2015; **Appendix 3**). • Understanding riparian vegetation responses to groundwater drawdown and discharge from below water table mining in the Pilbara (Eastham

Environmental factor	Studies, investigations and/or reports
	2015; **Appendix 3**).
Terrestrial Fauna	• October 2009 Targeted Northern Quoll survey at Yandi (Biota 2009). • July 2008 and March 2010 fauna surveys of the Yandi Expansion Billiard Deposit (Biota 2011; **Appendix 3**). • March 2014 and September 2014 fauna surveys of Pocket and Billiards South Deposits – Phase 1 and 2 (Biota 2014c, 2014e; **Appendix 3**). • August 2014 Targeted Northern Quoll survey at Yandi Billiards Deposit (Biota 2014d; **Appendix 3**). • October 2013 and April 2014 aquatic fauna surveys at Marillana & lower Weeli Wolli Creeks (WRM 2015a, 2015b; **Appendix 3**). • Yandi Terrestrial Fauna Integration Report (Biota 2015b; **Appendix 3**).
Subterranean Fauna	• Stygofauna sampling was conducted in 2003, 2005 and between 2008 and 2014 (Biota 2015c; **Appendix 3**). • Troglofauna phase 1 sampling was conducted in 2009. Phase 2 sampling was completed between 17th May and 10th July 2014 (Biota 2015d; **Appendix 3**).
Rehabilitation and Mine Closure	• Yandicoogina Closure Plan (Rio Tinto 2015c; **Appendix 4**). • Yandicoogina Billiard acid and metalliferous drainage risk (Rio Tinto 2014e; **Appendix 3**). • Water balance modelling for pit lakes (RPS 2015; **Appendix 3**).
Offsets	• Refer to Section 18.
Aboriginal Heritage	• Refer to Section 19.1.
Air Quality	• Refer to Section 19.2.
Amenity	• Refer to Section 19.3.

12. Environmental management system

Environmental management controls to be implemented as part of the Proposal, consistent with the information presented in this PER, are described in the Proponent's Environmental Management System (EMS), together with the Yandi Operations site specific management plans.

All Rio Tinto businesses, their managed sites and functional locations (including its Pilbara iron ore operations) must implement, or demonstrate conformance to an EMS, which is an integrated health, safety, environment and quality management system and outlines environmental standards that must be adhered to.

The Rio Tinto environment standards have been in place for over ten years, and have supported its operational environmental performance over this period. The current standards have been developed to provide consistency across all of Rio Tinto managed operations and to support the Group's approach to avoid and minimise impacts to the environment. The EMS covers key environmental risk areas and provides detail for their application to operational sites. The process includes internal site and Rio Tinto Corporate audits to ensure conformance with the five environment standards and one management system standard as outlined below.

12.1 Health, Safety, Environment and Quality (HSEQ) Management System Standard

The HSEQ Management System Standard details the requirements for Rio Tinto Group businesses to implement an integrated system for the management of health, safety, environment, communities and social performance and quality. Statutory and permitting requirements take precedence over Rio Tinto standards, except where the Rio Tinto standards are more stringent.

The standard comprises 17 key elements including:

- HSECQ policy;
- legal requirements;
- hazard identification and risk management;
- management improvement planning;
- organisational resources, accountabilities and responsibilities;
- training, competency and awareness;
- supplier and contractor management;
- documentation and document control;
- communication and consultation;
- operational control;
- management of change;
- business resilience and recovery;
- monitoring and measuring;
- incident and action management;

- data and records management;
- performance assessment and auditing; and
- management review.

12.2 Environmental standards

Rio Tinto has five environment standards:

- E11 Water Quality Protection and Water Management.
- E12 Air Quality Protection.
- E13 Chemically Reactive Mineral Waste Control.
- E14 Land Disturbance Control and Rehabilitation.
- E15 Hazardous Materials and Non-Mineral Water Control and Minimisation.

12.2.1 E11 Water Quality Protection and Water Management

The E11 Water Quality Protection and Water Management Standard addresses all activities associated with water withdrawal, use, storage, treatment, and discharge. It is applicable to any impacts or risks associated with water abstraction and discharge, including changes in water level, flow and quality. The E11 Standard outlines performance requirements to mitigate water related impacts, control water quality, optimise water use efficiency and adequately design and operate water related infrastructure to manage predicted variability and control risks.

12.2.2 E12 Air Quality Protection

The E12 Air Quality Protection Standard addresses air emissions from all sources including point sources and diffuse sources. The E12 Standard outlines performance requirements to monitor and manage emissions to prevent harm from air impacts, quantify the constraints that cumulative air impacts may pose, and prevent breaches of applicable criteria.

12.2.3 E13 Chemically Reactive Mineral Waste Control

The E13 Chemically Reactive Mineral Waste Control Standard addresses all mineral wastes including waste rock and overburden, tailings, rejects and other mineral processing residues. It covers all potential and actual releases from reactive mineral waste including primary waste material (erosion, fugitive dust) and reaction by-products (eg. acid mine drainage). The E13 Standard outlines performance requirements to monitor and manage chemically reactive mineral waste so contaminant release does not cause harm, and avoids riverine impacts.

12.2.4 E14 Land Disturbance Control and Rehabilitation

The E14 Land Disturbance Control and Rehabilitation Standard addresses all land owned, leased or managed by the business or for which the business may have liability. It includes both land directly disturbed by activities, as well as undisturbed land held as a buffer or for other reasons. The E14 Standard outlines performance requirements to confine disturbance within legally designated areas, locate and design facilities to limit new disturbance footprints, design and construct mineral waste facilities in a manner that facilitates successful rehabilitation, rehabilitate consistent with planned final land use, undertake rehabilitation as soon as practicable on land that is no longer needed, and define impact acceptance criteria for land, biodiversity and ecosystem services.

12.2.5 E15 Hazardous Materials and Non-Mineral Waste Control and Minimisation

The E15 Hazardous Materials and Non-Mineral Waste Control and Minimisation Standard addresses the import, storage, use and ultimate disposal of hydrocarbons, reagents, process fluids, non-mineral wastes and other materials which could pose environmental risks because of their physical and chemical properties. The E15 Standard outlines performance requirements to prevent contamination of surface water, groundwater and soil from hazardous materials and non-mineral wastes, minimise impacts of non-mineral waste disposal, and remediate or manage for the long term contaminated sites where investigation has demonstrated an unacceptable impact or risk.

12.3 Yandicoogina Environmental Management

The existing Yandi Operations environmental management utilises the Rio Tinto EMS, together with site specific management plans and procedures for environmental aspects that are potentially impacted by the Yandi Operations.

The existing Yandi Operations environmental management is currently managed via:

- Management plans and commitments required by MS 914 or EPBC Decision 2011/5815 requiring endorsement from either a State or Commonwealth government department:
    - Yandicoogina Monitoring and Management Plan (MMP; **Appendix 4**) which includes:
        - Yandicoogina Vegetation and Groundwater Dependant Ecosystems Monitoring and Management Plan
        - Yandicoogina Surface Water Discharge Monitoring and Management Plan
    - Yandicoogina Closure Plan (**Appendix 4)**; and
    - EPBC Threatened Species Offset Plan.
- Management plans and commitments that support implementation of MS 914 or EPBC Decision 2011/5815 that do not require endorsement from either a State or Commonwealth government department:
    - Yandicoogina Weed Action Plan;
    - Yandicoogina Weed Monitoring Plan; and
    - Yandicoogina addendum to the Proponent's Pilbara-wide Significant Species Management Plan (SSMP; **Appendix 4**).
- Site related management and monitoring actions required to comply with Rio Tinto HSECQ Performance Standards (outlined above).

The existing MMP has been reviewed and updated to apply to the Proposal.

12.3.1 Yandicoogina MMP

The Yandicoogina MMP specifically addresses the requirements of Conditions 6 and 7 of MS 914, including the development of an Environmental Values Statement (EVS) and a comprehensive monitoring program for surface water and groundwater dependent ecosystems with associated management strategies.

The key environmental objectives of the plan are to ensure that ensure that dewatering activities required to implement the Yandi Project, and any contingency measures implemented, will not result in long term impacts to the environmental values identified.

The EVS of the Weeli Wolli Creek system was updated in the revision of the MMP and is outlined in Section 6.1.

The MMP includes monitoring the health parameters of riparian vegetation including Digital Canopy Photography (DCP), vegetation condition transects, and spectral imagery. Water quality parameters include monitoring the discharge wetting footprint, ground water levels, surface water quality, and erosion and sediment assessments.

12.3.2 Significant Species Management Plan

The Rio Tinto SSMP applies across all Pilbara based projects. The SSMP addresses Matters of National Environmental Significance (MNES) relevant to the Pilbara, outlining management measures to be applied across all Pilbara based operations and projects to avoid or reduce impacts to these MNES. The SSMP provides the framework for Rio Tinto to minimise impacts to Pilbara populations of significant species from activities associated with its operations. The scope of the SSMP includes extensions to existing operations and new mining and infrastructure projects. The SSMP outlines over-arching management measures to be implemented to avoid and minimise impacts to MNES across all projects.

Additionally, for each Pilbara based project or operation, a site specific addendum to the SSMP has been prepared, detailing management measures for MNES relevant to the project. The Yandicoogina SSMP addendum is included with the Pilbara-wide SSMP (**Appendix 2**). The Yandicoogina SSMP addendum addresses management measures relevant to EPBC Act listed threatened species occurring, or potentially occurring, within the Revised Proposal Development Envelope including the Northern Quoll, Pilbara Olive Python, Pilbara Leaf-nosed Bat and *Lepidium catapycnon*. The Yandicoogina SSMP addendum outlines key management actions and accountabilities for clearing and direct disturbance, indirect disturbance and other operational issues and outlines surveys/monitoring requirements.

12.3.3 Yandicoogina Closure Plan

The Yandicoogina Closure Plan (**Appendix 4**) has been prepared to meet MS 914 Condition 9-4 ('…review and revise the Yandicoogina Decommissioning and Rehabilitation Plan…'). It addresses the closure of several mining areas associated with the Revised Proposal, including future development areas such as the Proposal. This Plan documents the current closure knowledge base for Yandicoogina. It outlines the objectives that need to be met at closure, the strategies and plans to be employed to achieve them, and provides an indication of the criteria that will be used to assess closure success. It has been developed in consultation with key stakeholders and will be regularly reviewed and revised throughout the life of the Revised Proposal to incorporate new information. The Yandicoogina Closure Plan has been prepared in accordance with the DMP and EPA (2015) Guidelines for Preparing Mine Closure Plans, as well as Rio Tinto's Closure Standard.

Part 5 – Assessment of environmental factors

This part assesses the potential environmental impacts of the Proposal on each identified preliminary key environmental factor (and other environmental factors). Proposed management measures and predicted outcomes are also presented.

13. Hydrological processes and inland waters environmental quality

13.1 Key statutory requirements, environmental policy and guidance

13.1.1 EPA objective

The EPA has applied the following objectives for the Proposal to its assessment of hydrological processes and inland waters environmental quality:

"To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.

To maintain the quality of groundwater and surface water, sediment and/or biota so that the environmental values, both ecological and social, are protected."

13.1.2 Regulatory framework

The following legislation is relevant to the Proposal Area with respect to the protection of surface water and groundwater and the above EPA objective:

- *Rights in Water and Irrigation Act 1914* (WA).
- *Environmental Protection Act 1986* (WA).

13.1.3 Relevant guidelines and policy

A number of State and Commonwealth policies are relevant to the protection of surface water and groundwater:

- Australian Water Quality Guidelines for Fresh and Marine Waters. (Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resources Management Council of Australia and New Zealand (ARMCANZ) 2000).
- State Water Quality Management Strategy Document No.6. Implementation Framework for Western Australia for the Australian and New Zealand Guidelines for Fresh and Marine Water Quality and Water Quality Monitoring and Reporting (Government of Western Australia 2001).
- Pilbara Water in Mining Guideline. Report No 34 (Government of Western Australia 2009).
- Western Australian Water in Mining Guideline. Report No 12 (Government of Western Australia 2013a).
- Statewide Policy No 5 - Environmental water provisions policy for Western Australia (WRC 2000).

- DoW Water Quality Protection Guidelines No. 1 to 11 and Water Quality Protection Note 22 (DoW 2008).
- Strategic policy 2.09: Use of mine dewatering surplus (DoW 2013).
- Environmental and water assessments relating to mining and mining related activities in the Fortescue Marsh management area (EPA 2013c).

13.2 Description of factor

Existing approved mining operations within the Weeli Wolli Creek catchment, including BHP's Marillana Creek (Yandi) and Mining Area C mine, Rio Tinto's Yandi Operations and Hamersley HMS's Hope Downs 1 Joint Venture undertake dewatering as well as discharge activities as part of their mining operations and have contributed to changes to the natural hydrological conditions of Marillana and Weeli Wolli Creeks since the mid 1990's and mid 2000's respectively. The BHP and Rio Tinto mining operations that occur within the CID (Rio Tinto's Yandi Operations, BHP's Marillana Creek [Yandi]), are within the same hydrological and hydrogeological setting as the Proposal, with the dewatering and discharge activities undertaken to manage the productive aquifers of the CID, in which the target mineralisation occurs. The aquifers associated with BHP's Mining Area C and Hamersley HMS's Hope Downs 1 operations occur in bedded ore deposits and dolomites with more alkaline groundwater conditions and are subject to different hydrological surface water-groundwater interactions.

The following sections provide a description of the pre-mining and modified hydrological and hydrogeological setting (Sections 13.2.1 to 13.2.3), identify the likely potential impacts of the Proposal, and propose mitigation measures to minimise potential impacts on the hydrological and hydrogeological regime.

The following studies provide an understanding of the hydrological setting of the Proposal:

- Hydrologic and hydraulic assessments undertaken as part of the Proposal Order of Magnitude study, to define the surface water hydrology and flow conditions of Weeli Wolli Creek (Rio Tinto 2013).
- A hydrogeological assessment of the CID to determine hydraulic properties as well as connectivity with the adjacent Weeli Wolli Creek floodplain alluvial aquifer, including bore installation and test pumping.
- A detailed geomorphological assessment of Weeli Wolli Creek (MWH 2015).
- Measurements of discharge and infiltration along Weeli Wolli Creek undertaken as part of the pre-feasibility Study, to better quantify the channel loss rates in reaches of the creek system and inform modelling of discharge scenarios (Rio Tinto 2014c).
- Investigations on the impact of current and proposed mine operations on the water quality and the potential for cumulative impacts on the Fortescue Marsh, including development of a surface water and groundwater model for the Proposal Area.
- Ecohydrological assessment to identify the likely changes to surface water flow regime as a result of implementing the Proposal and potential effects on riparian vegetation along Weeli Wolli Creek (Rio Tinto 2015b).

In addition to these studies, a number of additional research projects have been undertaken within both the Weeli Wolli Creek catchment and broader Fortescue Marsh catchment to understand the hydrogeological and hydrological processes of these catchments. This work underpins the hydrogeological studies undertaken for the Proposal.

13.2.1 Local hydrological setting of the Proposal

The Proposal Area is located within the Weeli Wolli Creek surface water catchment. Marillana Creek, a major tributary of Weeli Wolli Creek, discharges to Weeli Wolli Creek downstream of the Proposal (**Figure 25**). Approximately 10 km north of the confluence of Weeli Wolli and Marillana Creeks, Weeli Wolli Creek drains to a wide alluvial floodplain in the Fortescue Valley with flows terminating at the Fortescue Marsh (approximately 40 km north of the Weeli Wolli and Marillana Creek confluence). The Weeli Wolli Creek catchment, including Marillana Creek, represents approximately 10% of surface water flow into the Fortescue Marsh (Aquaterra 2001 as cited in Johnson and Wright 2003). The characteristics of the Weeli Wolli catchment are described in Section 5.6.

13.2.2 Pre-mining surface water hydrology

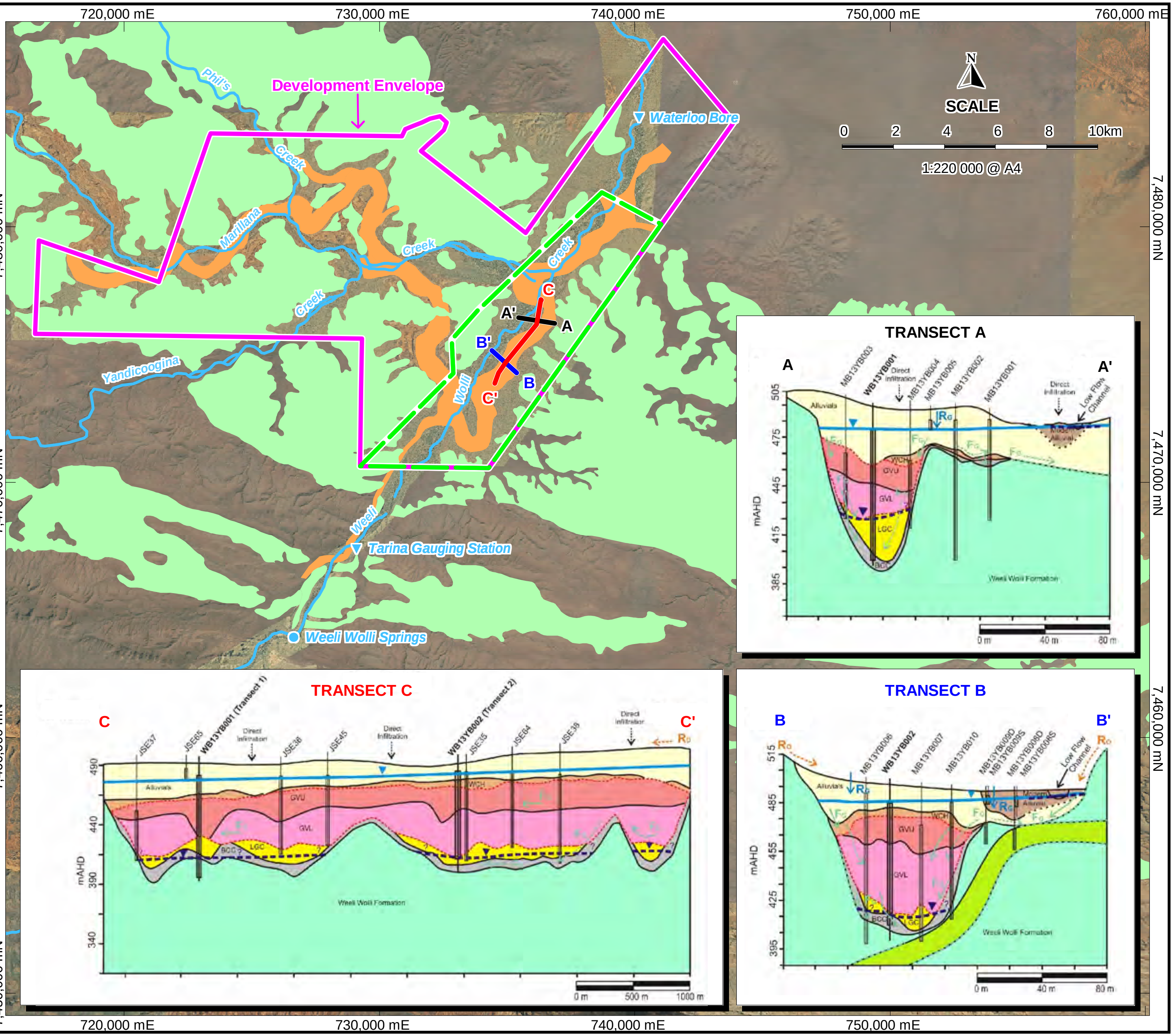
Weeli Wolli Creek is the dominant drainage feature which enters the Proposal Area from south of the Proposal deposit. This creek drains parallel to the Proposal deposit in a predominantly north easterly direction and drains into an alluvial fan on the southern flanks of Fortescue Marsh, outside of the Revised Proposal Development Envelope.

Marillana Creek is a major tributary of the Weeli Wolli Creek system. The lower Marillana Creek drains in an easterly direction through the existing BHP Yandicoogina (Marillana Creek) operations and the Revised Proposal Development Envelope. It continues its path downstream onto wide flat plains (400 – 600 m) located downstream of the existing Yandi Operations, before discharging into Weeli Wolli Creek (Rio Tinto 2014f). The confluence of Weeli Wolli Creek and Marillana Creek is located in the north west of the Proposal Area.

Weeli Wolli Creek is characterised by a generally singular, meandering low-flow channel set within a broader floodplain. The high flow channel comprises a gravel-bed stream, with large gravel bars present within the channel and more active anabranches (MWH 2015). These numerous anabranches of the Weeli Wolli Creek that cross the Proposal Area convey flows towards the creek as a result of episodic high rainfall events (**Figure 26**).

Long term stream flow records for Weeli Wolli Creek since 1985 to the present are available for sites located both upstream and downstream of the Proposal Area, at Tarina and Waterloo Bore respectively (**Figure 25**). The period until 1997 is representative of stream flow conditions prior to the commencement of discharge of surplus dewatering volumes as a result of mining operations within the catchment. Observations indicate that historically Weeli Wolli Creek was ephemeral, flowing only once or twice per year during episodic rainfall events. Baseline flow was widely variable with the initiation of runoff strongly dependent on antecedent conditions and the intensity and spatial distribution of rainfall. Generally only large rainfall events were sufficient to generate stream flow. During dry years, in which less than 300 mm of rainfall was experienced, surface water runoff was generally not sufficient to generate flow at either streamflow gauging station (URS 2015).

Natural perennial flows on the Weeli Wolli Creek did occur at Weeli Wolli Spring, located approximately 4.5 km upstream from Tarina (**Figure 25**). Pre-mining aerial photographs show that Weeli Wolli Creek was characterised by wetlands, pools and a shallow water table on reaches extending approximately 12 km downstream from Weeli Wolli Spring. As flow was not perennial at Tarina, this suggests a large proportion of the overflow from Weeli Wolli Spring was infiltrated to the underlying aquifer and transmitted as groundwater through-flow (URS 2015).



LEGEND

- Development Envelope
- Proposal Area
- Spring
- Gauging Station
- Major Creek
- Extent of CID
- Weeli Wolli Formation

Floodplain Alluvial Aquifer

- Modern Alluvials
- Alluvials

CID Aquifer

- WCH - Weathered Channel
- GVU - Goethitic Vitreous Upper
- GVL - Goethitic Vitreous Lower
- LGC - Lower Goethitic Clay
- BCC - Basal Conglomerate Clay

Basement Aquifer

- Weeli Wolli Formation
- Dolerite

- Contact
- Inferred Contact
- Ore Boundary
  Defined at 'JORC Measured' Status
- FG Groundwater Flow
- RO Runoff
- RG Recharge
- Groundwater Level Current
- 2030 Predicted Groundwater Lever
- Bore Screen Interval

RioTinto

Iron Ore (WA)

Figure 25
Major hydrological features

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0133901v2
Proj: MGA94 Zone50

Geospatial Information and Mapping

13.2.2.1 Surface water quality

Water quality data indicates that surface water in the vicinity of the Proposal is (Rio Tinto 2013):

- Neutral to slightly alkaline with median total dissolved solids (TDS) content of approximately 550 mg/L.
- Comprised of trace elements such as aluminium, iron, manganese and zinc at low levels.
- Subject to nitrogen increases, which are considered to originate from natural elevations within groundwater.

13.2.3 Hydrogeology

Hydrogeological investigations have been undertaken within and surrounding the Proposal Area since the late 1970's. The regional hydraulic gradient and discharge of groundwater at the Proposal is in a north-northeast direction towards the Fortescue Marsh. Groundwater is also lost from the area through the process of evapotranspiration within the riparian floodplain zone.

There are three main hydro-stratigraphic units recognised within the Yandicoogina region (Rio Tinto 2014d; **Figure 29**). They comprise:

- the fractured and weathered basement of the Weeli Wolli Formation;
- the overlying fractured CID; and
- the surficial unconfined floodplain aquifer.

These hydro-stratigraphic units are described below.

13.2.3.1 Weeli Wolli Formation

The Weeli Wolli Formation is a fractured rock aquifer consisting of inter-bedded banded iron formation, banded chert, shale and dolerite. It underlies and surrounds the alluvial/in situ weathered aquifer. Aquifer permeability is largely dependent on the development of structural features. Groundwater in the basement rocks only occurs in secondary porosity associated with the weathered zone and within fractures in the bedrock, with lower hydraulic conductivities than both the CID and the floodplain aquifers. There may be transmissive structures in the basement aligned beneath Weeli Wolli Creek (Fowers et.al.; cited in URS 2015).

13.2.3.2 Channel Iron Ore deposit

The Tertiary CID constitutes a relatively narrow meandering palaeo-channel between 600 m to 1,000 m wide and 100 m deep, imbedded into the low transmissivity Weeli Wolli Formation. The highly-transmissive CID forms a channel aquifer system, some of which underlies the modern day Weeli Wolli Creek system. Recent drilling has indicated that the CID is bound by an alluvium and weathered bedrock aquifer between the CID aquifer and the Weeli Wolli aquifer. The CID is variably connected with the floodplain aquifer.

13.2.3.3 Alluvial floodplain aquifer

Overlying the CID aquifer, and more broadly the Weeli Wolli Formation, is the alluvial floodplain aquifer. The floodplain aquifer consists of three geological units that exhibit strong hydraulic connection. Coarse creek bed colluviums and alluvium underlie Weeli Wolli Creek. This is the major source of recharge to the alluvial aquifer. The creek bed unit is incised within and discharges to floodplain sediments, comprising mixtures of poorly sorted gravels, sand, silt and clay. These sediments lie adjacent to the CID. The floodplain sediments unconformably overlie in situ weathered basement, heavily fractured and weathered in situ Weeli Wolli Formation.

Transmissivity is variable within the floodplain aquifer. Groundwater moves freely within the coarser less clayey sediments, but flow may slow within the underlying clayey sections of the weathered basement material. The coarse river gravels of the upper alluvium of the creek bed are highly permeable and, in locations of reasonable thickness, have the ability to transmit and store large volumes of groundwater. The thickness of the floodplain alluvials is estimated from 6 m to 24 m, with the greatest thickness adjacent to Weeli Wolli Creek and limited cover at locations away from the Creek.

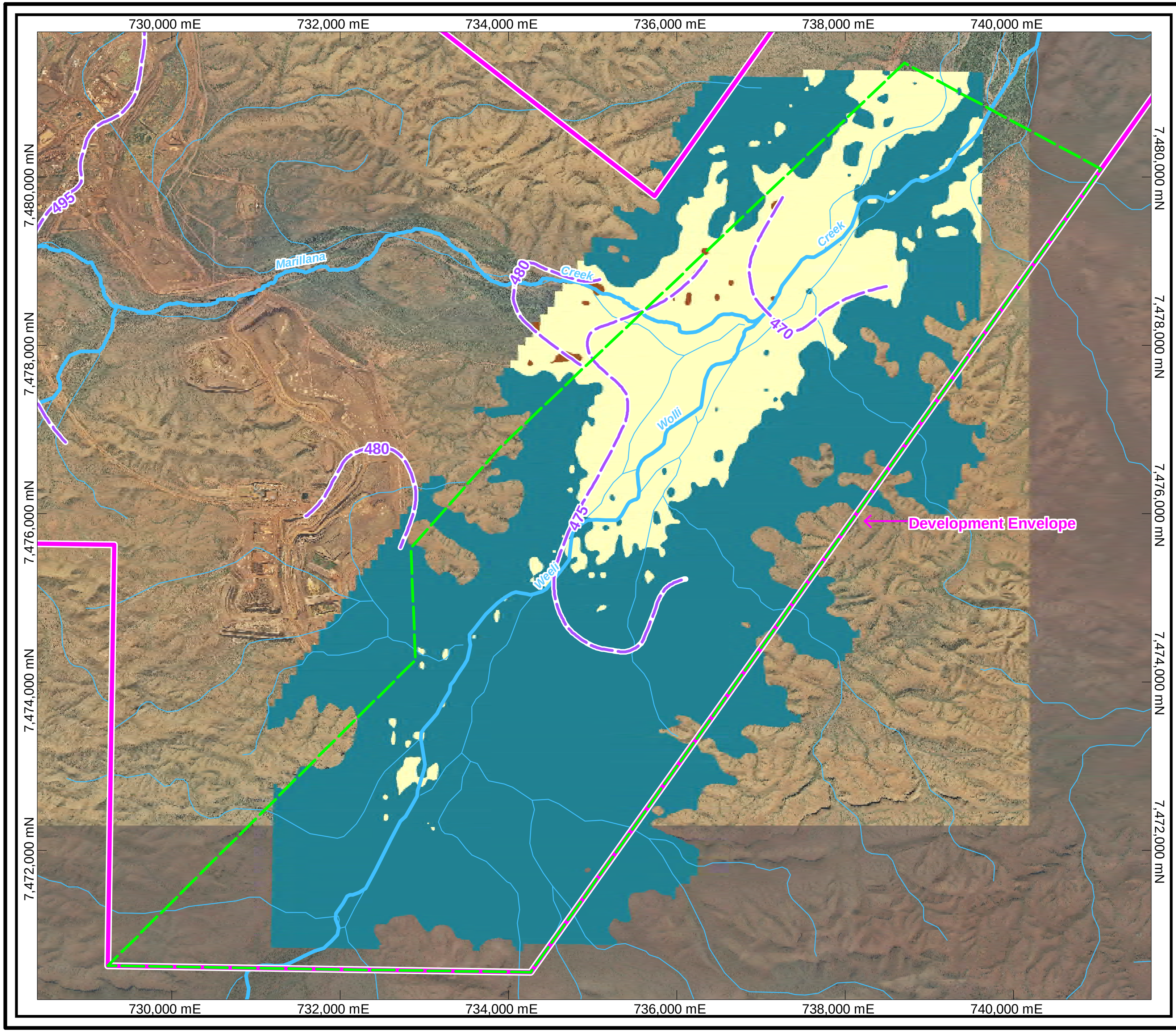
13.2.3.4 Groundwater quality

Baseline groundwater quality is typically characterised as fresh, with TDS concentrations of approximately 500 mg/L. Groundwater hosted by the floodplain aquifer tends to be comparatively higher in salinity (although still considered fresh), with measured TDS concentrations up to 1,290 mg/L. At greater depth, within the CID aquifer, known groundwater qualities occur in the range 370 to 780 mg/L TDS and pH from 6.8 to 9.6 (URS 2015).

The groundwater samples obtained from the monitoring bores close to Weeli Wolli Creek displayed increasing chloride concentrations in comparison to the groundwater samples within the monitoring and production bores away from the Creek. This is likely due to infiltration of surface water from Weeli Wolli Creek into the surficial aquifer and subsequently into the CID aquifer (Rio Tinto 2014d).

13.2.3.5 Groundwater levels

In areas where Weeli Wolli Creek intersects the CID, the coarse colluviums and alluvium are considered to be the conduit for recharge to the CID aquifer primarily from surface flow. Historically, groundwater levels were recorded to rise by up to 10 m within the CID aquifer as a result of through-flow from the floodplain aquifer following intense or prolonged rainfall events. Pre-mining water table elevations in the Proposal Area are shown below in **Figure 26**. Groundwater levels show significant spatial and temporal variation due to rainfall, stream flow and evaporation. The depth to water table cyclic-low and episodic high snapshots are presented in **Figure 27** and **Figure 28**.



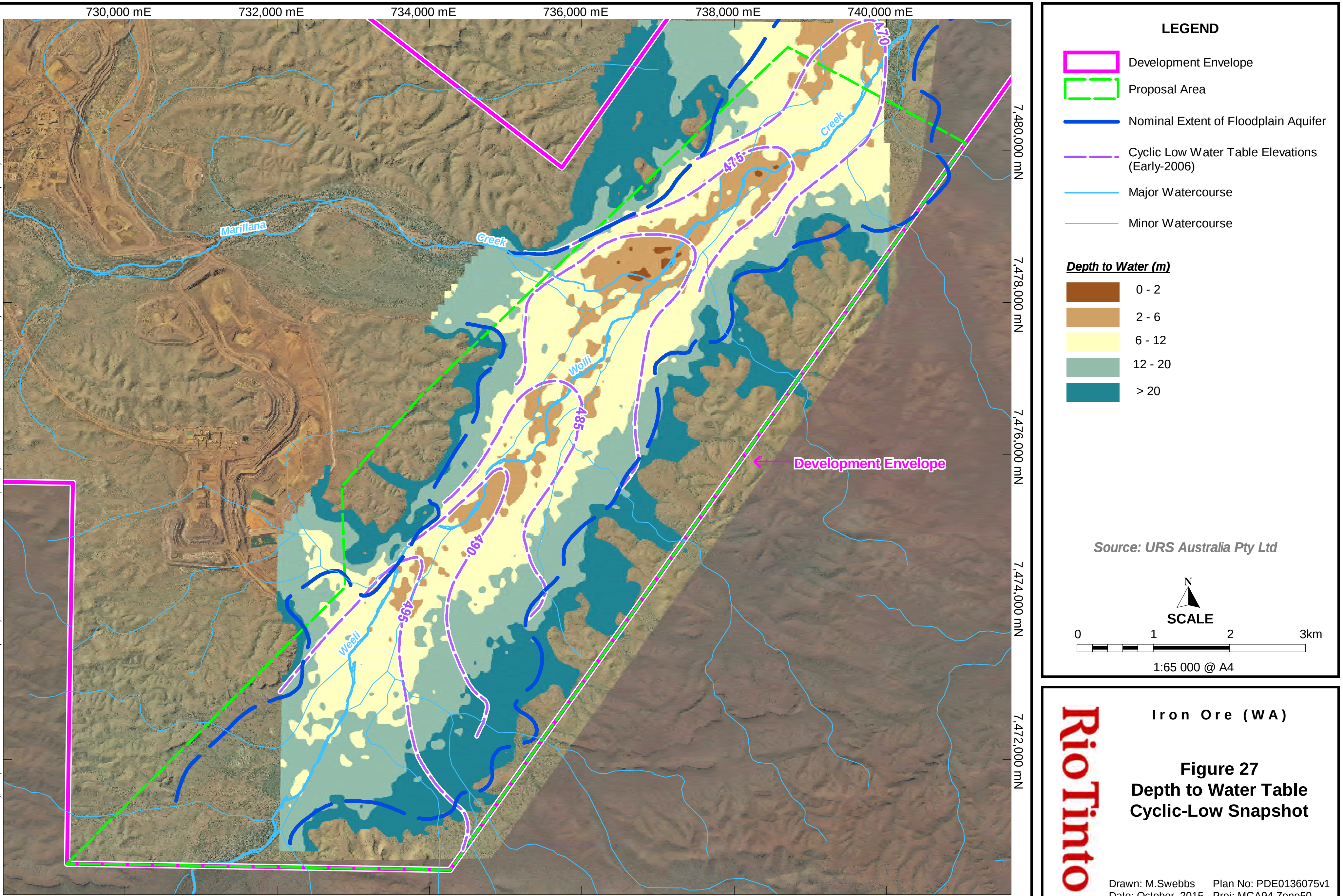
Rio Tinto

Iron Ore (WA)

Figure 26
Pre-mining groundwater levels

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0133928v2
Proj: MGA94 Zone50

Geospatial Information and Mapping



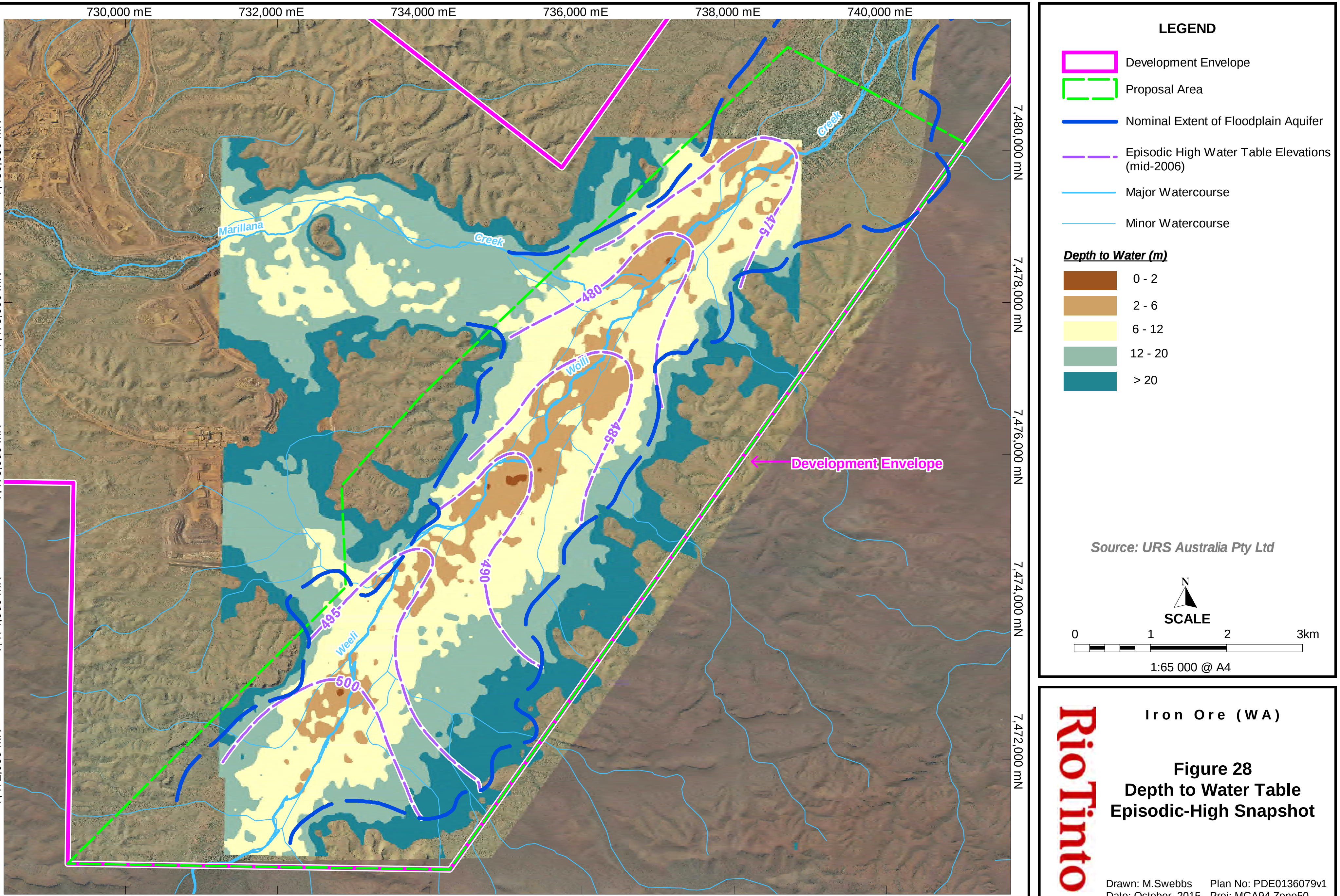
Rio Tinto

Iron Ore (WA)

Figure 27
Depth to Water Table Cyclic-Low Snapshot

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0136075v1
Proj: MGA94 Zone50

Geospatial Information and Mapping



Rio Tinto

Iron Ore (WA)

Figure 28
Depth to Water Table
Episodic-High Snapshot

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0136079v1
Proj: MGA94 Zone50

Geospatial Information and Mapping

13.2.4 Current altered hydrological regime

13.2.4.1 Water flow

Surface water and groundwater in the Proposal locality has been modified and managed for a number of years (since the mid 1990s) as a result of mining activities in the area. This includes dewatering of groundwater and discharge of surplus water to Marillana and Weeli Wolli Creeks. **Figure 29** provides a conceptual water balance for mines operating within the Proposal Area including discharge locations, and **Figure 30** provides a waterfall graph to demonstrate the cumulative water abstraction and discharge volumes across these operations.

The following sections provide a summary of the abstraction, discharge, recirculation and water use regime in the Proposal Area. The summary provides a sequence of mining upstream along the CID and Marillana Creek through to the Proposal Area. **Table 11** summarises the water balance described below.

Dewatering and discharge:

- BHP discharge from its Marillana Creek (Yandi) Mine upstream of the Proposal at an upstream point in Marillana Creek on to the Proponent's tenure boundary. Historical averages have been in the order of 9 GL/y with a licence limit of 15 GL/y.
- Oxbow is scheduled to discharge surplus water from Discharge Outlet(s) (DO) along Marillana Creek with a modelled peak of approximately 8 GL/y. A commitment was made in the JSW and Oxbow approvals to maintain some upstream discharge (including D03) to manage water levels as a result of drawdown from the existing Yandi Operations to maintain areas of stygofauna habitat and allow for riparian readjustment.
- JC is currently near the end of its mine life and so is not actively being dewatered for mining purposes; however, the groundwater table is kept locally depressed by sump pumping to keep water levels manageable after wet seasons. JC historically discharged from several discharge locations along Marillana Creek (DO2*, DO3, DO5, DO8*) with limited discharges currently from DO3.
- JSW currently discharges from DO9 into Marillana Creek with an estimated operational peak of 23 GL/y.
- JSE has historically discharged from DO5, DO6 & DO9, however discharge into the future will be maintained from DO5 and DO9, with DO6 being decommissioned and the water being diverted for use in the JSE wet plant.
- Hope Downs 1 is approved to discharge up to 40.15 GL/y into the upper reaches of Weeli Wolli creek from two locations: into the Weeli Wolli Spring through a spur system to negate the impacts of drawdown; and also from a gabion structure downstream of the Spring.

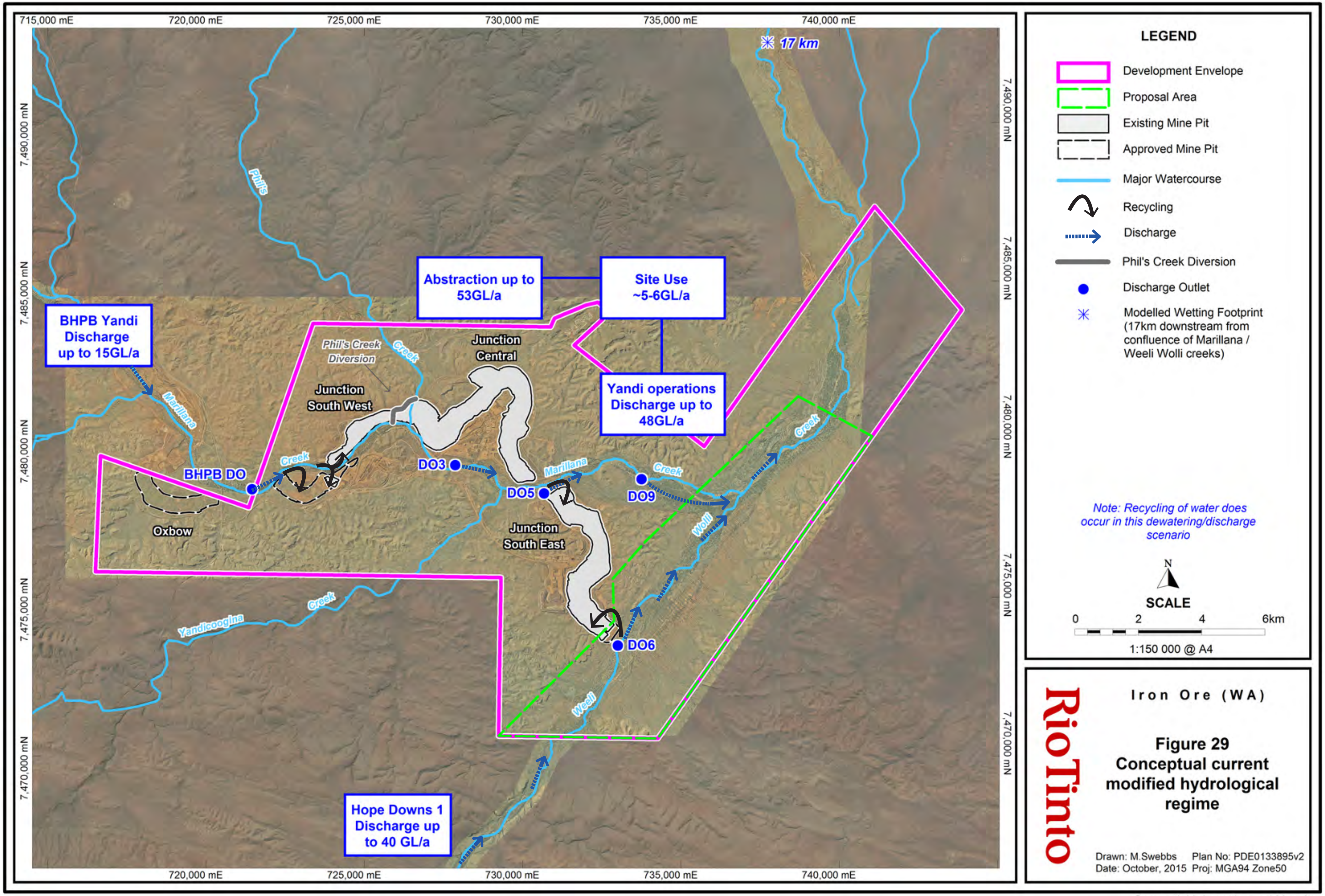


Figure 29
Conceptual current modified hydrological regime

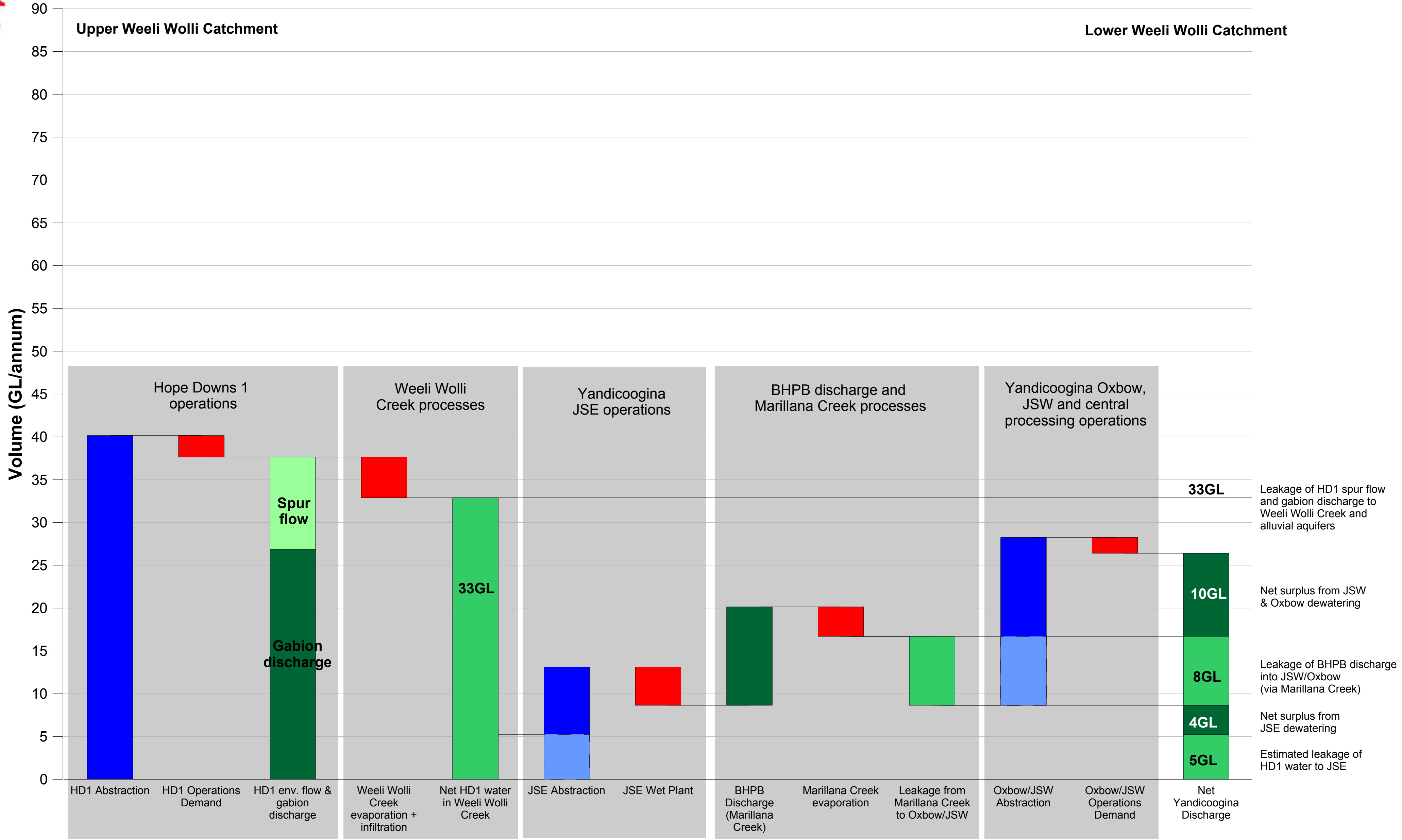
Drawn: M.Swebbs Plan No: PDE0133895v2
Date: October, 2015 Proj: MGA94 Zone50

Geospatial Information and Mapping

Weeli Wolli Catchment Water Balance

Pocket-Billiards South PER

Figure 30



Recirculation (re-dewatering of surplus water discharge):

Hydrogeological investigations into the catchment have shown that substantial amounts of the "dewatering" conducted by downstream operations is recirculation of surplus water discharged by upstream operations. This "recirculation" has been estimated between operations in the Proposal Area as follows:

- Up to 70% of BHP Marillana Creek (Yandi) Mine discharge is re-abstracted and discharged by the Proponent's Yandi Operations dewatering.
- A portion of the discharge from Hope Downs 1 has been recharging into JSE.

Water use:

- Approximately 5-6 GL/y of water is re-used on-site across the existing Yandi Operations for potable water supply, dust suppression and in the existing plants. A further 5 GL/y (total of 11 GL/y) is estimated to be used in the JSE wet plant which is currently being commissioned.

Table 11: Modified hydrological regime of the Proposal Area

Mine	Year commenced abstraction / discharge	Location of discharge	Creek	Abstraction Actual or proposed Individual pit contribution –(peak) (GL/y)	Abstraction Ministerial / licence limit (GL/y)	Site Use	Discharge Actual or Proposed (GL/y)	Discharge Ministerial limit (GL/y)	Recycling volume (or %)
BHP Yandi	1996	Upstream of JSW	Marillana	15	15	N/A	Up to 15	15	70%
Oxbow	Proposed 2017	– D03	Marillana	8	18	6	8	16	
JSW	2013	– D09	Marillana	23			20^		
JC	1997	– D02*, D03, D05, D08*	Marillana	NA	35		NA	NA	
JSE	2007	– D06 – D05 & D09	Weeli Wolli Marillana	19			16^		Unquantified
Proposal	Proposed 2017	– D09	Marillana	50	Additional 30	5**	45 - 50		70%
HD1	2007	Upstream of Proposal	Weeli Wolli	40.15	40.15	3	37.15	40.15	33GL to Proposal

*Now decommissioned
** from JSE wet plant: so total reuse on-site will be existing 6 GL/y + 5 GL/y from wet plant = 11 GL/y
^ Assumes of the 6 GL/y used on-site, 3 GL/y attributed to JSW and 3 GL/y attributed to JSE

Due to the continuous discharge of surplus dewater from multiple operations in the Proposal Area, permanent surface water within the low-flow channel occurs along Weeli Wolli Creek. MS 914 condition 6-3, currently limits the wetting front from surplus water discharge to 17 km downstream of the Marillana and Weeli Wolli Creek confluence. This limit also accommodates the surface water released from Hope Downs 1. The current wetting front reaches between 5 and 9 km downstream of the Weeli Wolli Creek and Marillana Creek confluence.

The current modified groundwater table is connected to the low-flow channel for the majority of the length of the surface water wetting front. The location of the surface water wetting front changes due to the capacity for infiltration of surface water flows to the floodplain and CID aquifer. Where groundwater levels are high and the profile is fully saturated, there is no additional capacity for infiltration to the aquifer, therefore surface water flows will propagate further downstream but still within accordance of MS 914. Where the aquifer is not fully saturated (i.e. the groundwater table is not at or near the surface) there is capacity for surface flows to infiltrate to the floodplain aquifer, which will result in a retreat of the surface water wetting front. The wetting front appears relatively stable, with observations since continuous discharge began indicating no further propagation of the wetting front further downstream (**Figure 31**).

Discharge of surplus water from mine dewatering operations to Weeli Wolli Creek has resulted in greater recharge within the creek bed alluvium to the floodplain aquifer (**Figure 32**), and has increased mounding below the alluvial aquifer when compared to pre-mining conditions (URS 2015; **Figure 32**). Drilling undertaken within the Proposal Area in 2013 recorded groundwater levels between 2 - 10 m below ground level (Rio Tinto 2014d).

An investigation has been undertaken to understand the impact that continuous discharge has had on the overall water balance of Weeli Wolli Creek and underlying aquifers (Dogramaci et al. 2015). For the purpose of the investigation, results of surface water and groundwater sampling were combined with field observations of surface saturation along Weeli Wolli Creek and recorded discharge rates at the Hope Downs 1 discharge location.

The major finding of the study suggests that the impact of recharge from continuous flow on the hydrological regime of the creek has not extended beyond 27 km from the discharge point, which is no further than 8 km from the Weeli Wolli Creek and Marillana Creek confluence. It was concluded that although more than 220 gigalitres (GL) of mine water discharge since 2007 has changed the nature of the connectedness of Weeli Wolli Creek to the underlying aquifer in the upper section, associated with the impermeable Weeli Wolli Formation, there has been negligible impact on the overall hydrological regime of the broader catchment. Most of the recharge to the groundwater aquifer along Weeli Wolli Creek occurs where the creek flows adjacent to or across the CID aquifer.

The calculated rates of recharge as a result of continuous discharge from Hope Downs 1 were found to be commensurate with those from large flooding events that occur in the region every few years (Dogramaci et al. 2015). It was noted, that changes in surface water connectivity and sustained periods of saturation may have localised impacts on the ecology of streams. Section 14.3.3 provides an assessment of the potential impacts on riparian vegetation from the modified hydrological regime.

LEGEND

Development Envelope

Proposal Area

Extent of CID

Major Watercourse

Observed Surface Water Wetting Front and Date of Measurement

Approved Wetting Front Extent (MS914)

N

SCALE

0 1 2 3 4km

1:85 000 @ A4

Rio Tinto

Iron Ore (WA)

Figure 31
Surface water wetting fronts

Drawn: M.Swebbs Plan No: PDE0133898v2
Date: October, 2015 Proj: MGA94 Zone50

Geospatial Information and Mapping

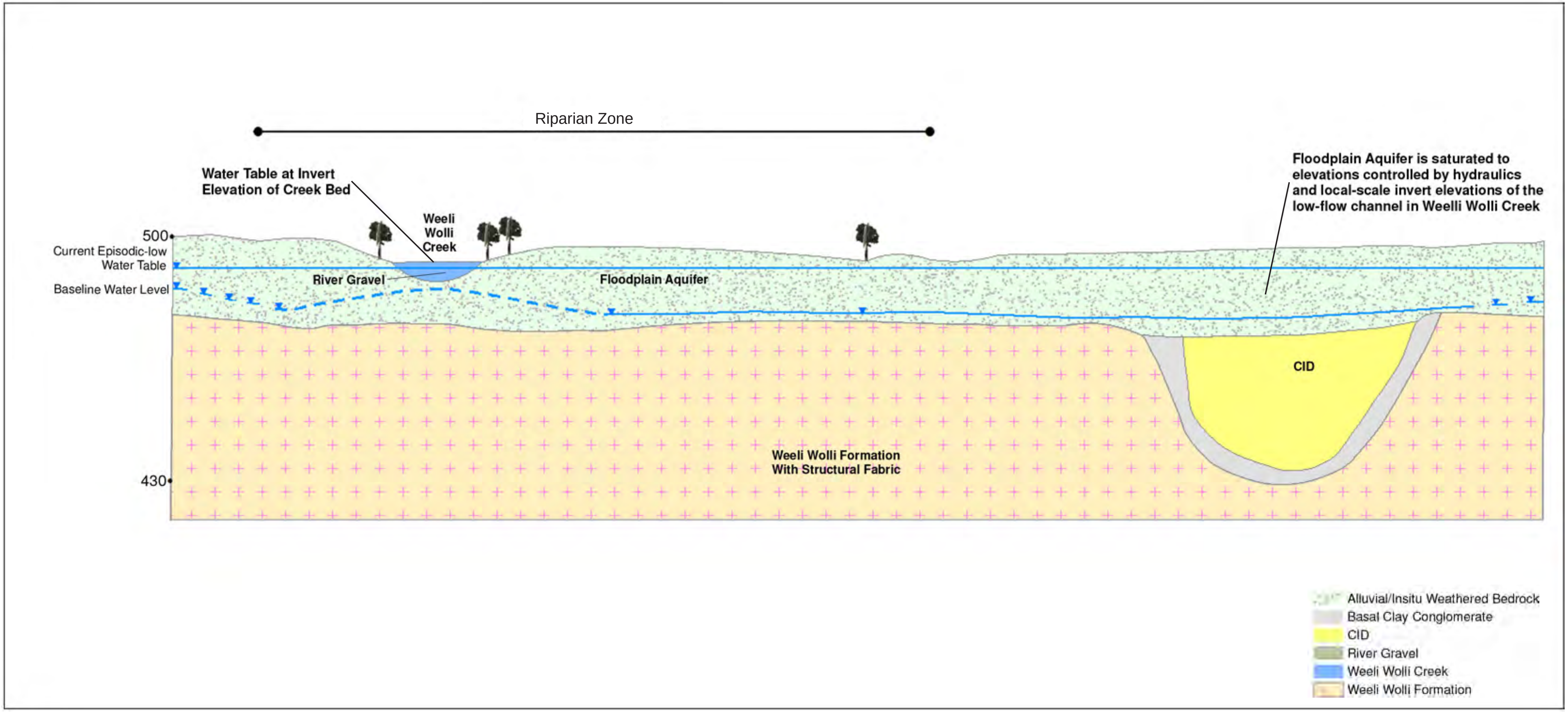


Figure 32 - Post mining groundwater levels

Source: Figure courtesy of URS Australia Pty Ltd

13.2.4.2 Water quality

Water quality monitoring has been undertaken along Weeli Wolli Creek and Marillana Creek prior to and following abstraction and discharge activities. The analysis of water quality is based on a standard suite of water quality parameters including electrical conductivity, total suspended solids, TDS, alkalinity, pH, hardness and a range of nutrients and other elements such as barium, boron, calcium, chloride, magnesium, nitrate, total nitrogen, total phosphorus, potassium, sodium, sulphate, sulphur, and uranium.

Monitoring results to date indicate some minor variation in water quality parameters, however this is considered to be natural fluctuations and no significant effects on baseline water quality has occurred as a result of abstraction and discharge activities.

Water availability and discharge by transpiration and evaporation has resulted in salt accumulation within the groundwater environment. Chloride ion levels have increased slightly (by approximately 50 mg/L) along the surface water wetting front extending from Hope Downs 1 operations along Weeli Wolli Creek, which is considered to be a result of salt accumulation due to evaporation and transpiration losses along the flow path (Dogramaci et al. 2015).

13.3 Assessment of potential impact, mitigation and residual impact

The EPA has listed the following potential impacts for the Proposal in relation to hydrological processes and inland waters environmental quality:

- Impacts to natural surface water systems and flows as a result of placement, design and operation of a new mine pit and associated infrastructure (including surface waste dumps and stockpiles, and drainage structures).
- Impacts to surface water resources including Weeli Wolli Creek due to surface discharge of surplus mine dewater.
- Altered flow regime to the Fortescue Marsh due to groundwater drawdown and discharge of surplus water into Weeli Wolli and Marillana Creeks.
- Potential changes to the groundwater quality over time from pit lakes left by the proposal.
- Potential contamination of surface water and groundwater, if management of waste dumps containing at risk material (material with potential for acid or metalliferous drainage) is not appropriate.

The potential impacts as a result of the development of the Proposal are described in the following sections.

Impacts to groundwater dependent ecosystems and subterranean fauna as a result of groundwater drawdown are discussed in Section 14 and 15 respectively.

Cumulative impacts of groundwater drawdown and discharge of surplus water into Weeli Wolli and Marillana Creeks, and any potential impacts to Fortescue Marsh, are discussed in Section 13.4.

13.3.1 Natural surface water systems and flows

The construction and physical presence of the pit, overburden storage areas, roads and other associated mine infrastructure will modify local topography and intercept surface water flows. Modifications to surface drainage patterns have the potential to cause changes to flood depths and velocities in downstream environments.

There is the potential for high velocity water movement off areas with steep gradients to contribute to the erosion of cleared landforms and unconsolidated materials in the Proposal Area. This has the potential to result in increased sediment load into the downstream environment.

A local surface water management strategy for the Proposal has been prepared to address surface water risks associated with local runoff from catchments east of Weeli Wolli Creek (Rio Tinto 2014f). The strategy includes measures to minimise the impact of surface water movement by the construction of a comprehensive framework of stormwater management structures. This is likely to include (but not be limited to) levees around the pit, diversion drains around waste dumps, and culverts under roads. These management measures will aim to maintain surface water drainage regimes by diverting surface water flows around infrastructure and into downstream drainage lines, thereby limiting opportunities for sediment transport from disturbed surfaces. Any incident surface water intercepted within operational areas will be diverted to sediment traps or retained in in pit sumps, to minimise sediment load prior to discharge to the natural drainage system.

Stormwater management design in Australia is guided by Australia Rainfall and Runoff (Pilgrim 2001) and the AUSTROADS Waterway Design Guide (Flavell 1994). Using these guidelines, a minimum of a 1% Annual Exceedance Probability (AEP; or a 100 year Annual Recurrence Interval; ARI) flood protection criteria will be adopted for the design of the flood protection levee. A 2% AEP (50 year ARI) flood protection will be adopted for the design of local diversion drains.

13.3.2 Weeli Wolli Creek

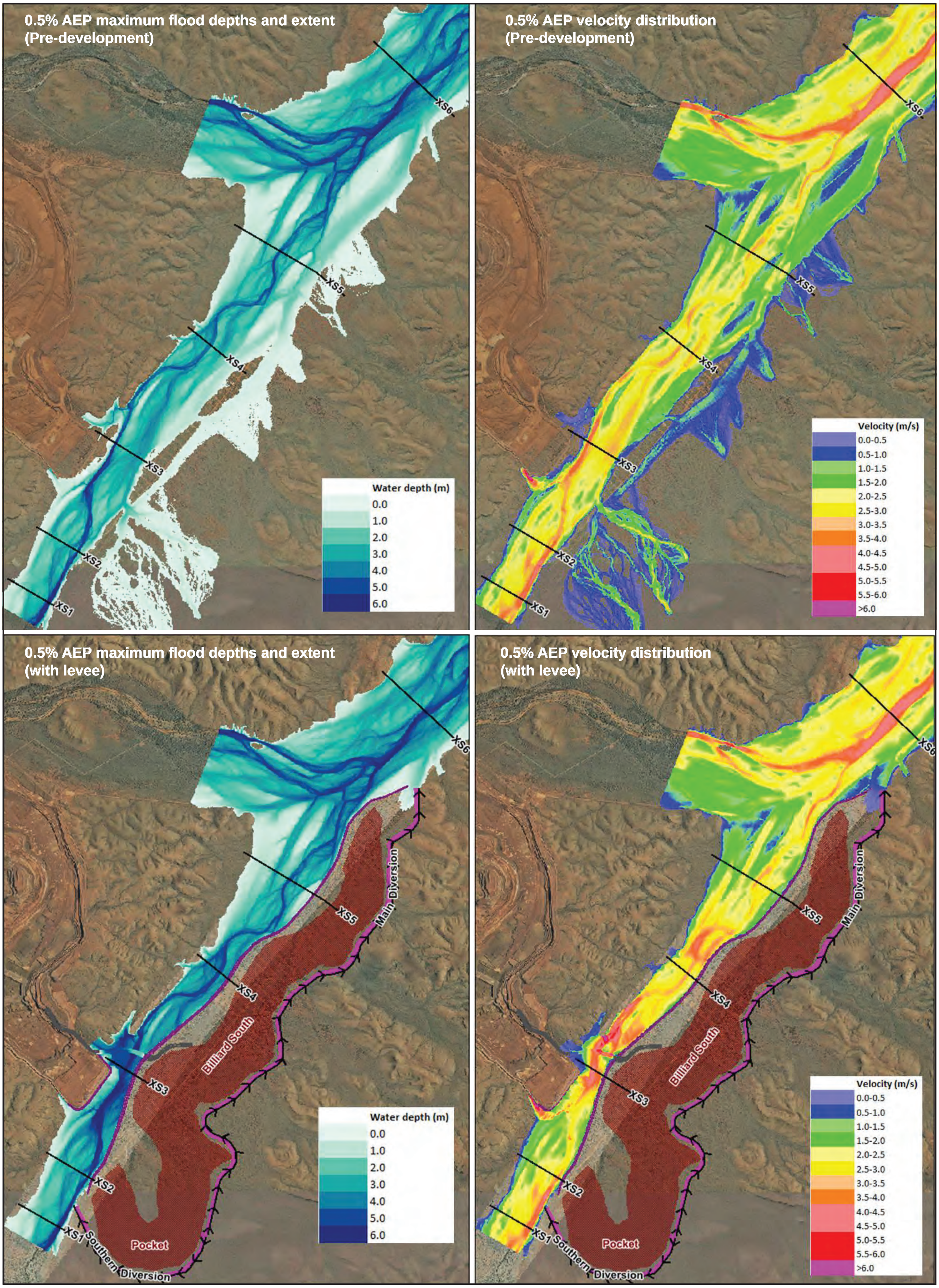
Development of the Proposal will encroach into the Weeli Wolli Creek floodplain. Results of hydrologic modelling of catchment runoff and hydrodynamic modelling of flood conditions have been used to assist in the design of a flood protection levee for the Proposal. The results that have been derived from the modelling are considered to provide a reliable representation of flow conditions during the major flooding of Weeli Wolli Creek, and are therefore suitable for use in the development of concept designs for the proposed flood protection levee (WorleyParsons 2015), with further detailed engineering work to be undertaken as the Proposal progresses.

Disruption to the existing surface water flows along Weeli Wolli Creek is currently negligible during low-flow events. As the magnitude of the flood increases, changes to the flow regime also increase due to greater constriction and obstruction of flows imposed by the infrastructure along the creek. Overall change is confined to a section of creek adjacent to the proposed mine and unlikely to impact the wider creek area (URS 2015; **Figure 33**).

13.3.3 Dewatering and groundwater drawdown

Due to the nature of the orebody being located below the water table, dewatering will be required to allow for mining. A numerical groundwater model has been developed to simulate dewatering scenarios and assess resulting impacts to groundwater. This model is a regional model covering the whole of the Revised Proposal Development Envelope, including the Oxbow, JSW and JSE pits together with the Proposal pit. It is based on a groundwater model first developed for the existing Yandi Operations in 2008.

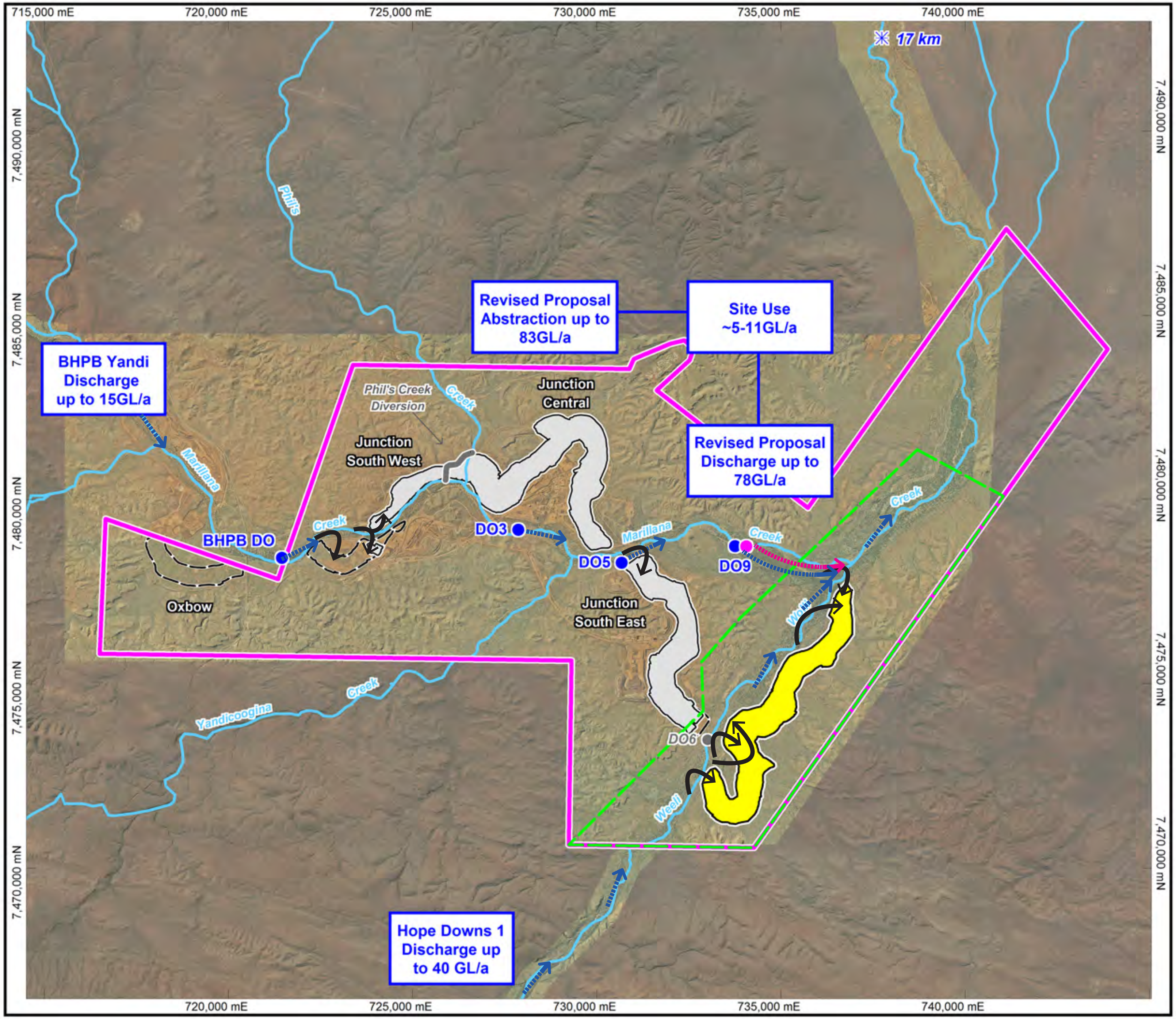
The model predicts peak cumulative abstraction volumes from current and proposed operations from the Yandi Operations, including the Proposal of up to 83 GL/y may occur (**Figure 34** and **Figure 35**) within the first 6 years of dewatering. Local maximum drawdown during this period within the floodplain and CID aquifer system would be in the order of 45 to 50 m to enable dry mining conditions. Drawdown would be most pronounced along the CID aquifer, and would separate the groundwater and surface water flows that currently occur along the low-flow channel of Weeli Wolli Creek from continuous discharge of surplus dewatering from upstream mining operations. Predicted drawdown over the expected life of the mine is shown in **Figure 36** and **Figure 37** for Pocket and Billiard South respectively.



RioTinto

Figure 33 - Flood footprints pre- and post-mining

Source: Figure courtesy of URS Australia Pty Ltd



LEGEND

- Development Envelope
- Proposal Area
- Existing Mine Pit
- Approved Mine Pit
- Conceptual PBS Mine Pit
- Major Watercourse
- Recycling
- Discharge
- New Discharge (PBS)
- Phil's Creek Diversion
- Discharge Outlet
- Proposed Discharge Outlet
- Modelled Wetting Footprint (17km downstream from confluence of Marillana / Weeli Wolli creeks)

Note: Recycling of water does occur in this dewatering/discharge scenario

N

SCALE

0 2 4 6km

1:150 000 @ A4

RioTinto

Iron Ore (WA)

Figure 34
Conceptual proposed hydrological regime

Drawn: M.Swebbs Plan No: PDE0133897v2
Date: October, 2015 Proj: MGA94 Zone50

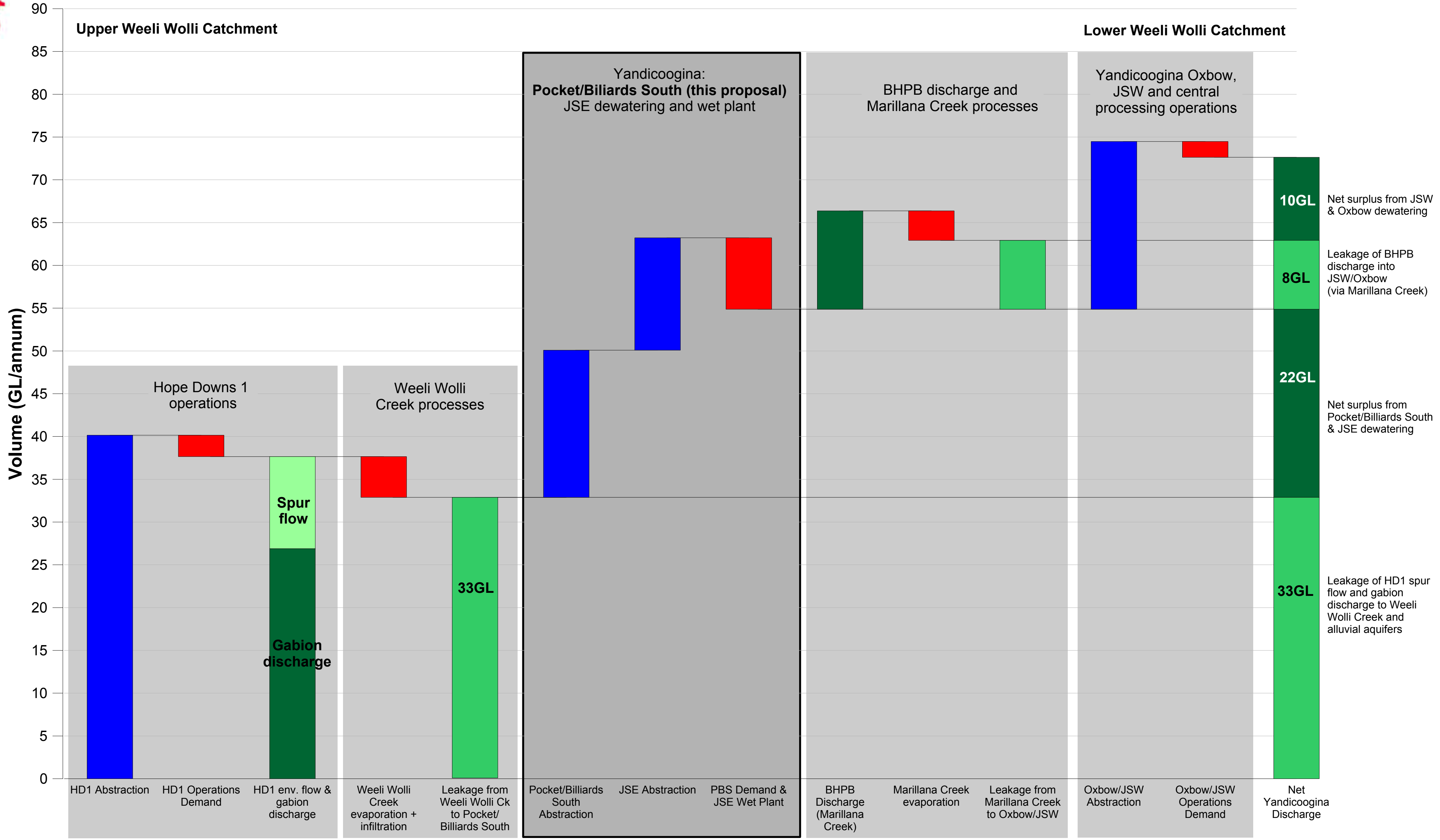
Geospatial Information and Mapping

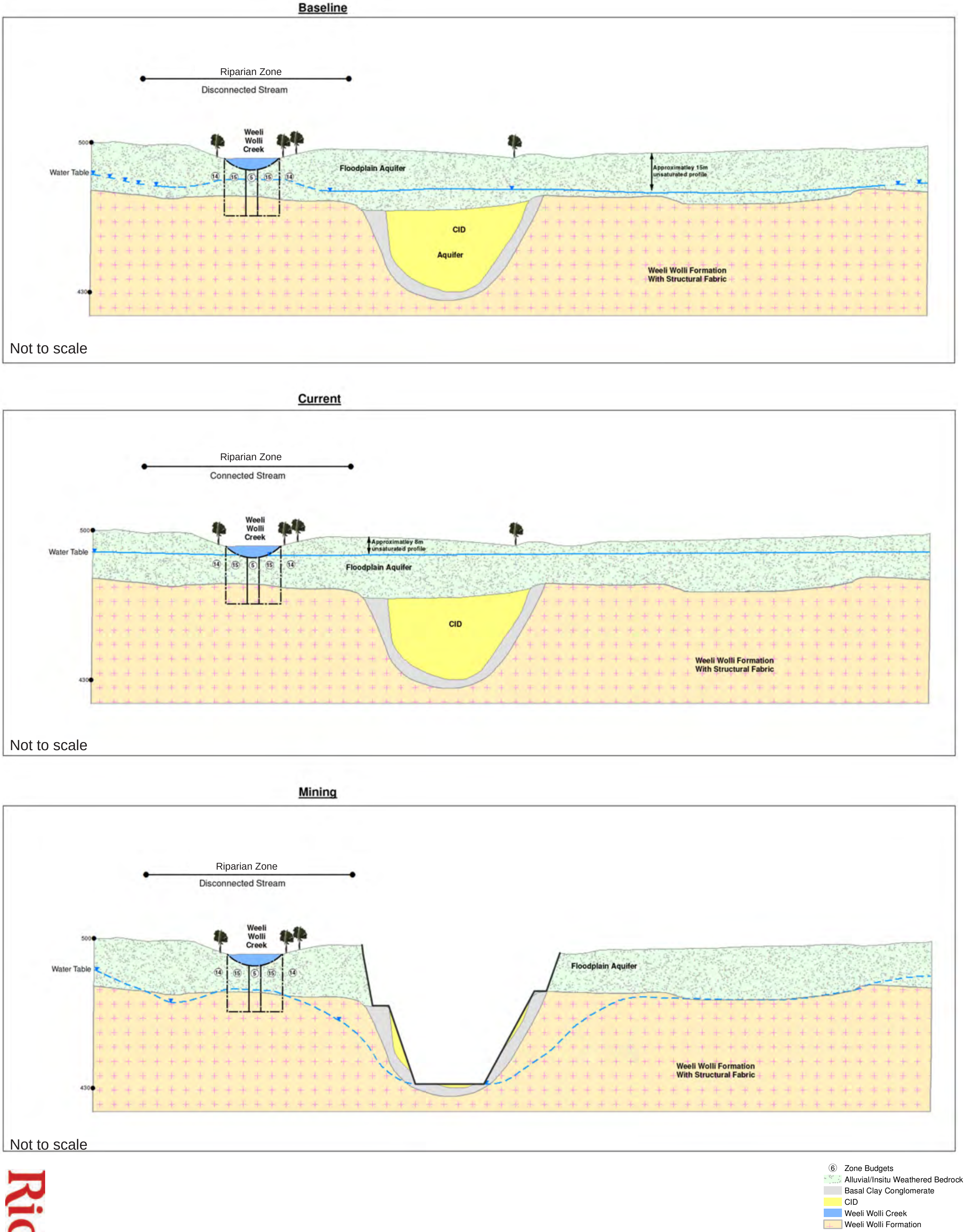
RioTinto

Weeli Wolli Catchment Water Balance

Pocket-Billiards South PER

Figure 35





Rio Tinto

Figure 36 - Groundwater drawdown schematic - Pocket

Source: Figure courtesy of URS Australia Pty Ltd

PDE0133864v2

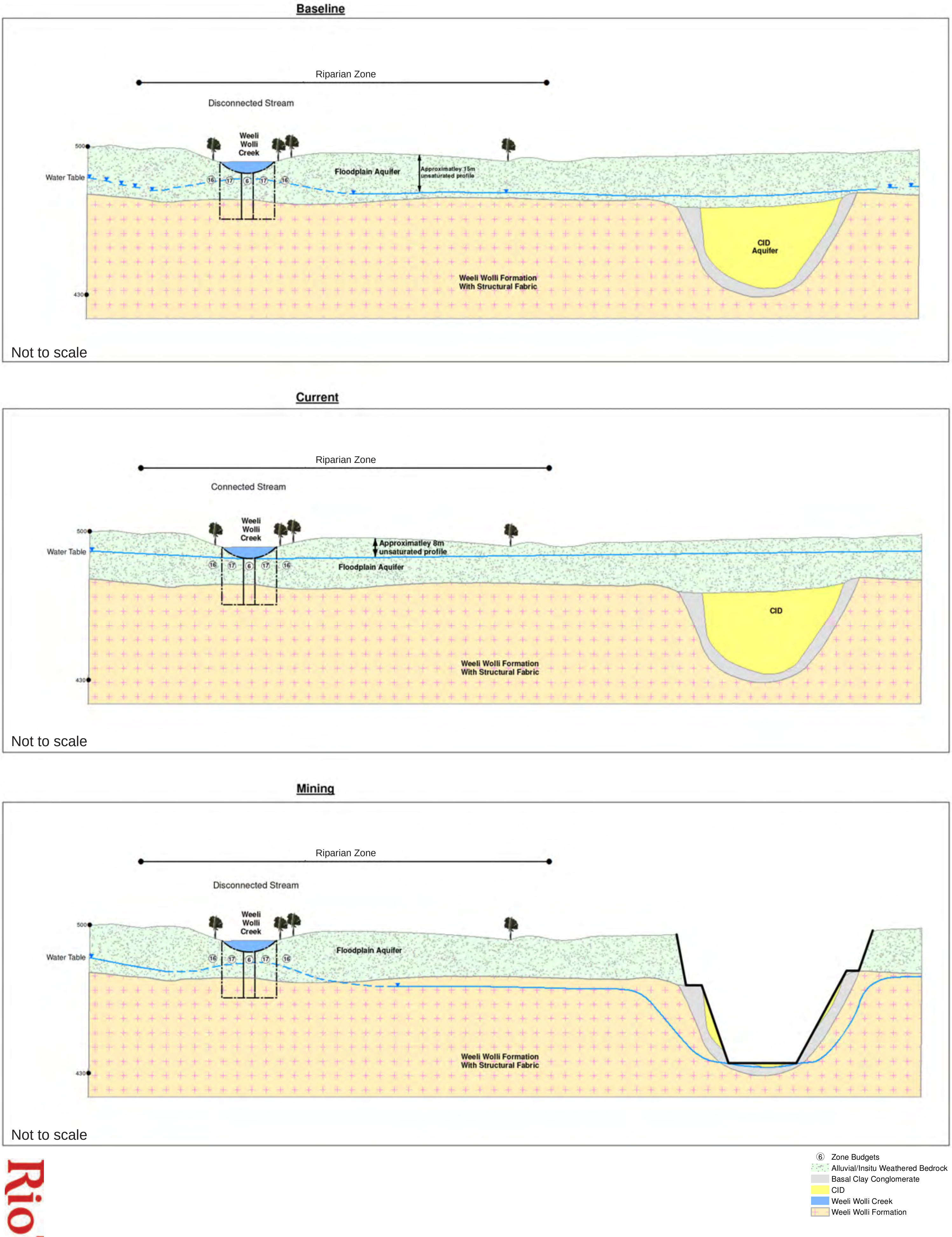


Figure 37 - Groundwater drawdown schematic - Billiard South

Source: Figure courtesy of URS Australia Pty Ltd

13.3.4 Discharge of surplus water

The Proposal is estimated to require, at its peak, approximately 50 GL/y of dewatering from the total dewatering volume of 83 GL/y produced by the Revised Proposal. Of the 50 GL/y, approximately 33 GL/y is modelled to be from re-dewatering of the discharge volumes from upstream discharge, equivalent to approximately 70% of the Proposal dewatering volume (**Figure 34** and **Figure 35**).

Dewatering volumes will be integrated with the existing and proposed site water demand, with approximately 5 GL/y (up to 11GL/y) to be used for on-site purposes at the Yandi Operations, such as dust control, camp usage and ore processing. Surplus water discharge will include the existing Yandi Operations approved 47 GL/y, which will increase up to 78 GL/y (average of 61 GL/y). The Proposal is predicted to contribute an additional 45-50 GL/y (**Figure 34** and **Figure 35**) of this discharge at its peak.

An extensive range of options (numbering over 20) were considered, with five possible options investigated in further detail for the management of surplus water from the Proposal. Detailed options assessments were carried out for the following:

- Storage of water in JC pit lake.
- Reduction of Hope Downs 1 discharge by reinjecting Hope Downs 1 dewatering volumes.
- Transfer to other current and future mining projects (including Koodaideri).
- Re-injection of Proposal water close to Yandi lease.
- Creek discharge to Marillana Creek.

The findings of these investigations are summarised in **Table 12** with the only technically feasible option being identified as potential to discharge to Marillana Creek.

Table 12: Options assessment for alternative surplus water management strategies

Option	Outcome
Store water in JC pit lake	This option was not feasible because it was found that 90% of the volume would recirculate to nearby dewatering wells.
Re-injection of Hope Downs 1 water	This option was not feasible due to the lack of third party tenure approval/access (to undertake preliminary drilling testwork to prove up suitable locations, and potentially for ongoing use), availability of unsaturated thickness of suitable host aquifers, and limited technical feasibility.
Early transfer to other options	This option cannot manage volumes from the Proposal during peak dewatering periods. Transfer to other projects will continue to be investigated as opportunities arise (including a potential option for the Koodaideri Project).
Re-injection of Proposal water close to Yandi lease	This option was eliminated because the target aquifers were found to be small and would fill quickly. In addition, the proximity of target aquifers to Fortescue Marsh was highlighted as a constraint.
Creek discharge to Marillana Creek	Discharge was determined to be a technically feasible option.

Given the limitations of the water management options, surplus water produced by the Proposal is proposed to discharge in Marillana Creek from a new discharge outlet adjacent to D09. Discharge has been occurring from D09 since the second half of 2013. The water is constrained to a well defined low-flow line, and is not predicted to extend beyond the existing MS 914 approved extent of 17 km beyond the Marillana – Weeli Wolli Creek confluence. By discharging from D09, the impact footprint along Weeli Wolli Creek is constrained to within currently approved limits.

Given the wetting front is modelled to be within existing approved limits, it is considered that there will be minimal additional effects on the downstream hydrological system of Weeli Wolli Creek. **Figure 38** to **Figure 42** shows a time series of the groundwater drawdown and mounding sequence throughout the Proposal mine life.

13.3.5 Fortescue Marsh

The results of modelling the potential wetting front as a result of discharge from Proposal is not expected to extend beyond the current approved wetting footprint limit in MS 914 of 17 km beyond the Marillana – Weeli Wolli confluence. Given that the current wetting footprint limit is set 28 km from the boundary of the Fortescue Marsh and that wetting front is predicted to be within existing approved limits, it is considered there will be negligible impacts on Fortescue Marsh.

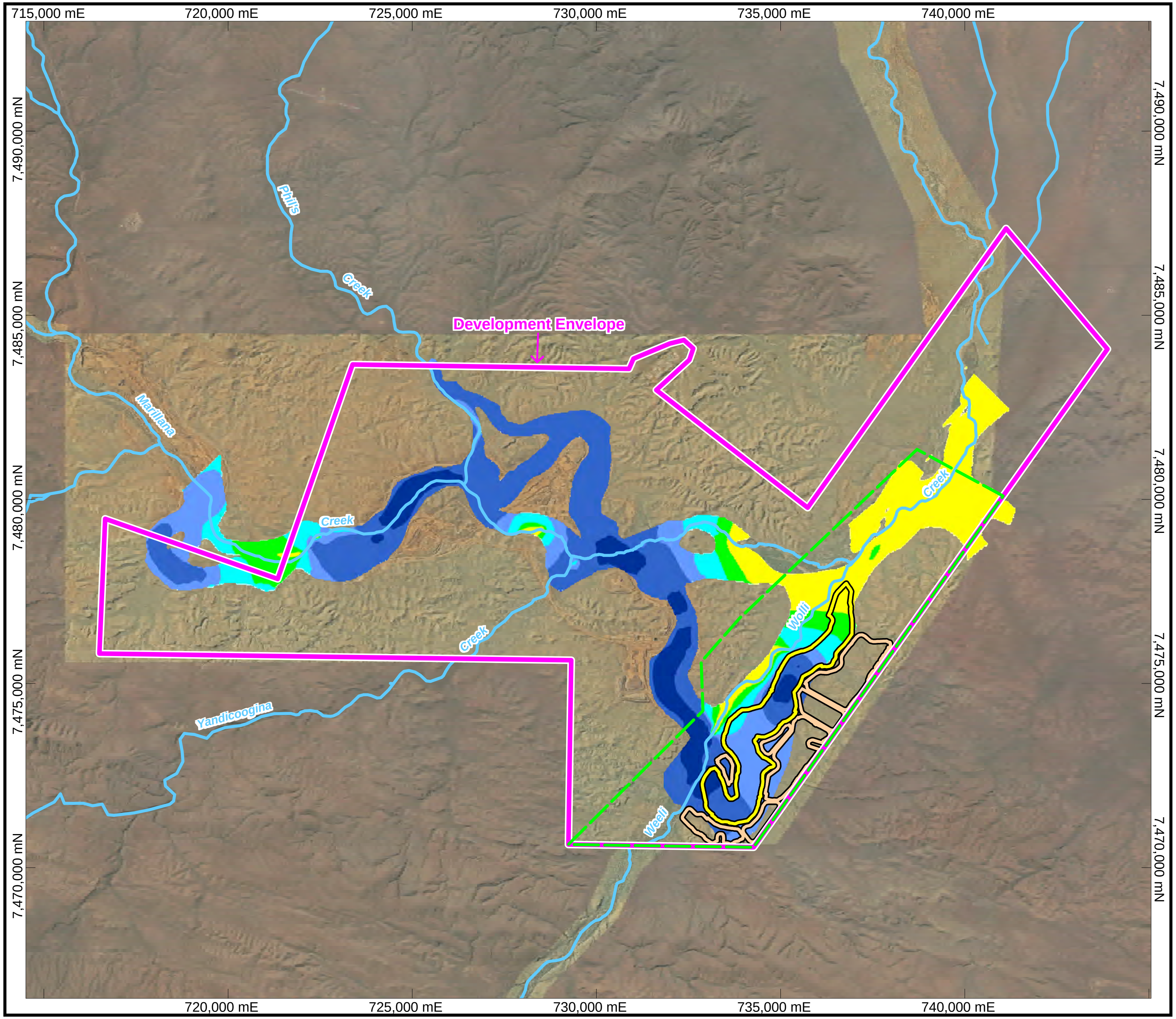
The controlled nature of CIA (impact of the Revised Proposal, Hope Downs 1 and BHP Yandi on Fortescue Marsh water balance) in terms of volume of discharge, and the extent of surface water expression and extensive transient sampling of the surface water and groundwater for chlorine concentration and environmental isotope composition, allowed partitioning of components of water balance that otherwise would not have been possible by water mass balance method alone. The study concluded that although mine water discharge has changed the nature of the connectedness of Weeli Wolli Creek to the underlying aquifer in the upper section associated with the impermeable Weeli Wolli Formation, there has been negligible impact on the overall water balance of the broader catchment.

Most of the recharge to the groundwater aquifer along Weeli Wolli Creek occurs where the creek flows adjacent or across the CID aquifer. The calculated rates of recharge are also commensurate with large flooding events that occur in the region every few years. Changes in surface water connectivity and sustained periods of saturation may nevertheless have localised and probably relatively short term impacts (until the next flood) on the ecology of streams.

Groundwater modelling results suggest that the maximum extent of the drawdown in the CID is 2 km downstream from the Proposal (Rio Tinto 2014d; updated addendum 2015). The location of zero drawdown is approximately 7 km upstream from the Weeli Wolli fluvial plan and 35 km from the Fortescue Marsh.

The cumulative impact of creek discharge and dewatering clearly shows no measurable chlorine concentration change in CID groundwater 4 km up gradient from Weeli Wolli fluvial plane and 32 km from the Fortescue Marsh.

For further details, please see Dogramaci et al. (2015), Dogramaci and Skrzypek (2015), Skrzypek et al. (2013) and Rouillard et al. (2015).



LEGEND

- Development Envelope
- Proposal Area
- Conceptual Mine Pit
- Conceptual Waste Dump / Stockpile
- Major Watercourse

Drawdown in December 2017

metres

50
30
20
10
5
0

N

SCALE

0 2 4 6km

1:150 000 @ A4

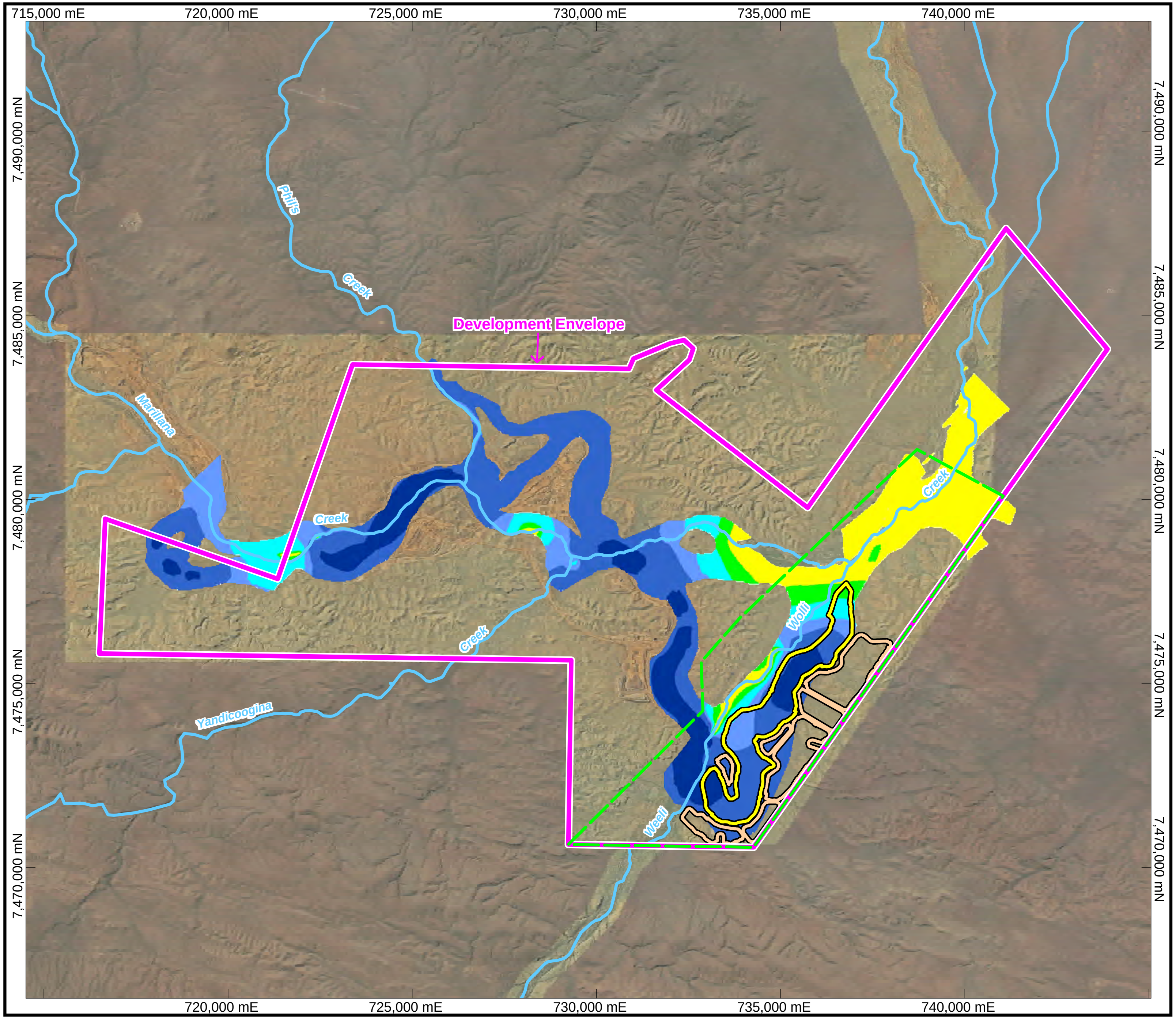
RioTinto

Iron Ore (WA)

Figure 38
Predicted water table drawdown in 2017

Drawn: B Jackson
Date: October, 2015
Plan No: PDE0133868v2
Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

Development Envelope
Proposal Area
Conceptual Mine Pit
Conceptual Waste Dump / Stockpile
Major Watercourse

Drawdown in December 2019

metres

50
30
20
10
5
0

N

SCALE

0 2 4 6km

1:150 000 @ A4

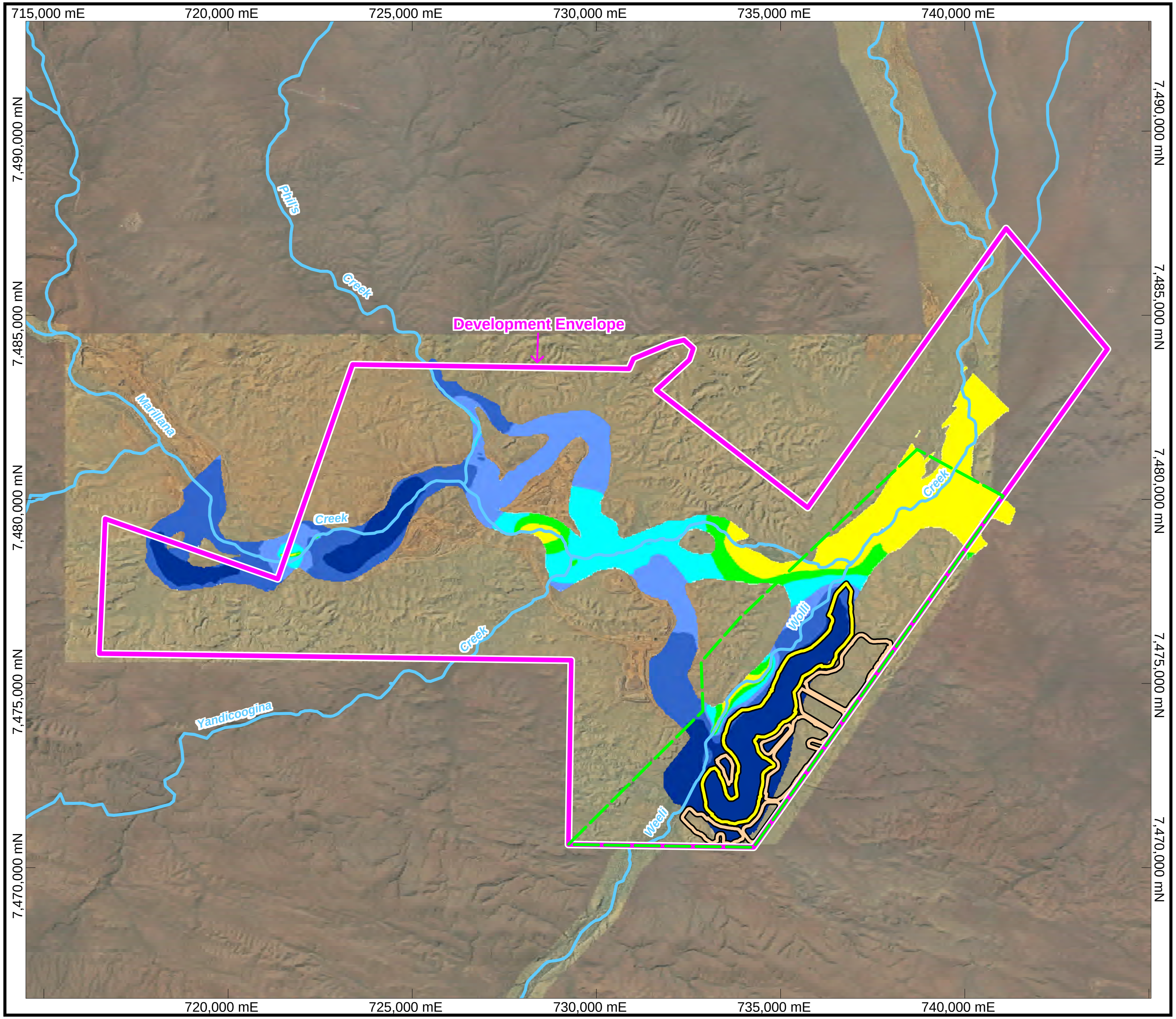
RioTinto

Iron Ore (WA)

Figure 39
Predicted water table drawdown in 2019

Drawn: B Jackson Plan No: PDE0133869v2
Date: October, 2015 Proj: MGA94 Zone50

Geospatial Information and Mapping



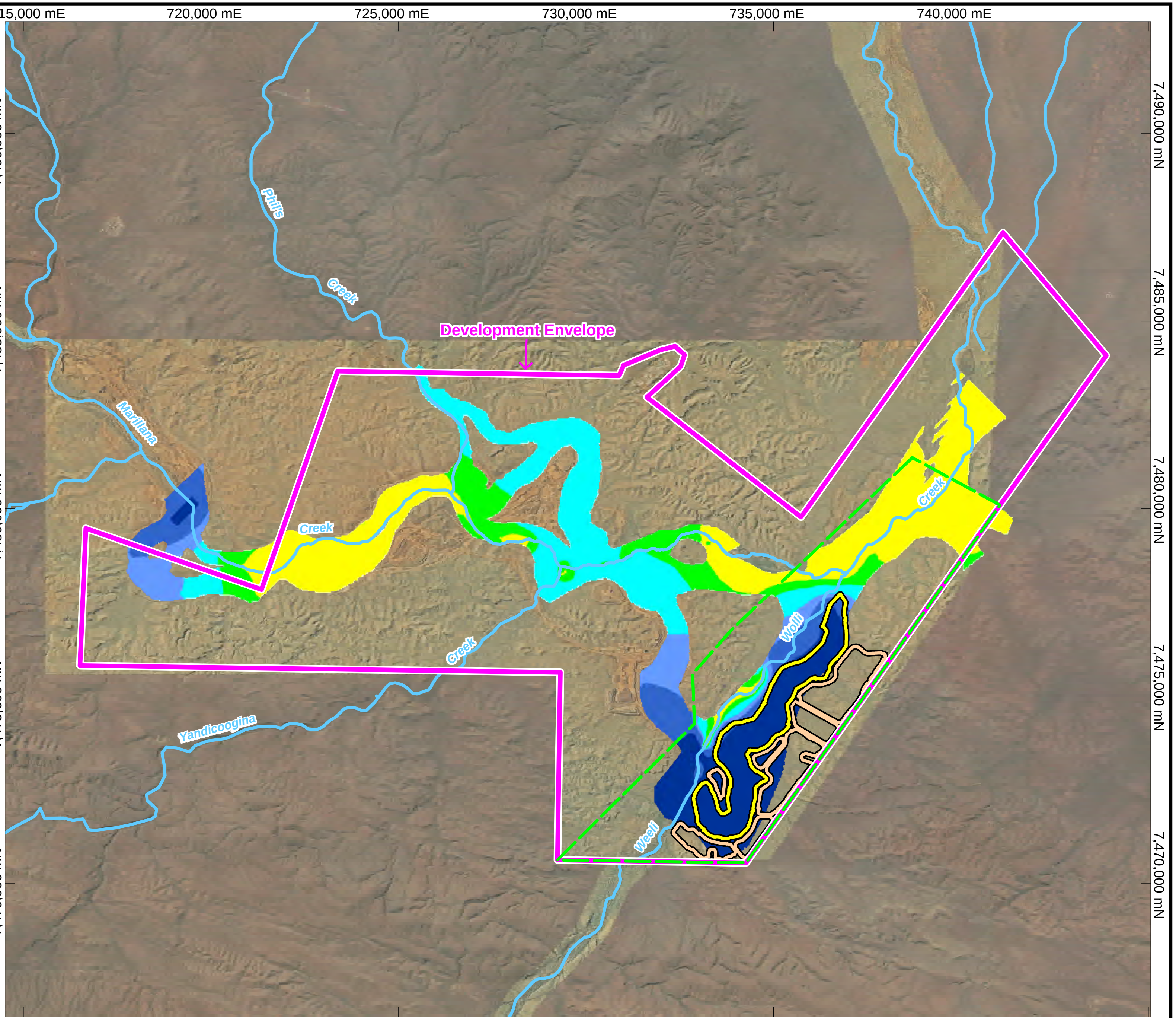
Rio Tinto

Iron Ore (WA)

Figure 40
Predicted water table drawdown and mounding in 2023

Drawn: B Jackson
Date: October, 2015
Plan No: PDE0133870v2
Proj: MGA94 Zone50

Geospatial Information and Mapping



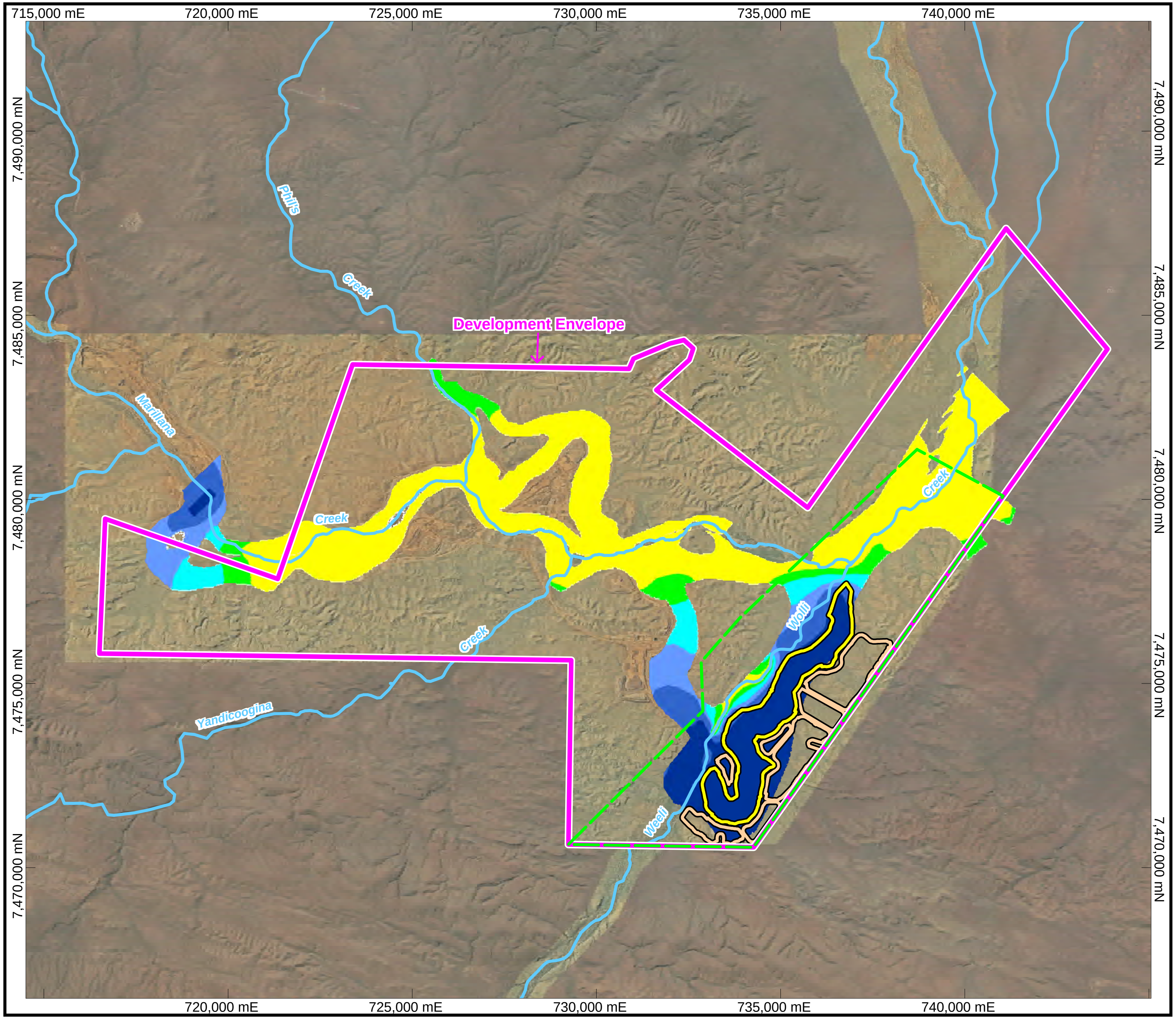
Rio Tinto

Iron Ore (WA)

Figure 41
Predicted water table drawdown and mounding in 2027

Drawn: B Jackson
Date: October, 2015
Plan No: PDE0133871v2
Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

- Development Envelope
- Proposal Area
- Conceptual Mine Pit
- Conceptual Waste Dump / Stockpile
- Major Watercourse

Drawdown in December 2031

metres

50
30
20
10
5
0

N

SCALE

0 2 4 6km

1:150 000 @ A4

Iron Ore (WA)

Figure 42
Predicted water table drawdown and mounding in 2031

Drawn: B Jackson Plan No: PDE0133872v2
Date: October, 2015 Proj: MGA94 Zone50

Geospatial Information and Mapping

13.3.6 Water quality

As described in Section 13.2.4.2, water quality monitoring to date indicates some minor variation in water quality parameters. However, this is considered to be within natural fluctuations and no significant effects on baseline water quality has occurred as a result of abstraction and discharge activities.

Given the abstraction and discharge of water from the Proposal is from the same water source as the current approved operations, and the wetting front would remain within the limits of MS 914, it is expected that there will not be any significant effects on water quality as a result of the Proposal activities.

Water monitoring will continue in accordance with the Surface Water Discharge and Groundwater Dependent Ecosystem Monitoring and Management Plan.

13.3.7 Contamination of surface and groundwater from waste dumps

Appropriate management of waste dumps will ensure that risks of contamination of surface and groundwater are minimised. Rio Tinto has developed practice standards for handling and managing mineral wastes, as described in the following internal standards:

- Iron Ore (WA) Mineral Waste Management Plan.
- Iron Ore (WA) Spontaneous Combustion and Acid Rock Drainage (SCARD) Management Plan.
- Iron Ore (WA) Rehabilitation Management Plan.
- Iron Ore (WA) Landform Design Guidelines.

Operational waste dumps will incorporate water management features to reduce the potential for sediment-laden surface water runoff, such as continuous windrows around the base of the dumps and on-site drainage structures being stabilised to minimise erosion. Stormwater will be directed to sedimentation traps to reduce sediment loads in surface water discharged off-site.

The risk of acid rock drainage at the Revised Proposal has been assessed as low based on geochemical interpretation and analytical testing of drill hole samples. As a result, waste rock stockpiles are not considered to present a risk to water quality in the surrounding environment.

Ongoing geochemical sampling and analysis will be undertaken during the life of the Proposal and if the risk from acid rock drainage increases, an Acid Rock Drainage Management Plan for Yandicoogina will be prepared and implemented with endorsement of the relevant decision making authority.

13.3.8 Contamination of surface water from hydrocarbons

Site drainage will be designed to minimise or eliminate surface runoff into areas where activities with a potential risk of hydrocarbon contamination occur.

All areas where there is risk of hydrocarbon contamination will be contained and stormwater collected in these areas will be treated to remove hydrocarbons. These locations may include:

- Bulk fuel storage and handling.
- Heavy vehicle refuelling.

- Light vehicle refuelling.
- Bulk lubricant storage and handling.
- Heavy vehicle workshop.
- Light vehicle workshop.
- Fixed plant maintenance workshop.
- Heavy vehicle wash down.
- Light vehicle wash down.

Treated oily water will be discharged to local evaporation ponds. Treated water from the evaporation ponds may be used for dust suppression on roads within the Revised Proposal Development Envelope. Provision will be made in operating plans for periodic removal of sludge residue from the oily water separators to a licensed disposal facility.

The Proposal will comply with all relevant Australian Standards (e.g. Australian Standard 1940-2004) and statutory requirements (e.g. Operating Licence conditions) for the transport, handling and storage of hydrocarbons, ammonium nitrate and other chemicals required on-site for operations and maintenance purposes.

13.3.9 Post-mining hydrology and pit lakes

Discussion of the post-mining hydrology, including information regarding the two pit lakes that will be formed is addressed in Section 17.

13.4 Cumulative impacts

13.4.1 Cumulative impacts to Marillana and Weeli Wolli Creeks

A preliminary assessment of cumulative impacts to surface water hydrology in the Marillana-Weeli Wolli Creek system was conducted based on a review of the potential impacts of the Proposal, the existing Yandi Operations and six other projects identified as being potentially relevant based on their location in the Weeli Wolli Creek or Marillana Creek sub-catchments of the Upper Fortescue River Catchment (**Table 13**).

The average of existing discharge to the Marillana - Weeli Wolli Creek system is approximately 46 GL/y, with a peak of approximately 70 GL/y. Average discharge is expected to increase to approximately 97 GL/y and may reach a peak of approximately 140 GL/y. The Proposal (this assessment), is predicted to account for approximately 50 GL/y of discharge (approximately 35% of the total peak discharge), with the Revised Proposal modelled to reach a peak discharge of approximately 78 GL/y (approximately 54% of the total catchment peak discharge; **Table 13**).

Table 13: Assessment of potential cumulative impacts to surface water hydrology in the Marillana-Weeli Wolli Creek system

Project	Surface water discharge to the Marillana-Weeli Wolli Creek system	Reference
Past and present actions		
Hamersley HMS's Hope Downs 1 Iron Ore Mine Expansion (EP Act Assessment No. 1308)	Approximately 28 GL/y (up to 36 GL/y) existing discharge. Up to 40 GL/y future discharge. Groundwater abstraction and associated surface discharge of excess water commenced in 2007. Average discharge from 2007 to 2013 was approximately 28 GL/y, with a peak of approximately 36 GL/y. Future discharge is expected to increase to approximately 40 GL/y.	URS (2015)
Iron Ore Holdings Iron Valley Iron Ore Project (EP Act Assessment No. 1905; EPBC Act Ref. 2012/6458)	0 GL. The Iron Valley Iron Ore Project, as referred in 2012, did not include mining below the water table, nor dewatering for pit excavation and ore extraction (and therefore did not include surface discharge of excess dewater).	URS (2012)
BHP Jinidi Iron Ore Mine (EP Act Assessment No. 1904; EPBC Act Ref. 2012/6299)	0 GL existing discharge. 1 GL/y, potentially up to 7 GL/y future discharge. As referred in 2011, construction of the Jinidi Iron Ore Mine was proposed to commence in 2012; however, the proposal is yet to commence. The 2011 referral documentation stated that the proposal could potentially discharge the maximum mine dewatering volume of approximately 7 GL/y to one or more nominated creek locations during discrete periods; however, approximately 6 GL/y was expected to be used during operations for ore conditioning and dust management.	BHP (2011)
BHP Marillana Creek (Yandi) (EP Act Assessment No. 1555)	Approximately 7 GL/y (up to 13 GL/y) existing discharge. Up to 15 GL/y future discharge. Average discharge from 1997 to 2013 was approximately 7 GL/y, with a peak of approximately 13 GL/y. The licensed limit is for a discharge of 15 GL/y.	URS (2015)
BHP Mining Area C (EP Act Assessment No. 1108)	0 GL. The Mining Area C Project, as documented in 1997, did not include mining below the water table, nor dewatering for pit excavation and ore extraction (and therefore did not include surface discharge of excess dewater).	Woodward-Clyde (1997)
Mineral Resources Phil's Creek Iron Ore Mine (EPBC Act Ref. 2009/5107)	0 GL. The Phil's Creek Iron Ore Mine, as referred in 2009, did not include mining below the water table, nor dewatering for pit excavation and ore extraction (and therefore did not include surface discharge of excess dewater).	URS (2009)

Project	Surface water discharge to the Marillana-Weeli Wolli Creek system	Reference
Rio Tinto Yandicoogina Iron Ore Project, comprising: • Junction Central (EP Act Assessment No. 809 & 946) • Junction South East (EP Act Assessment No. 1590) • Junction South West and Oxbow (EP Act Assessment No. 1726; EPBC Act Ref. 2011/5815)	Approximately 11 GL/y (up to 25 GL/y) existing discharge. Average discharge from 1998 to 2013 was approximately 11 GL/y, with a peak of approximately 25 GL/y. The expected future discharge from the Yandicoogina Iron Ore Project (as approved under MS914), is up to 47 GL/y.	URS (2015)
Anticipated project actions		
Rio Tinto Yandi PBS Proposal (this assessment)	The forecast discharge is approximately 50 GL/y from the Proposal. The Revised Proposal will include a combined cumulative peak discharge of up to 78 GL/y and average of approximately 61 GL/y (which includes recycling of discharge from upstream operations).	URS (2015)
Reasonably foreseeable future actions		
NA – none located in the Weeli Wolli Creek or Marillana Creek sub-catchments		
Cumulative impact		
All projects	Existing discharge 46 GL/y (average) up to 70 GL/y (peak). Future discharge 97 GL/y (average/standard) up to 140 GL/y (peak).	As above

13.5 Key management actions

Surface and groundwater values in the Revised Proposal Development Envelope will be protected through implementation of measures set out in the Yandi MMP (**Appendix 4**); the Yandicoogina Groundwater Operating Strategy (GWOS); the E11 Standard: Water Quality Protection and Water Management; the E13 Standard: Chemically Reactive Mineral Waste Control; the E15 Standard: Hazardous Materials and Non-Mineral Waste Control and Minimisation; the Yandicoogina Closure Plan; and existing DoW and DER licence conditions. Key measures include:

- Establishing baseline surface water quality for the local catchment, including the development of site specific trigger values (**SSTV**s) in accordance with ANZECC guidelines. This has also included a hazard analysis to focus on key analytes of concern for the local ecosystem.
- Monitoring of surface water quality at discharge outlets, at upstream inputs of surface water discharge and downstream pools 'mixing zones' to enable a comprehensive understanding of any changes to water chemistry as a result of upstream operations discharges, Revised Proposal discharge, and cumulative downstream water chemistry.
- Monitoring the surface water discharge wetting extent on a monthly basis to ensure that the discharge footprint remains within a 17 km limit from the Marillana – Weeli Wolli confluence.

- Monitoring of aquifer groundwater levels and groundwater quality on a monthly basis via a network of monitoring bores to ensure pH, TDS and hydrocarbons are within acceptable limits.
- The borefield design is optimised and informed by numerical groundwater modelling, field test pumping programs, and the existing monitoring bore network.
- Contaminants such as hydrocarbons are managed via appropriate storage and containment facilities (eg. secondary containment such as bunding); and leak detection systems installed for any below ground storage. Hydrocarbon treatment facilities are used at wash down and workshop areas to minimise potential release into the environment.
- Non-mineral waste is disposed of in engineered, controlled and approved facilities.

13.5.1 Status of existing Yandi Operations management

The ESD prepared by the EPA required provision of information on:

- The current status and outcomes of surface water discharge management actions required by MS 914 Condition 6 – Surface water discharge (Weeli Wolli Creek).
- The effectiveness of the current water management scheme and provide a comparison of its actual operation versus what was predicted including discussion of accuracy. Also detail any problems with how the system has operated and what management measures have been taken when it is not operating as expected.
- Surface water and groundwater quality collected from the existing mining operation at the site. Identifying any adverse changes caused by the mining operation and outlining avoidance, minimisation and management methods to be used to prevent further impacts.

This information is provided in the following sections.

13.5.1.1 Current status and outcomes of MS 914 Condition 6

Condition 6 requires that the Proponent ensures discharge of excess water from the existing Yandi Operations does not cause long term impacts to environmental values of the Weeli Wolli Creek system, and that it does not cause water flow or pooling further than 17 km downstream from the Marillana Creek and Weeli Wolli Creek system confluence.

Surface expression of discharge is managed through implementation of the Yandi MMP. Surface water discharge modelling predicted that the discharge wetting footprint for the Revised Proposal would have a maximum perennial surface expression up to 17 km downstream from the confluence of Marillana and Weeli Wolli Creeks, assuming that Hope Downs 1 and BHP Yandi Operations are discharging at their full licensed capacity.

Ongoing monitoring indicates that since implementing JSW in 2013, the wetting footprint has ranged between 4 and 10 km downstream from the confluence. Historical measurements of the wetting footprint since 2010 has ranged between 5 and 9 km from the confluence, so the current risk of extending beyond the predicted wetting footprint is deemed low. This is also supported by more recent hydrogeological studies.

The dewatering infrastructure network includes six active discharge outlets, and accommodates an adaptive approach to discharge management. Riparian vegetation condition is monitored concurrently with discharge, taking into account the relationship between vegetation health and water availability. Monitoring results inform the discharge management regime, and discharge volume is adjusted at individual outlets where it is deemed appropriate to support the riparian communities. This adaptive functionality is also taken into consideration in the planning and design phase of new dewatering infrastructure, to maintain capacity to respond to monitoring results throughout the life of mine, as outlined in the management actions of the Yandi MMP.

13.5.1.2 Effectiveness of current water management scheme

Hydrogeological conceptualisation for the Revised Proposal has been refined through numerous investigations, with aquifer geometry, hydraulic properties, response to dewatering stress and groundwater / surface water interactions and is well understood. This detailed level of hydrogeological understanding has allowed for development of appropriate dewatering strategies over time to allow mining of the below water table component of the CID deposit.

The dewatering requirements are reviewed annually to determine if the planned mining progression can be achieved with current dewatering infrastructure. A numerical groundwater model is used to predict temporal and spatial variations in groundwater levels for the period of the mine plan and dewatering targets for each bore and borefield are developed and updated regularly and are set against current mine (medium term plan and Life of Mine) and abstraction licence volumes.

For input into the groundwater model and for reporting purposes, monthly water level data gathered from observation bores across the site is analysed against historical data, taking into account seasonal trends. Water levels generally rise and fall due to seasonal activity and water levels in some monitoring bores can vary significantly due to adjacent operational pump activity, which itself varies over time.

Review of historical abstraction performance shows that actual abstraction was between 90-100% of modelled volumes from 2010 to 2012, decreasing to approximately 70-75% of model target volumes in during 2013 and 2014. These dewatering volumes are lower again from the Groundwater Licence volume allocation which allow for a conservative buffer between the modelled volumes and the licence limit. Therefore the actual volume of dewatering at Yandi Operation has been up to 30% less than the licensed limit. This divergence of actual from modelled volumes has been attributed to: periodical mining disruptions; delay in fit-out of bores during 2013; achievable rates from installed bores being less than model-assumed rates; and engineering design matters resulting in non-continuous bore pumping (i.e. oversized pumps and electrical faults).

To date, the mine plan has not been affected by the lower than expected (modelled) abstraction rates.

The effectiveness of the existing re-injection scheme in the vicinity of Billiard South has been limited with the system never reaching full capacity as designed. The maximum re-injection reached was 6.0 GL/y, with an average re-injection rate of around 3.4 GL/y. The limiting factors being attributable to clogging of the bores from iron-reducing bacteria; suitability of localised geology at individual bores to receive large volumes of water; and location of the re-injection scheme within an aquifer receiving discharge from upstream operations, which has been effectively “filling up” the aquifer, limiting available storage to receive re-injection water. The re-injection scheme was subsequently decommissioned in mid 2014.

13.5.1.3 Review of surface and groundwater quality

Surface water quality is managed in alignment with ANZECC/ARMCANZ (2000) guidelines, to protect the environmental values of Weeli Wolli Creek listed in the Environmental Values Statement. Water quality is monitored at each active discharge outlet, and in the surface waters of Marillana and Weeli Wolli Creeks, upstream and downstream from operational discharge. A conservative approach has been adopted by establishing baseline water quality conditions in Marillana and Weeli Wolli Creeks individually, and selecting the 80th percentile of the baseline range as outlined in the ANZECC/ARMCANZ guidelines, as a trigger to investigate water quality trends downstream from discharge outlets. Investigation includes water quality trends within the catchment up to the furthest extent of the wetting footprint, and reviewing the potential impacts of water quality on aquatic fauna.

A specialist consultancy (Wetland Research and Management) has been engaged to complete extensive studies on aquatic fauna, and provide annual wet and dry season monitoring and reports to validate the impacts of discharge water quality to the surrounding catchment.

Complementary to the aquatic fauna program, a hazard analysis was completed for operational discharge into Marillana and Weeli Wolli Creeks. The hazard analysis took into consideration baseline information on aquatic fauna monitoring along with the Environmental Values Statement, and provided a risk ranking for individual analytes naturally occurring in the groundwater being discharged. Stress from nitrates and carbonate were identified as the most notable risks, as they can support processes which lead to eutrophication and creek bed 'armouring' as a result of deposition of precipitate, which has the potential to remove suitable habitat for aquatic fauna. Toxicity from a range of analytes was acknowledged as posing a lower risk to the catchment.

Ongoing monitoring and analysis of both water quality and aquatic fauna has improved the understanding of aquatic ecology within the lower Weeli Wolli Creek catchment. The 2014 Annual Compliance Assessment Report (required by condition 4-6 of MS 914) details the results of water quality monitoring, including each individual water quality result which exceeded the 80th percentile trigger value. The 80^{th} percentile trigger value was exceeded at least once during the reporting period for hardness, alkalinity, bicarbonate alkalinity, electrical conductivity, total suspended solids, total dissolved solids, barium, boron, calcium, chloride, magnesium, nitrate, total nitrogen, total phosphorus, potassium, sodium, sulphate, sulphur, and uranium. These exceedances have triggered the "focus" and "investigate" actions (including resampling to check for potential sampling issues such as cross contamination during the sampling process). The occurrence of exceedances is not unexpected given the triggers have been established using a conservative 80^{th} percentile value to ensure that any management response (if necessary) can be implemented sufficiently soon to ensure environmental impacts are minimised. To date, no management or control actions in response to water quality exceedances have been necessary.

Field observations, which included localised variation in aquatic fauna assemblages and habitat both upstream and downstream of operational discharge, indicate that the existing Yandi Operations discharge is not causing long term impacts to the values of Weeli Wolli Creek. Taxa richness of microinvertebrates, macroinvertebrates, hyporheic invertebrates and fish does not appear to be adversely impacted by water quality, indicating that eutrophication and creek bed ‘armouring’ risks are currently low. Algal growth, nitrate concentrations and nutrient cycling remain key components of ongoing monitoring, and a continually developing understanding of the relationships between these components at a local scale will ensure that the correct approach is taken to evaluate ecosystem health.

13.6 Predicted outcome

A range of measures have been or will be implemented to reduce potential impacts to the environmental values of hydrological processes and inland waters environmental quality (**Table 14**).

Table 14: Mitigation hierarchy for hydrological processes and inland waters environmental quality values

Mitigation measure	Description
Avoidance	Direct disturbance to Weeli Wolli Creek will largely be avoided and low-flow lines will be maintained. Impacts to the Fortescue Marsh are predicted to be avoided. No impacts from acid mine drainage are expected due to the low risk presented by the geochemistry of the waste rock and pit wall material.
Minimisation	Infrastructure in Weeli Wolli Creek designed to avoid disruption of low-flow line and flood flows. Discharge would occur from existing approved locations. The surface water wetting front is predicted to remain within existing approved limits.
Rehabilitation	Disturbed areas will be rehabilitated consistent with the Yandicoogina Closure Plan. Key functional creek elements retained (e.g. flood pathways, vegetation seed bank) to support natural rehabilitation upon closure.

After the mitigation hierarchy has been applied, it is expected that the Proposal will result in the following residual outcomes in relation to hydrological processes and inland waters environmental quality:

- **Natural surface water systems and flows** – potential impacts likely to be minor and can be managed through typical stormwater management measures such as levees around the pit, diversion drains around waste dumps, and culverts under roads.
- **Surface water resources including Weeli Wolli Creek due to surface discharge of surplus mine dewater** – wetting front will be within existing approved limits, and therefore there will be negligible additional impacts on the downstream hydrological system of Weeli Wolli Creek.
- **Altered flow regime to the Fortescue Marsh** – surface water wetting front associated with the additional discharge from the Proposal is predicted to remain within existing approved limits of MS 914.
- **Potential contamination of surface water and groundwater** – acid rock drainage at the Revised Proposal has been assessed as low due to the geology. Site drainage will be designed to minimise or eliminate surface runoff into areas where activities with a potential risk of hydrocarbon contamination occur. Management of waste dumps will ensure that risks of contamination of surface and groundwater are minimised.

With the exception of the development of pit lakes upon closure (which are addressed further in Section 17), the above residual outcomes are potential environmental impacts that may occur during the mine life and are not predicted to result in long term or significant changes for hydrological processes and inland water quality.

14. Flora and vegetation

14.1 Key statutory requirements, environmental policy and guidance

14.1.1 EPA objective

The EPA has applied the following objective for the Proposal to its assessment of flora and vegetation:

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

14.1.2 Regulatory framework

The following legislation is relevant to the Proposal with respect to the protection of flora and vegetation values and the above EPA objective:

- *Wildlife Conservation Act 1950* (WA) and associated Wildlife Conservation (Rare Flora) Notice 2014.
- *Conservation and Land Management Act 1984* (WA).
- *Environmental Protection Act 1986* (WA) and associated Native Vegetation Regulations 2004.
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).

14.1.3 Relevant guidelines and policy

The following guidelines are relevant to the Proposal with respect to the protection of flora and vegetation values and the above EPA objective:

- EPA Position Statement No. 2: Environmental Protection of Native Vegetation in Western Australia (EPA 2000).
- EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002).
- EPA Position Statement No. 7: Principles of Environmental Protection (EPA 2004a).
- EPA Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004c).

14.2 Description of factor

14.2.1 Flora and vegetation surveys

Biota conducted a number of flora and vegetation surveys within the Proposal Area and in the wider Yandicoogina locality (Biota 2014a, Biota 2015a). A consolidated list of all flora and vegetation surveys completed to date is provided in **Table 15**. In March and July of 2014 Biota conducted seasonal surveys of the Proposal Area (Biota 2014a).

A total of 121 quadrats and 28 relevés have been sampled in the study area to date, with 46 quadrats and eight relevés established during Phase 1 of the most recent survey, and three additional quadrats established during Phase 2. In total, 68 quadrats have been sampled twice within the Proposal Area, including quadrats sampled prior to this survey (**Table 16**; **Figure 43**).

In addition to the Biota vegetation mapping, a Rio Tinto botanist further refined the mapping within major creeklines and tributaries and identified 12 additional riparian associations (**Table 16**; Rio Tinto 2015a).

Limitations of the flora and vegetation surveys primarily constituted the following factors:

- While targeted searches for conservation significant flora were undertaken and opportunistic taxa were recorded during representative traverses through all habitats in the study area, the entire study area was not systematically searched. The list of vascular flora documented from the study area is therefore not exhaustive.
- The Phase 1 survey was undertaken in March 2014 and was optimally timed for the collection of annual flora. The Phase 2 survey was undertaken in July, which is typically a dry time of year in the Pilbara, however, above average rainfall was received prior to this survey. Given the favourable rainfall conditions, most species should have been present during the field surveys, however, it is possible that some annual fire ephemeral or cryptic perennial species would have been absent during the Phase 2 survey due to the seasonal timing.
- Consistent with the accepted level of effort for a survey of this type and scale, fungi and nonvascular flora (algae, mosses and liverworts) were not sampled.
- One Hills, Ridges and Breakaways vegetation type (H5) was described from relevés rather than quadrats. Quadrats could not be established in this vegetation type due to the narrow dimensions of the habitat and the steep, rocky terrain.
- Areas already cleared for drilling and associated activities were not surveyed.

Table 15: Flora and vegetation survey effort within the wider Yandicoogina locality

Study (Reference)	**Area Surveyed Within Study Area (Total Area of Survey)**	**Survey Description** **Survey Timing (Conditions for Plant Growth)**
Yandi Billiards – Phase 1 and Phase 2 (Yandi PBS; Biota 2014a)	8,640 ha (8,640 ha)	Two phase (seasonal) vegetation and flora survey of the PBS survey area to expand the existing data for the area to a Level 2 standard. 8 – 20 March 2014 (favourable); 7 – 11 July 2014 and 14 July 2014 (favourable)
Yandi Junction South West (JSW)/Oxbow (YOX) Vegetation and Flora Integration Report (Biota 2014b cited in Biota 2015a)	2,133 ha (2,192 ha)	Integration of existing data with a further botanical survey to provide additional information on the values associated with the JSW and YOX survey areas. 27 February – 4 March 2012 (favourable)
Yandi Additional Areas (Biota 2014c cited in Biota 2015a)	2,807 ha (2,828 ha)	Establish additional quadrats to validate vegetation mapping of additional areas around the JSW and YOX deposits to match the project footprint. 12 – 18 June 2012 (favourable)
Yandicoogina Additional Vegetation Mapping (Biota 2011a cited in Biota 2015a)	2,806 ha (3,030 ha)	Mapping of additional areas around the JSW and YOX deposits to match the project footprint. 29 November – 3 December 2010

Study (Reference)	Area Surveyed Within Study Area (Total Area of Survey)	Survey Description Survey Timing (Conditions for Plant Growth)
		(unfavourable)
Vegetation and Flora Surveys of the Oxbow and Junction South West Deposits, near Yandicoogina (Biota 2010a cited in Biota 2015a)	YOX: 665 ha (725 ha) JSW: 1,460 ha (1,460 ha)	Two phase (seasonal) vegetation and flora survey of the JSW and YOX survey areas. YOX: 27 July-6 August 2008 (unfavourable); 3-9 June 2009 (favourable). JSW: 4 – 16 June 2007 (unfavourable); 27 July – 6 August 2008 (unfavourable); 3 – 9 June 2009 (favourable)
A Flora and Vegetation Survey of the Billiards Deposit, near Yandi (Biota 2009a cited in Biota 2015a)	1,512 ha (1,512 ha)	Two phase (seasonal) vegetation and flora survey of the Billiards survey area. 11 – 20 June 2007 (unfavourable); 27 July – 6 August 2008 (unfavourable); 3 – 9 June 2009 (favourable)
Yandicoogina Waste Dumps, Topsoil Stockpiles and Haulroads Native Vegetation Clearing Permit Report (Biota 2009b cited in Biota 2015a)	406 ha (406 ha)	Single phase vegetation and flora survey of four development areas to support a Native Vegetation Clearing Permit. 4 – 7 September 2008 (unfavourable)
Vegetation Mapping and Rare Flora Searches of Yandi Backfill Hill (Biota 2005 cited in Biota 2015a)	189 ha (189 ha)	Vegetation mapping and systematic Rare Flora searches of the Yandi Backfill Hill survey area. 31 May – 2 June 2005 (unfavourable)
Yandi Expansion Vegetation and Flora Survey (Biota 2004a cited in Biota 2015a)	2,245 ha (2,245 ha)	Single phase vegetation and flora survey of the Yandi Expansion area, near the YJC deposit. 30 August – 5 September 2004 (unfavourable)
Flora and Vegetation Survey of the Hope Downs Rail Corridor Extension through the Hamersley Range (Biota 2004b cited in Biota 2015a)	1,492 ha (3,977 ha)	Single phase vegetation and flora survey of the Hope Downs Rail Corridor Extension through the Hamersley Range. April 2003 (favourable)
Vegetation and Flora of the Hope Downs Rail Corridor from Port Hedland to Weeli Wolli Creek (Biota 2002 cited in Biota 2015a)	805 ha (2,774 ha)	Single phase vegetation and flora survey of the Hope Downs Rail Corridor from Port Hedland to Weeli Wolli. 25 April – 14 May 2001 (favourable) 29 May – 10 June 2001 (favourable)
Hope Downs Rail Corridors Biological Surveys (Halpern Glick Maunsell 2000a cited in Biota 2015a)	2,594 ha (16,420 ha)	Single phase vegetation and flora survey of the Hope Downs Rail Corridors. 25 November – 3 December 1999 (unfavourable)
Flora and Vegetation: Yandicoogina Junction Area (Mattiske 1995a cited in Biota 2015a)	3,591 ha (3,745 ha)	Single phase vegetation and flora survey of the YJC survey area. January and March 1994 (unknown) February 1995 (unknown)
Flora and Vegetation: Northern Transport Corridor, Yandicoogina Junction Project Area (Mattiske 1995b cited in Biota 2015a)	3,035 ha (24,703 ha)	Single phase vegetation and flora survey of the Yandi Northern Transport Corridor. February 1995 (unknown)
Flora and Vegetation: Southern Transport Corridor, Yandicoogina	2,450 ha (30,103 ha)	Single phase vegetation and flora survey of the Southern Transport

Study (Reference)	Area Surveyed Within Study Area (Total Area of Survey)	Survey Description Survey Timing (Conditions for Plant Growth)
Junction Project Area (Mattiske 1995c cited in Biota 2015a)		Corridor. January and March 1994 (unknown) February 1995 (unknown)
Ecological appraisal of the Yandicoogina Project Area (Integrated Environmental Services 1981)	25,000 ha	Single phase Flora, fauna and vegetation survey of the area in favourable conditions

Table 16: Flora and vegetation survey effort within the Proposal Area

Survey	Timing	Methodology
Riparian vegetation of Marillana and Weeli Wolli Creeks: Mapping refinement and assessment of values and significance (Rio Tinto 2015a)	April 2015	Desktop and mapping traverses
Yandi PBS flora and vegetation survey (Phase 2; Biota 2014a)	July 2014	Three new quadrats established and 30 quadrats resampled
Yandi PBS flora and vegetation survey (Phase 1; Biota 2014b)	March 2014	46 quadrats established, 32 quadrats resampled and eight relevés recorded
Yandi additional areas Level 2 flora and vegetation survey (Biota 2014c cited in Biota 2015a)	June 2012	11 quadrats and five relevés established
Vegetation and flora survey of the Billiards deposit, near Yandi (Biota, 2009a cited in Biota 2015a)	June 2007	29 quadrats and 14 relevés established
	July/August 2008	Seven new quadrats established and 11 quadrats resampled
	June 2009	Six quadrats resampled
Flora and Vegetation Survey of the Yandi Expansion Area (Biota 2004a cited in Biota 2015a)	Aug/Sept 2004	13 quadrats and one relevés established
Flora and Vegetation Survey of the Hope Downs Rail Corridor Extension through the Hamersley Range (Biota 2004b cited in Biota 2015a)	April 2003	Nine quadrats established
Vegetation and Flora of the Hope Downs Rail Corridor from Port Hedland to Weeli Wolli Creek (Biota 2002 cited in Biota 2015a)	April/May 2001	Two quadrats established
Hope Downs rail Corridor Biological Surveys (Halpern Glick Maunsell 2000a cited in Biota 2015a)	Nov/December 1999	One quadrat established

14.2.2 Vegetation

14.2.2.1 Vegetation communities present in the Proposal Area

The Proposal lies within the Fortescue Botanical District of the Eremaean Botanical Province as defined by Beard (1975a, 1975b). The Proposal intersects two of the vegetation units defined by Beard (1975a, 1975b), both of which have the majority of their pre-European extent remaining (Table 17).

Table 17: Beard's (1975b) mapping units that occur in the study area and their extent in the Pilbara bioregion

Beard's vegetation mapping unit	Current extent in the Hamersley/Fortescue subregion (ha) (% remaining)	Extent within the study area (% of the current mapped extent)
Fortescue Valley 29	893,222 (>99.9%)	2,586 (0.3%)
Hamersley 82	2,165,235 (99.4%)	1,909 (0.1%)

Source: Government of Western Australia (2013b)

Biota (2014a) mapped and described 23 vegetation sub-associations ('vegetation units') within the Proposal Area (**Figure 44** to **Figure 47**). A full list of the Biota (2014a) mapping units are provided in **Appendix 3**. The Biota (2014a) vegetation units have been grouped according to the major landform with which they are associated. In addition to the Biota vegetation mapping, a Rio Tinto botanist further refined the mapping within the riparian zones in Marillana and Weeli Wolli Creeks. Biota's original C1-C5 units were further differentiated and a total of 13 riparian sub-associations throughout the greater Yandicoogina area (**Appendix 3**). The vegetation units shown in **Figure 44** to **Figure 47** are the Biota mapping units, the refined riparian vegetation mapping is shown in **Figure 48** to **Figure 52**. Refer to Appendix 3 for full descriptions of all refined riparian vegetation units (Rio Tinto 2015a).

Vegetation of Major Creeklines and Tributaries

Of Biota's five original riparian units, four (C1-C4) were mapped within the Proposal Area. Further refinement of these units by Rio Tinto (2015a) identified 13 sub-associations of which 10 occurred in the Proposal Area. These units were characterised by the presence of *Eucalyptus camaldulensis* and *E. victrix* and to a lesser extent *Melaleuca argentea*. All of these units are associated with the "all major ephemeral water courses" ecosystem at risk listed by Kendrick (2003a, 2003b).

The major creekline vegetation units comprised 18% of the Proposal Area.

Vegetation of Minor Creeklines, Floodplains and Valleys

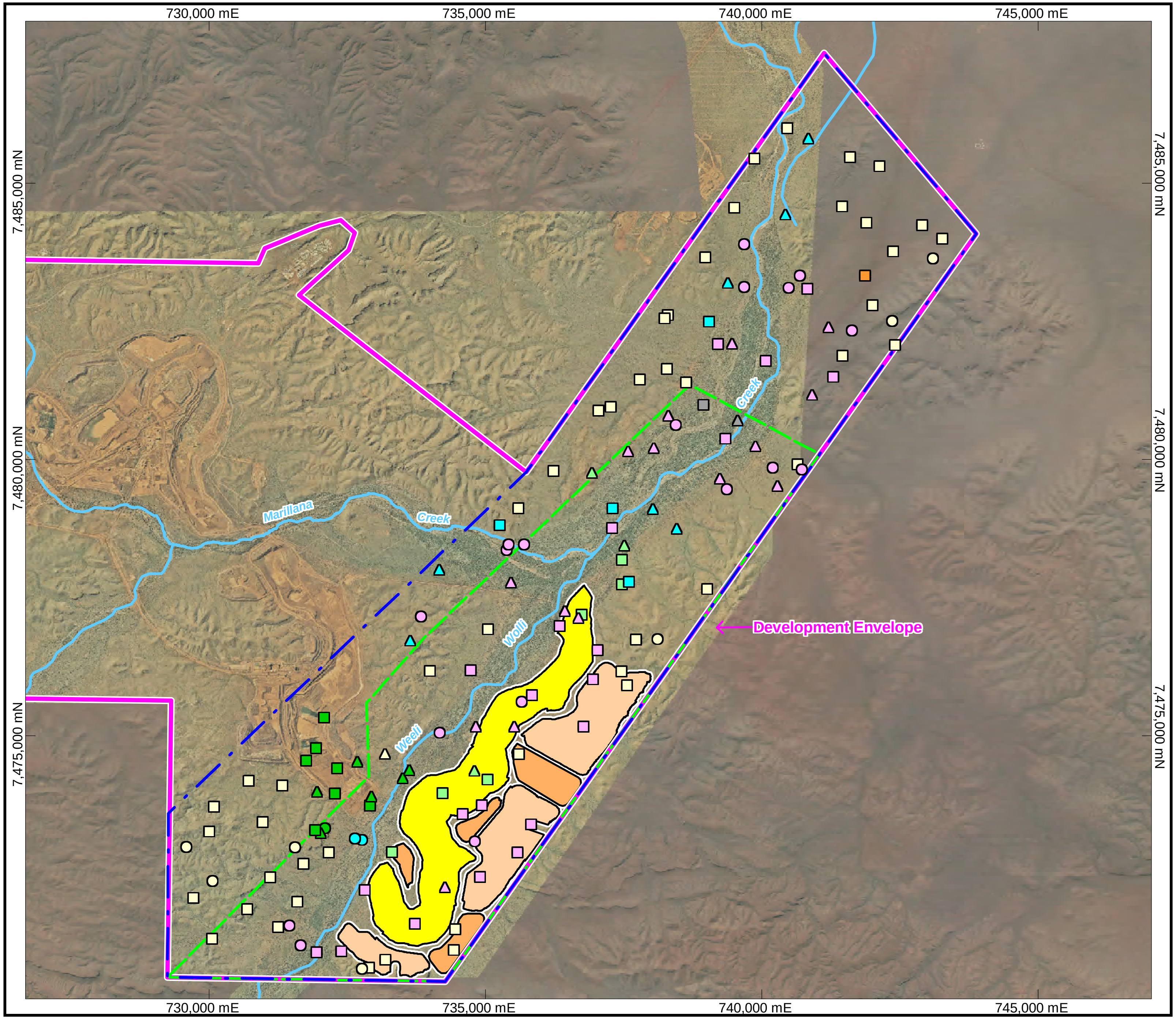
Five vegetation units (F1-F5) have been mapped in minor drainage lines, floodplains and valleys. The minor creekline, floodplain and tributaries vegetation units comprised 8% of the Proposal Area.

Vegetation of Hills, Ridges and Breakaways

Five vegetation units (H1-H5) have been mapped associated with hills, ridges and breakaways. These units comprised 28% of the Proposal Area and supported the recorded populations of the Threatened *Lepidium catapycnon*.

Vegetation of Plains

Eight vegetation units (P1-P8) have been mapped associated with plains. The Priority 4 *Goodenia nuda* is associated with claypans of the Plains units. Plains vegetation units comprised 46% of the Proposal Area.



LEGEND

- Development Envelope
- Proposal Area
- Biota 2014a Study Area
- Conceptual Mine Pit
- Conceptual Waste Dump
- Conceptual Topsoil / Subsoil Stockpile

Flora Sampling Sites

Site Type

- Quadrat
- Quadrat (Resampled)
- Releve

Study

- Biota (Current Study)
- Biota (2014b)
- Biota (2009b)
- Biota (2004a)
- Biota (2004b)
- Biota 2002
- Halpern Glick Maunsell (2000)

N

SCALE

0 1 2 3 4 5km

1:100 000 @ A4

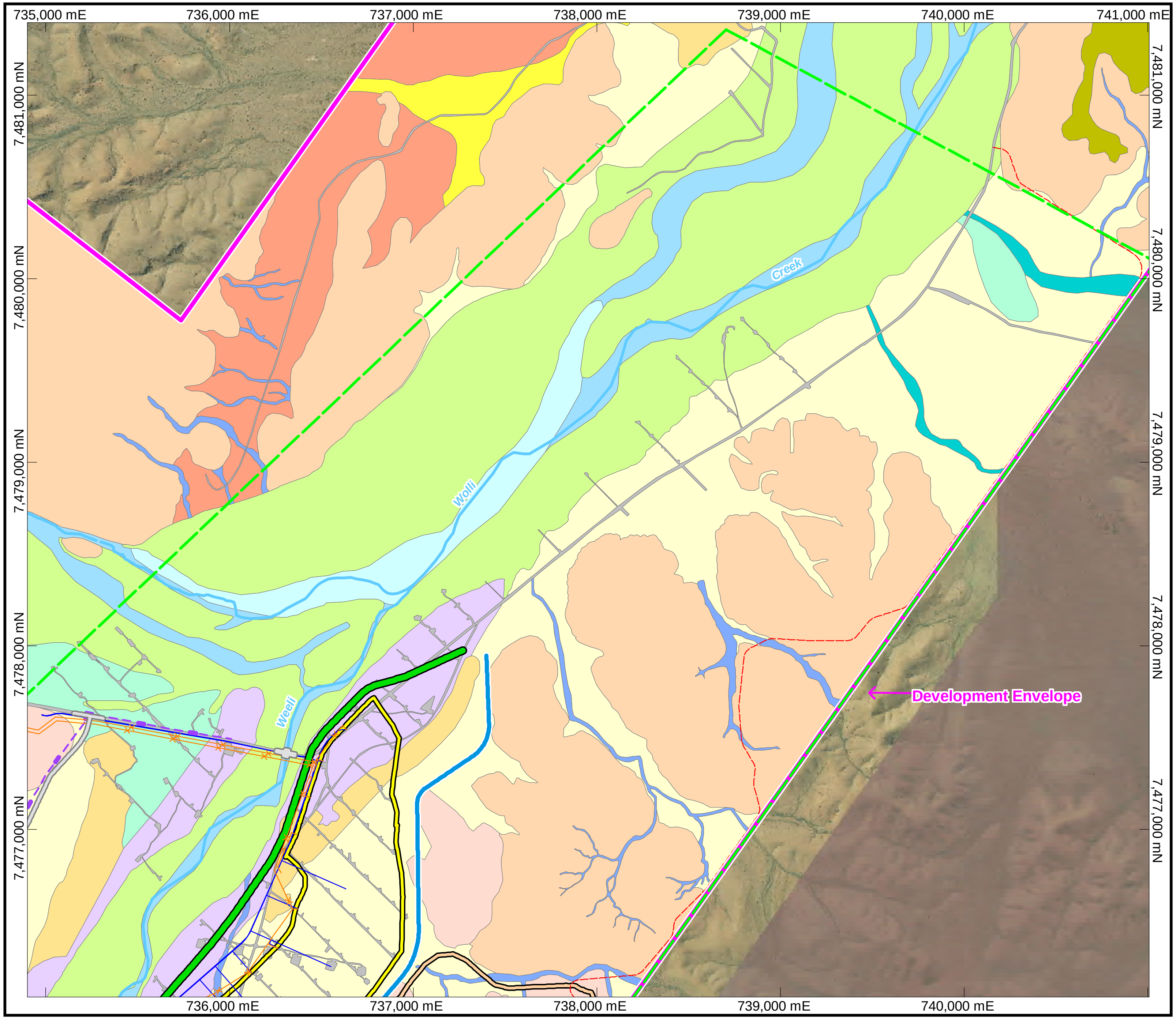
Rio Tinto

Iron Ore (WA)

Figure 43
Flora and vegetation sampling locations in the Proposal Area

Drawn: M.Swebbs Plan No: PDE0131880v2
Date: October, 2015 Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

Development Envelope
Proposal Area
Major Watercourse

Conceptual Mine Layout

Mine Pit
Waste Dump
Levee
HV & LV Road
Diversion Drain
Dewatering Pipeline
33kV Powerline
Fibre Optic Cable
Bypass Track

N

SCALE

0 0.5 1 1.5km

1:30 000 @ A4

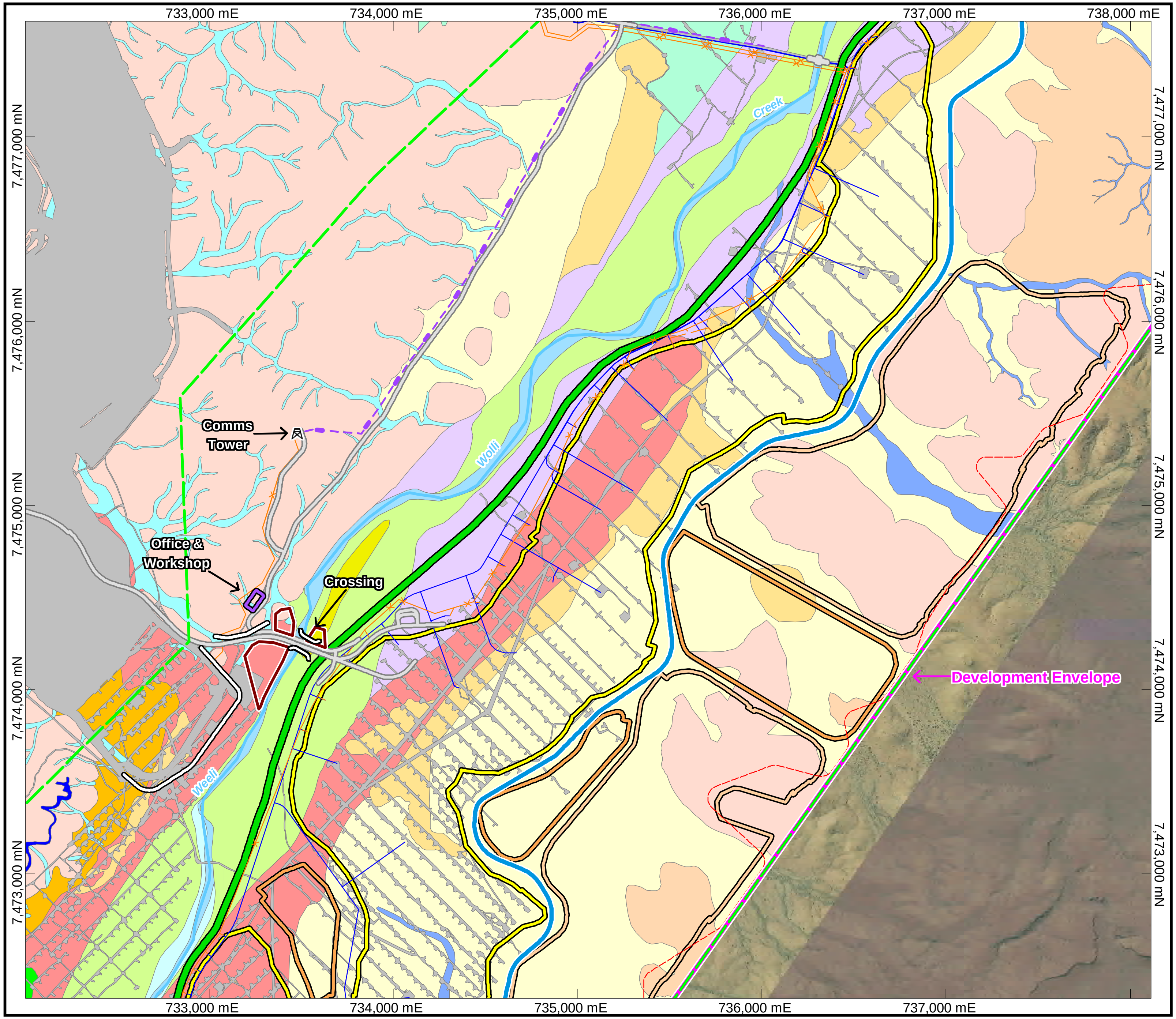
Rio Tinto

Iron Ore (WA)

Figure 44
Vegetation units in the Proposal Area (Map 1)

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0131793v3
Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

- Development Envelope
- Proposal Area
- Major Watercourse

Conceptual Mine Layout

- Mine Pit
- Waste Dump
- Topsoil / Subsoil Stockpile
- Office & Workshop
- Crossing Drainage Management
- Levee
- Pillar Levee
- HV & LV Road
- Diversion Drain
- Dewatering Pipeline
- 33kV Powerline
- Fibre Optic Cable
- Bypass Track

N

SCALE

0 0.5 1 1.5km

1:30 000 @ A4

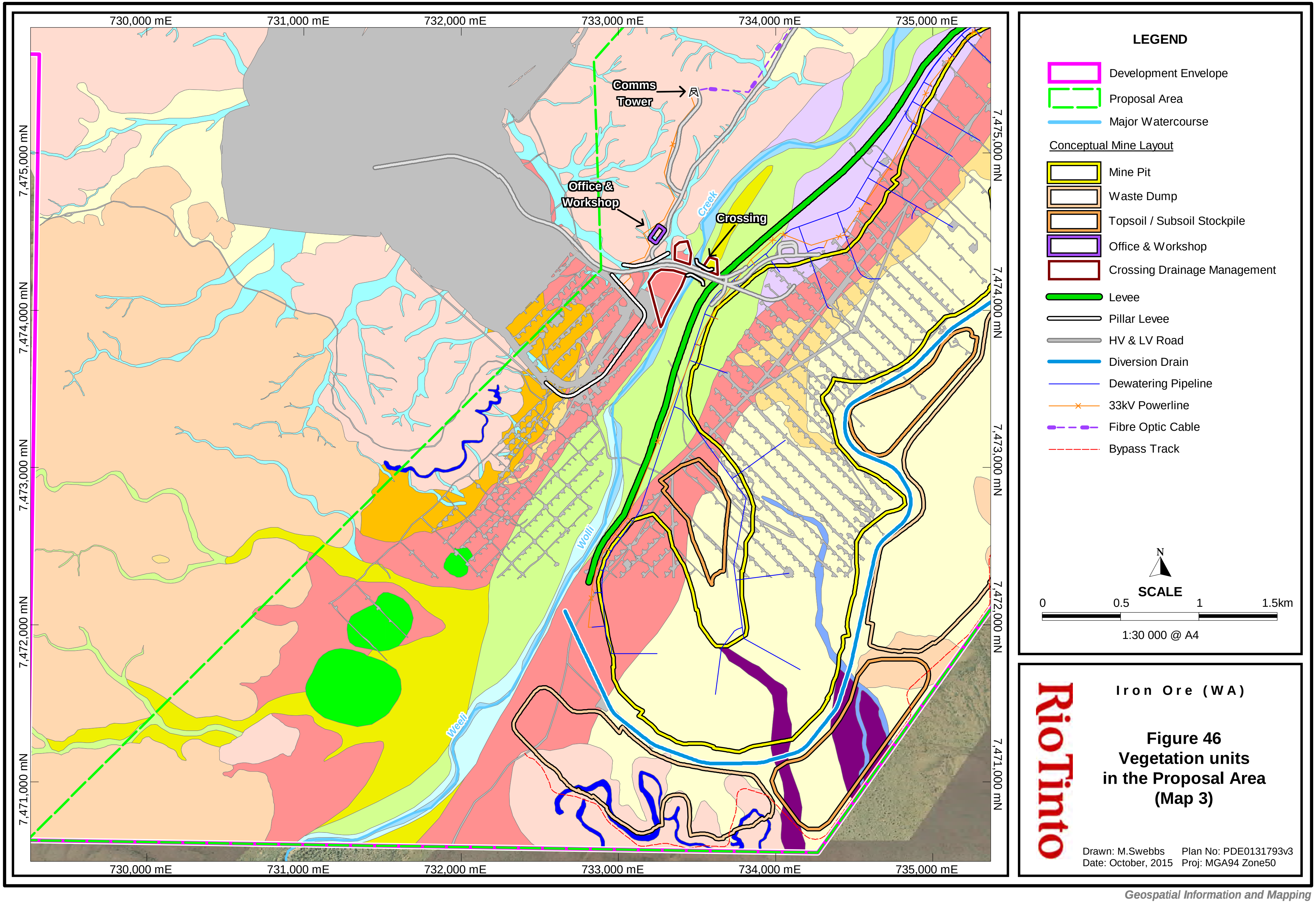
RioTinto

Iron Ore (WA)

Figure 45
Vegetation units in the Proposal Area (Map 2)

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0131793v3
Proj: MGA94 Zone50

Geospatial Information and Mapping



730,000 mE
731,000 mE
732,000 mE
733,000 mE
734,000 mE
735,000 mE
7,475,000 mN
7,474,000 mN
7,473,000 mN
7,472,000 mN
7,471,000 mN
Comms Tower
Office & Workshop
Crossing
Creek
Wolli
Weeli
LEGEND
Development Envelope
Proposal Area
Major Watercourse
Conceptual Mine Layout
Mine Pit
Waste Dump
Topsoil / Subsoil Stockpile
Office & Workshop
Crossing Drainage Management
Levee
Pillar Levee
HV & LV Road
Diversion Drain
Dewatering Pipeline
33kV Powerline
Fibre Optic Cable
Bypass Track
N
SCALE
0 0.5 1 1.5km
1:30 000 @ A4
RioTinto
Iron Ore (WA)
Figure 46
Vegetation units
in the Proposal Area
(Map 3)
Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0131793v3
Proj: MGA94 Zone50
Geospatial Information and Mapping

Figure 47 - Vegetation units in the Proposal Area

Vegetation of Major Creeklines and Tributaries

C1: EcEvMaMgAc
Eucalyptus camaldulensis subsp. refulgens, E. victrix woodland over Melaleuca argentea, M. glomerata, Acacia coriacea subsp. pendens low open woodland

C2: EvChAtuGwTErCYpERltTHt
Eucalyptus victrix, (Corymbia hamersleyana) scattered low trees over Acacia tumida var. pilbarensis, Grevillea wickhamii tall shrubland over Tephrosia rosea var. Fortescue Creeks (M.I.H. Brooker 2186) low shrubland over Cymbopogon ambiguus, C. procerus Eriachne tenuiculmis, Themeda triandra very open tussock grassland

C3: EvAciAcMgCEc
Eucalyptus victrix scattered trees over Acacia citrinoviridis, A. coriacea subsp. pendens, Melaleuca glomerata tall open shrubland over *Cenchrus ciliaris scattered tussock grasses

C4: EvAciAprAThCEc
Eucalyptus victrix open woodland over Acacia citrinoviridis, A. pruinocarpa, Atalaya hemiglauca low woodland over *Cenchrus ciliaris tussock grassland

Vegetation of Minor Creeklines, Floodplains and Valleys

F1: ChAtuGwTp
Corymbia hamersleyana scattered low trees to low open woodland over Acacia tumida var. pilbarensis, Grevillea wickhamii tall open shrubland over Triodia pungens hummock grassland

F2: AprAciCEc
Acacia pruinocarpa, A. citrinoviridis tall open shrubland over *Cenchrus ciliaris tussock grassland

F3: ElChAtuAaAbGwTspp
Eucalyptus leucophloia, Corymbia hamersleyana low open woodland over Acacia tumida var. pilbarensis, A. ancistrocarpa, A. bivenosa, Grevillea wickhamii tall open scrub over mixed Triodia hummock grassland

F5: ChAciAaAiSENsppTp
Corymbia hamersleyana scattered low trees over Acacia citrinoviridis, A. ancistrocarpa, A. inaequilatera tall open shrubland over Senna spp. open shrubland over Triodia pungens open hummock grassland.

Vegetation of Hills, Ridges and Breakaways

H1: ElHcAiGwTsps
Eucalyptus leucophloia subsp. leucophloia scattered low trees over Hakea chordophylla, Acacia inaequilatera, Grevillea wickhamii tall open shrubland over Triodia sp. Shovelanna Hill (S. van Leeuwen 3835) hummock grassland

H2: ElAiTwTsps
Eucalyptus leucophloia subsp. leucophloia scattered low trees over Acacia inaequilatera scattered tall shrubs over Triodia wiseana, (T. sp. Shovelanna Hill (S. van Leeuwen 3835)) open hummock grassland

H5: ElCfERlmTHspp
Eucalyptus leucophloia subsp. leucophloia, Corymbia ferriticola scattered low trees over Eremophila latrobei subsp. filiformis, Senna spp. scattered shrubs over Cymbopogon ambiguus, Eriachne mucronata, Themeda sp. Mt Barricade (M.E. Trudgen 2471), T. triandra open tussock grassland

Vegetation of Plains

P1: ElEgAprAbAaAdTwTpTsps
Eucalyptus leucophloia subsp. leucophloia scattered low trees over E. gamophylla scattered low mallees over Acacia pruinocarpa scattered tall shrubs over A. bivenosa, A. ancistrocarpa, A. dictyophleba shrubland over Triodia wiseana, T. pungens, T. sp. Shovelanna Hill (S. van Leeuwen 3835) hummock grassland

P2: ChAprAiAsclApaTp
Corymbia hamersleyana, Acacia pruinocarpa scattered low trees over A. inaequilatera, A. sclerosperma subsp. sclerosperma, A. pachyacra tall open shrubland over Triodia pungens hummock grassland

P3: AprAciAiAsclTlo
Acacia pruinocarpa low open woodland over A. citrinoviridis, A. inaequilatera, A. sclerosperma subsp. sclerosperma open shrubland over Triodia longiceps hummock grassland

P4: AprAsyAiTw
Acacia pruinocarpa low open woodland over A. synchronicia, A. inaequilatera scattered tall shrubs over Triodia wiseana open hummock grassland

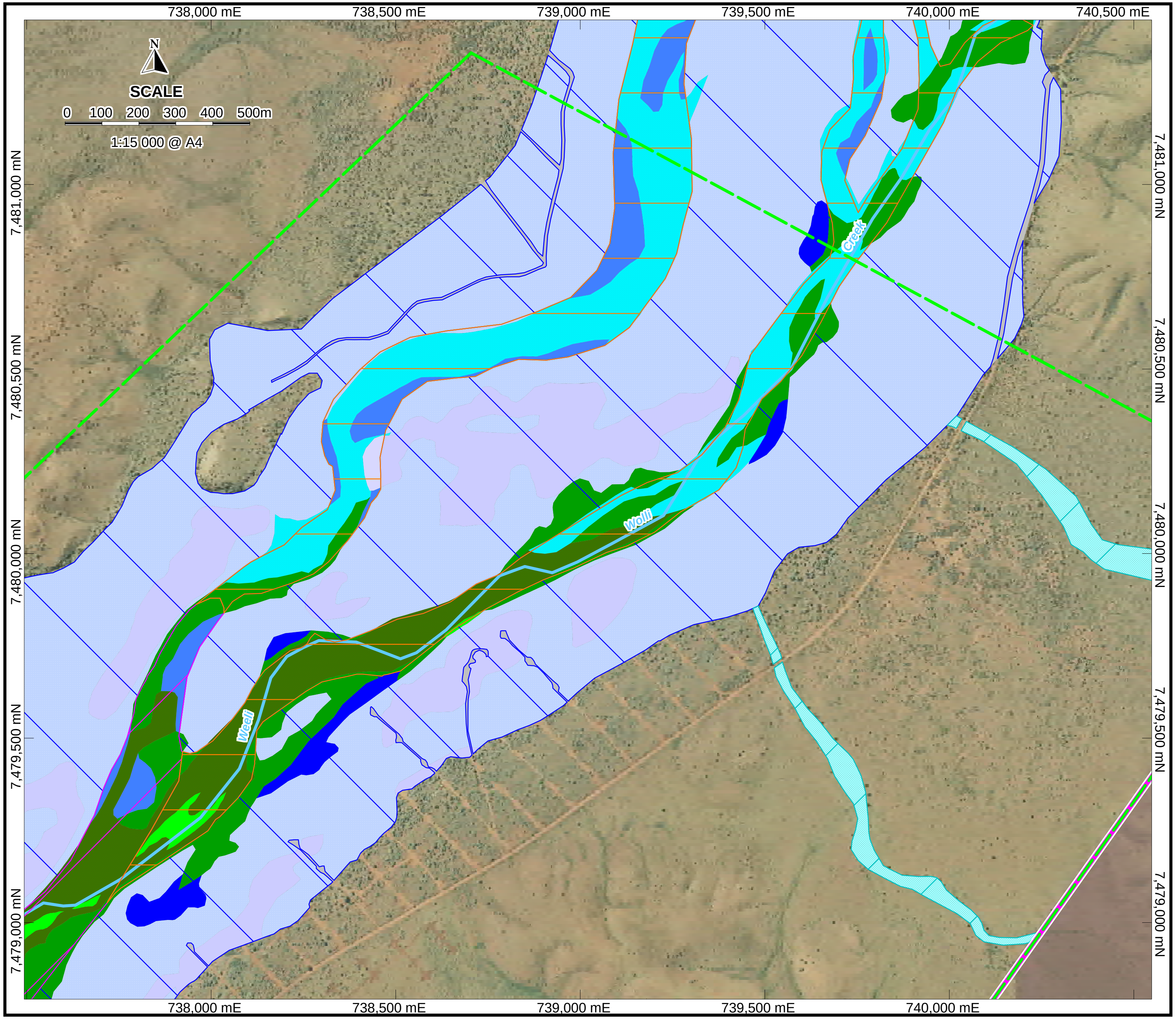
P5: ElEgAbAaTb
Eucalyptus leucophloia subsp. leucophloia scattered low trees over E. gamophylla scattered low mallees over Acacia bivenosa, A. ancistrocarpa open shrubland over Triodia basedowii open hummock grassland

P6: AapERfoERl/g
Acacia aptaneura low open forest over Eremophila forrestii subsp. forrestii open shrubland over E. lanceolata low open shrubland over mixed very open grassland

P7: ERf/G
Eremophila fraseri subsp. fraseri open shrubland over mixed very open grassland

P9: ChEgAiAaAprPcTb
Corymbia hamersleyana scattered low trees over Eucalyptus gamophylla scattered low mallees over Acacia inaequilatera, A. ancistrocarpa, A. pruinocarpa tall open shrubland over Petalostylis cassioides open shrubland over Triodia basedowii open hummock

Disturbed
Disturbed



LEGEND

Development Envelope

Proposal Area

Refined Riparian Zone Vegetation Units

C1/C2-A

C1B

C2/C1

C2A

C2Asb

C2B

C3A

C3Asb

C4

F2

Disturbed

Biota 2014 Major Creekline Vegetation Units

C1: EcEvMaMgAc

C3: EvAciAcMgCEc

C4: EvAciAprAThCEc

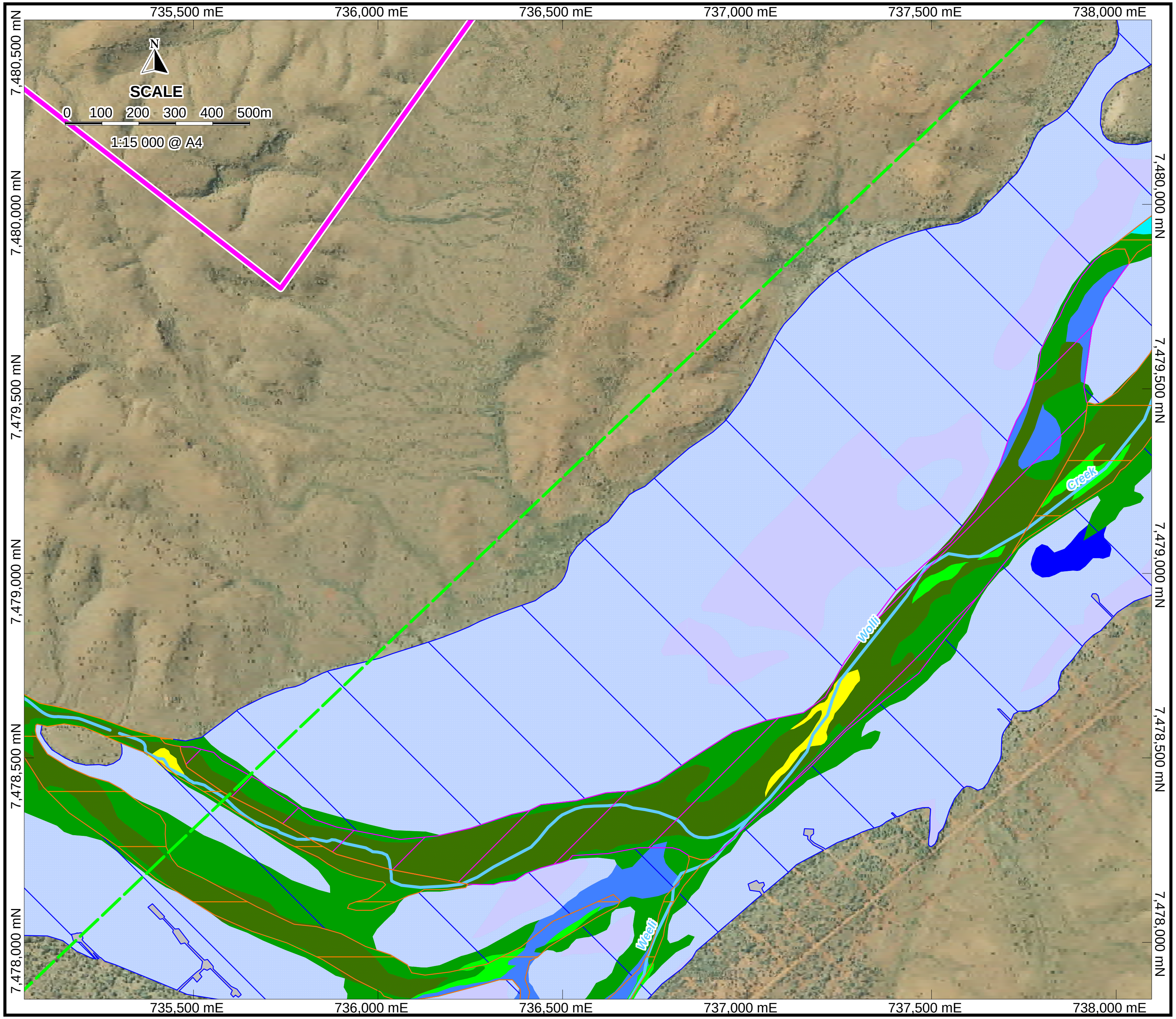
Iron Ore (WA)

Figure 48
Refined riparian zone vegetation units in the Proposal Area (Map 1)

Drawn: M.Swebbs
Date: October 2015

Plan No: PDE0134176v2
Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

Development Envelope

Proposal Area

Refined Riparian Zone Vegetation Units

C1/C2-A

C1B

C2/C1

C2A

C2Asb

C2B

C3A

C3Asb

C4

F2

Disturbed

Biota 2014 Major Creekline Vegetation Units

C1: EcEvMaMgAc

C3: EvAciAcMgCEc

C4: EvAciAprAThCEc

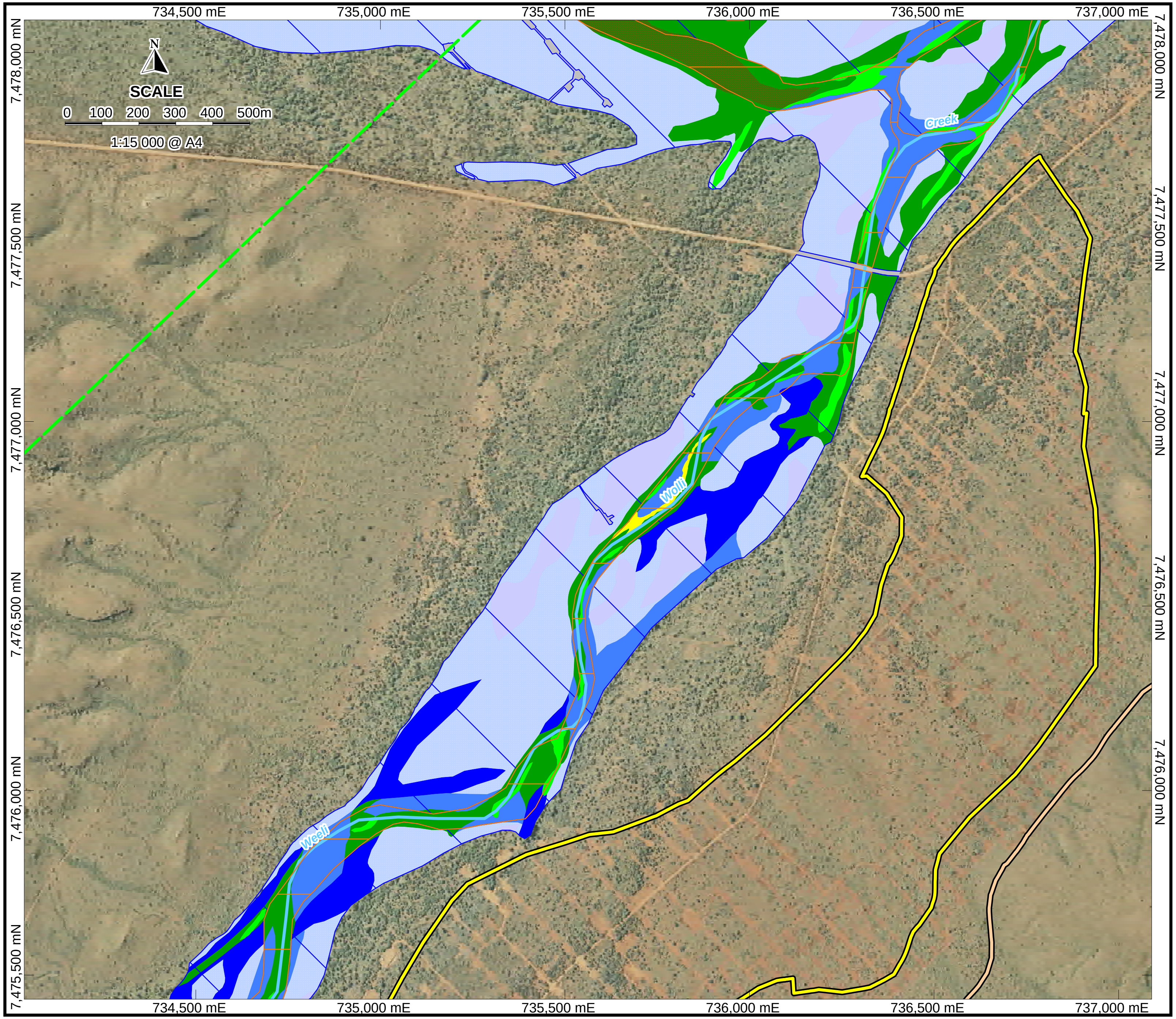
Rio Tinto

Iron Ore (WA)

Figure 49
Refined riparian zone vegetation units in the Proposal Area (Map 2)

Drawn: M.Swebbs
Date: October 2015

Plan No: PDE0134176v2
Proj: MGA94 Zone50



LEGEND

Development Envelope
Proposal Area
Conceptual Mine Pit
Conceptual Waste Dump

Refined Riparian Zone Vegetation Units

C1/C2-A
C1B
C2/C1
C2A
C2Asb
C2B
C3A
C3Asb
C4
F2
Disturbed

Biota 2014 Major Creekline Vegetation Units

C1: EcEvMaMgAc
C3: EvAciAcMgCEc
C4: EvAciAprAThCEc

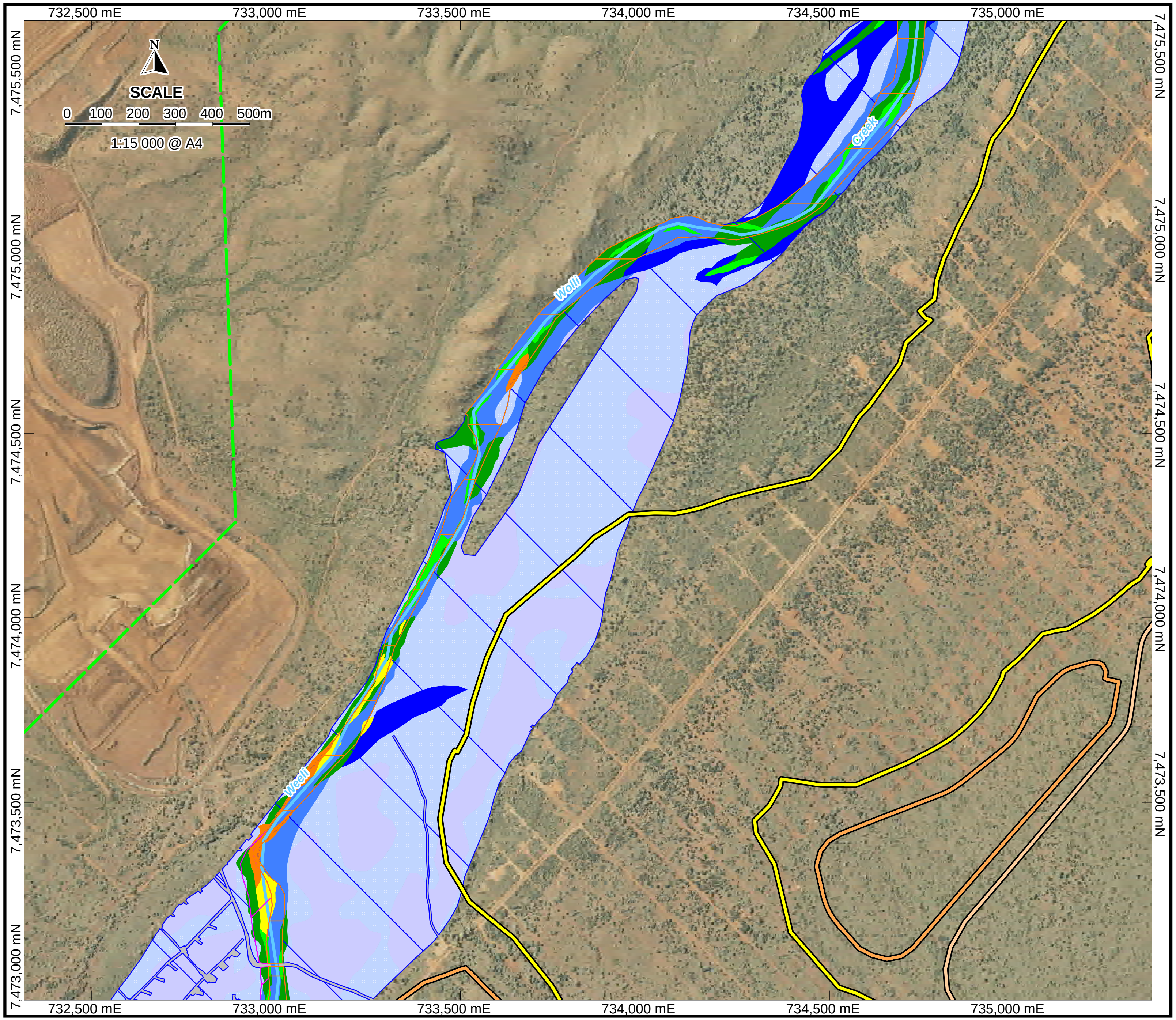
Rio Tinto

Iron Ore (WA)

Figure 50
Refined riparian zone vegetation units in the Proposal Area (Map 3)

Drawn: M.Swebbs
Date: October 2015
Plan No: PDE0134176v2
Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

- Development Envelope
- Proposal Area
- Conceptual Mine Pit
- Conceptual Waste Dump
- Conceptual Topsoil / Subsoil Stockpile

Refined Riparian Zone Vegetation Units

- C1/C2-A
- C1B
- C2/C1
- C2A
- C2Asb
- C2B
- C3A
- C3Asb
- C4
- F2
- Disturbed

Biota 2014 Major Creekline Vegetation Units

- C1: EcEvMaMgAc
- C3: EvAciAcMgCEc
- C4: EvAciAprAThCEc

RioTinto

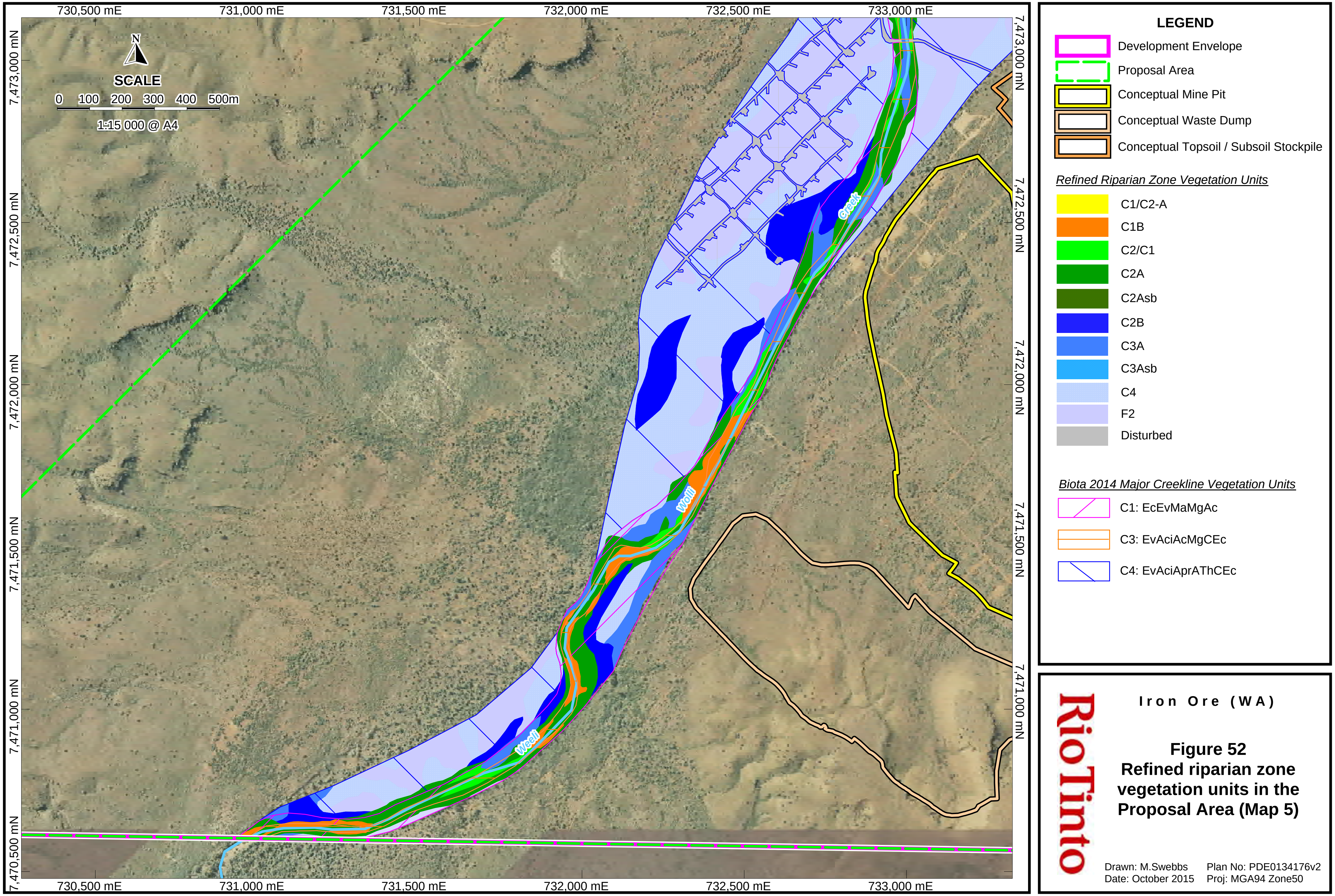
Iron Ore (WA)

Figure 51
Refined riparian zone vegetation units in the Proposal Area (Map 4)

Drawn: M.Swebbs
Date: October 2015

Plan No: PDE0134176v2
Proj: MGA94 Zone50

Geospatial Information and Mapping



Iron Ore (WA)

Figure 52
Refined riparian zone vegetation units in the Proposal Area (Map 5)

Drawn: M.Swebbs
Date: October 2015

Plan No: PDE0134176v2
Proj: MGA94 Zone50

Geospatial Information and Mapping

Vegetation condition

Surveys within the Proposal Area recorded vegetation condition (after Trudgen 1988) to be Excellent to Very Poor (Biota 2014a; see **Table 18** and **Figure 53**). The main disturbance factors in the area are weed invasion and disturbance from livestock (cattle) including grazing, tracks, and trampled vegetation. Approximately 3% of the study area is mapped as Disturbed or Completely Degraded. These areas comprised current and historic vehicle roads and tracks, drill lines and drill pads. The majority of the Proposal Area is comprised of vegetation in either Good or Excellent condition (73%).

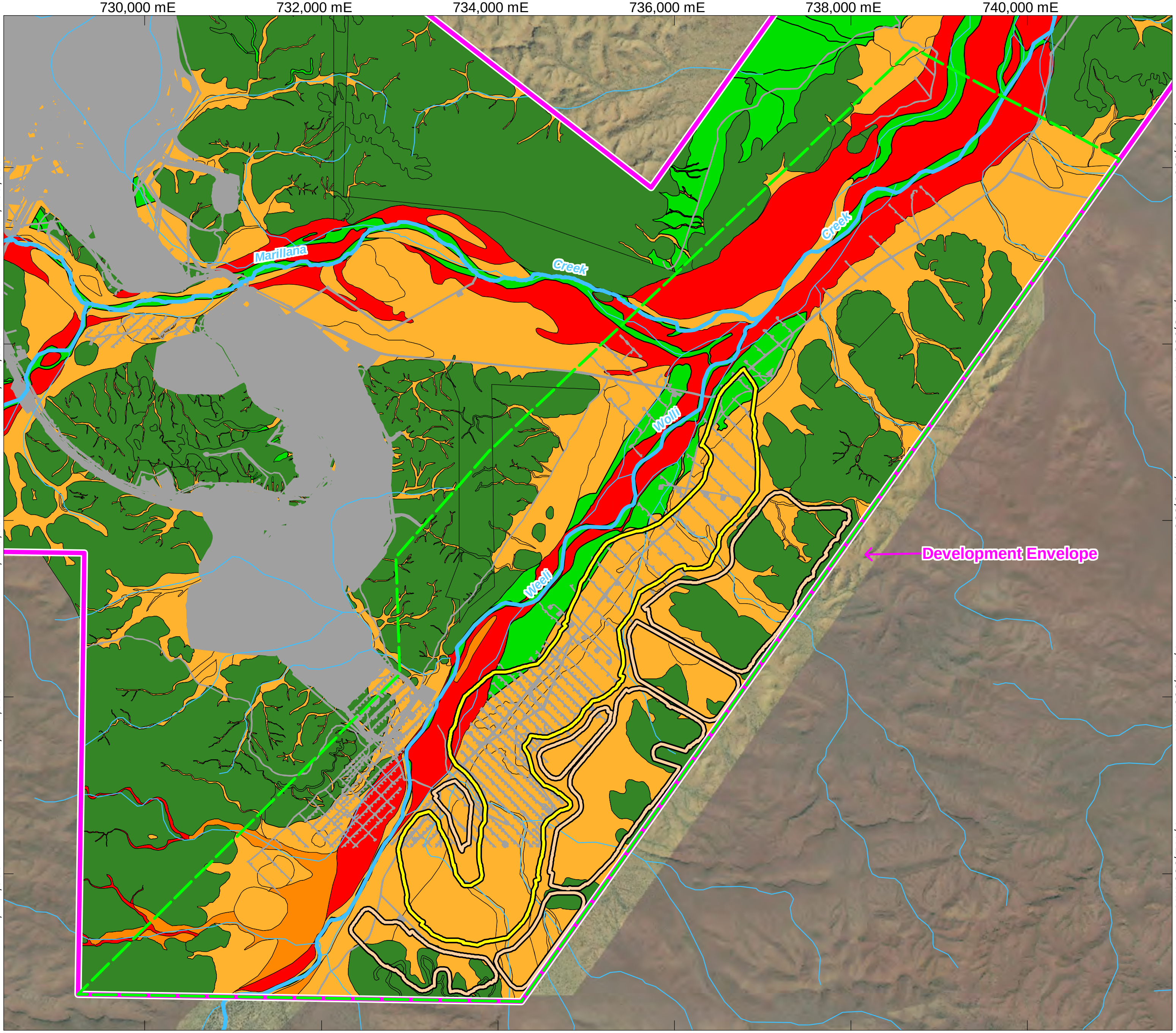
Table 18: Vegetation Condition (%) in the Proposal Area

Vegetation condition	% of Project Area
Excellent	26.6
Very Good	7.0
Good	46.0
Poor	0.8
Very Poor	16.5
Completely Degraded	3.1

Most creekline and floodplain vegetation types were rated as being in Good condition, although some areas were rated as Very Poor due to the high weed cover and evidence of extensive grazing and trampling by cattle. Buffel grass (**Cenchrus ciliaris*) was the most prolific weed in these habitats, sometimes occurring together with **Cenchrus setiger*. **Cenchrus* species were present as a continuous population along the edges of Weeli Wolli and Marillana Creeks and on adjacent floodplains (Biota 2014a).

The vegetation condition of the plains ranged from Good to Excellent. Some weed species were recorded, although they were usually only present as scattered individuals. Occasionally a very open tussock grassland of **Cenchrus ciliaris* was present, usually on plains adjacent to creeklines or floodplains. Evidence of cattle was also occasionally noted on the plains (Biota 2014a).

The hills, ridges and breakaways of the study area were in Excellent condition and were mostly free from any form of disturbance. Some of the hills and slopes of the study area had been recently burnt. Fire is a natural process in the Pilbara region, and natural fire regimes need not affect the overall condition of vegetation (Biota 2014a).



LEGEND

Development Envelope

Proposal Area

Major; Minor Watercourse

Conceptual Mine Layout

Mine Pit

Waste Dump / Stockpile

Vegetation Condition

Excellent

Very Good

Good

Poor

Very Poor

Completely Degraded

N

SCALE

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Rio Tinto

Iron Ore (WA)

Figure 53
Vegetation condition in the Proposal Area

Drawn: M.Swebbs
Date: October, 2015

Plan No: PDE0131812v3
Proj: MGA94 Zone50

Geospatial Information and Mapping

14.2.2.2 Conservation significance of vegetation communities

Threatened and Priority Ecological Communities

None of the vegetation types recorded in the Proposal Area represent Threatened Ecological Communities or Priority Ecological Communities.

Vegetation units of elevated conservation significance

A number of "other ecosystems at risk" are identified for the Hamersley and Fortescue subregions of the Pilbara bioregion (Kendrick 2003a, 2003b). These are ecosystems with some level of significance that are at risk of degradation from a variety of factors including development, groundwater drawdown, frequent fires, grazing and weed invasion. One of these is relevant to the Proposal Area:

- 'All major ephemeral water courses' in the Hamersley subregion (Kendrick 2003a). These water courses are described as supporting "Eucalyptus forests with a shrubby understorey", which are under threat of degradation from weed invasion and grazing and trampling by feral herbivores (Kendrick 2003a). Groundwater drawdown could also potentially impact such vegetation if it included phreatophytic (groundwater dependent) species such as *Melaleuca argentea* (Cadjeput) or *Eucalyptus camaldulensis* (River Red Gum).

While Kendrick (2003a) referred to this ecosystem at risk being represented by the National Vegetation Information System (NVIS) major vegetation sub-group 4 (Eucalyptus open forests with a shrubby understory), no communities in the Proposal Area are classified as having Eucalyptus species consistently of this density (30-70%). Despite this, many of the C coded vegetation units occurring in the main incised channel of the Proposal Area are generally considered representative of this ecosystem at risk.

The Biota C1 vegetation unit was initially considered to be of elevated conservation significance however this unit was further differentiated into the C1B community and three closely associated sub-associations (C1/C2A, C2/C1 and C2A units). These four units are now considered to represent the key riparian communities of elevated significance. Of these units, the C1B unit is considered more significant; C1/C2A and C2/C1 are those units which have been interpreted by Rio Tinto (2015a) as being discharge augmented versions of the C2A community; and the C2A unit represents the regionally well represented *Eucalyptus camaldulensis* and *Eucalyptus victrix* open woodland community of large creek systems in the Pilbara. These communities are associated with Marillana and Weeli Wolli Creeks and are considered to be of elevated significance due to their inherent ecological values, restricted distribution in the Hamersley subregion, and their similarity to the Kendrick (2003a) ecosystem at risk (**Table 19**). The remaining C coded vegetation types comprise riparian vegetation but do not generally feature eucalypt forests and are widespread in moderate-sized creek systems throughout the Pilbara (Biota 2014a).

Table 19: Vegetation units of elevated significance in the Proposal Area

Vegetation unit	Condition	Total extent (ha)
C1B	Good	6
C1/C2-A	Good	3
C2/C1	Poor	11
C2A	Good - Poor	115
C2Asb	Very Good	52

14.2.3 Flora

A total of 455 native vascular flora taxa from 154 genera and 47 families have been recorded from the Biota (2014a) study area. This level of species richness is high for the broader locality but within the range that would be expected for a survey area of this size (Biota 2014a).

14.2.3.1 Conservation listed flora

Threatened (Declared Rare) Flora

One species, *Lepidium catapycnon* (Hamersley Lepidium), listed under the WC Act as Threatened (Declared Rare) Flora has been recorded in the Proposal Area. *L. catapycnon* is also listed as Vulnerable under the EPBC Act. *L. catapycnon* was recorded from two locations in the Proposal Area during previous surveys (Biota 2015a).

Searches undertaken during the Phase 1 survey at the locations of existing records, as well as targeting areas deemed potentially suitable habitat, found no individuals of *L. catapycnon*. Further targeted searches undertaken during the Phase 2 survey recorded *L. catapycnon* from 26 locations comprising three separate populations, two of these represented new populations for the area (Biota 2014a; **Figure 54**). A total of 777 individuals were recorded in the wider Yandicoogina locality during the Phase 2 surveys, with 948 recorded in this area to date. At present the Rio Tinto Rare and Priority flora database contains 1317 records of *L. catapycnon* totalling approximately 27,400 individuals.

It is noted that the conservation status of *L. catapycnon* is currently under review due to the extent of new records in the Pilbara.

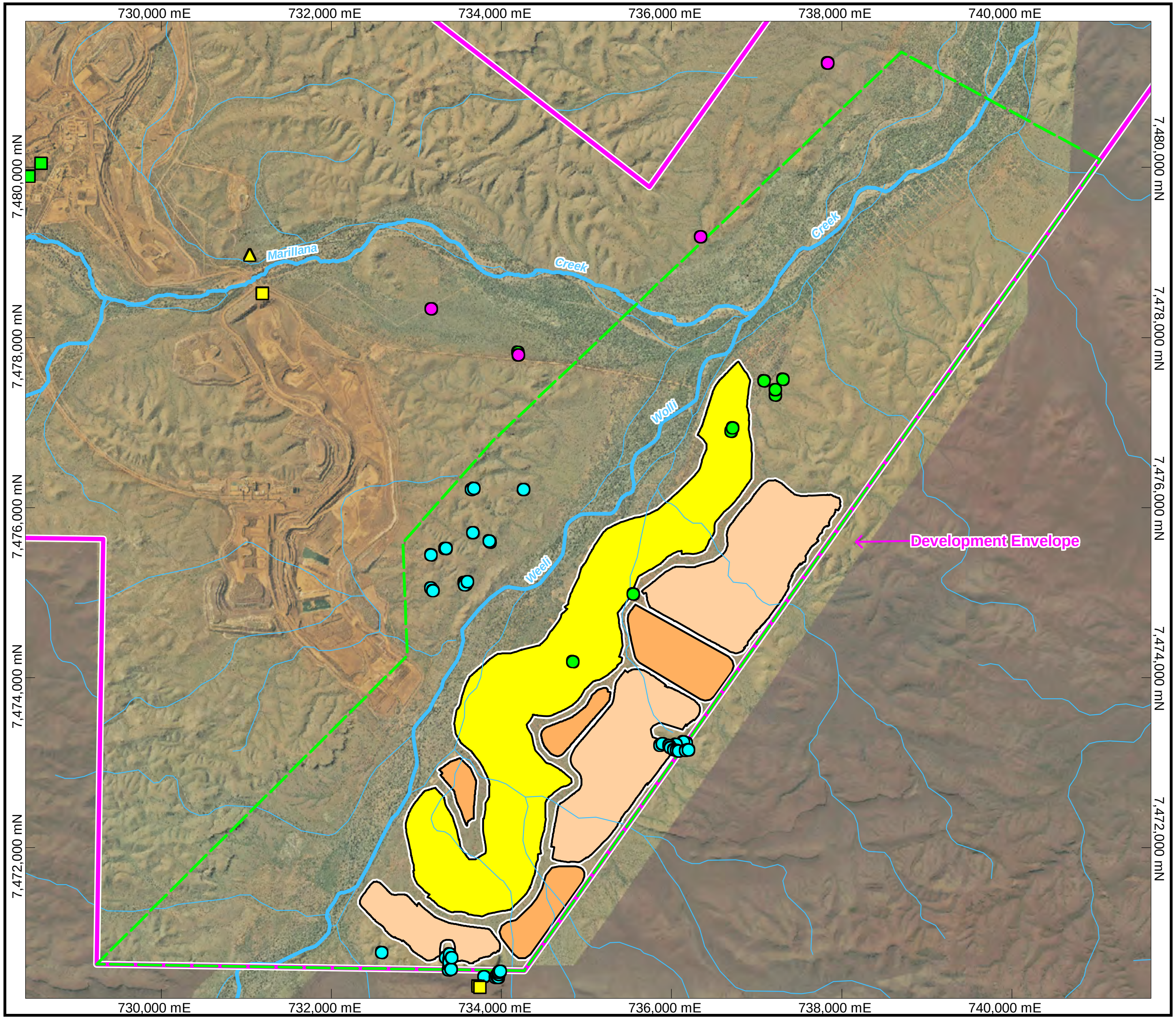
Priority flora

One Priority flora species, *Goodenia nuda* (Priority 4), was recorded in the Proposal Area (Biota 2014a; **Figure 54**). Seventy-two *Goodenia nuda* individuals were recorded in the Proposal Area.

A Priority 3 species, *Sida* sp. Barlee Range (S. van Leeuwen 1642), was located 1.5 m (three individuals) and 11 m (two individuals) outside the southern boundary of the Proposal Area. Additional historical records of *Sida* sp. Barlee Range (S. van Leeuwen 1642), Themeda sp. Hamersley Station (M.E. Truden 11431; Priority 3), *Rhynchosia bungarensis* (Priority 4), *Eulalia* sp. (Three Rivers Station B. Forsyth AQ6789133; species of interest) and *Glycine* sp. aff. *arenaria* (species of interest) are located between 0.25 – 3.7 km from the Proposal Area (Biota 2015a; see **Figure 54**). As these populations are outside the Proposal Area, they will not be disturbed as part of the Proposal.

14.2.3.2 Introduced flora species

Eighteen introduced flora species were recorded within or in the vicinity of the Proposal Area (Biota 2014a). One species, **Argemone ochroleuca* (Mexican Poppy) is listed as a Declared Plant for the whole of WA under the *Biosecurity and Agricultural Management Act 2007*. None of the species recorded were ranked as Very High or High Management priorities for the Pilbara under the Parks and Wildlife Weed Prioritisation Process (DPaW 2013). **Acetosa vesicaria* (Ruby Dock) is ranked by Parks and Wildlife as a Medium management priority and all other species were ranked as Low, Negligible or were not listed. It is important to note that some species are ranked as lower priorities more because of the difficulty of control rather than their perceived invasiveness (e.g. Buffel grass, **Cenchrus ciliaris*; Biota 2014a).



LEGEND

- Development Envelope
- Proposal Area
- Conceptual Mine Pit
- Conceptual Waste Dump
- Conceptual Topsoil / Subsoil Stockpile
- Major; Minor Watercourse

Rare Species

- *Lepidium catapycnon*

Priority 3 Flora

- *Sida* sp. Barlee Range (S. van Leeuwen 1642)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431)

Priority 4 Flora

- *Goodenia nuda*
- *Rhynchosia bungarensis*

Species of Interest

- *Eulalia* sp. (Three Rivers Station, B.Forsyth AQ6789133)
- *Glycine* sp. aff. *arenaria*

N

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RioTinto

Iron Ore (WA)

Figure 54
Records of conservation significant flora within the Proposal Area

Drawn: M.Swebbs
Date: October, 2015

Plan No: PDE0133743v2
Proj: MGA94 Zone50

Geospatial Information and Mapping

14.3 Assessment of potential impact, mitigation and residual impact

Potential impacts associated with the Proposal in relation to flora and vegetation were identified by the EPA in the ESD as follows:

- The proposal involves additional clearing that will increase the disturbance footprint in the Revised Proposal Development Envelope from 5,600 ha to 7,400 ha for the mine and supporting infrastructure.
- The clearing includes up to 69 ha of riparian zone vegetation within Weeli Wolli Creek, consisting of approximately 16 ha for the mine pit and 9 ha for flood protection levees. There are potential for impacts on Priority flora species and *Lepidium catapycnon*, which is a Threatened Flora species.
- Groundwater drawdown from the mine has the potential to impact on the health of riparian vegetation along an 8 - 10 km stretch of Weeli Wolli Creek.
- Discharge of surplus water from mine pit dewatering has the potential to impact on riparian vegetation along Marillana and Weeli Wolli Creeks.
- There is the potential for the introduction of weeds through vehicle movements and earthworks.
- There is also the potential to impact on vegetation through the generation of dust from mining operations.

14.3.1 Clearing of native vegetation and potential loss of important vegetation communities

Vegetation clearing is an unavoidable component of mine development and infrastructure construction. Clearing will be required to enable development of the mine pit and associated infrastructure that were outlined in Section 4. The conceptual layout of each element of the Proposal is shown in **Figure 4**. Where practicable, the final mine site layout and infrastructure alignment will be designed to minimise clearing within the Clearing Restriction Area and areas containing vegetation and flora of elevated significance subject to mine planning and engineering constraints.

The Proposal Area covers 4,363 ha of which 1,327 ha of vegetation is currently proposed to be cleared (**Table 20**; note that vegetation mapped as Completely Degraded condition has been excluded from this clearing total as it has already been cleared). The majority of the clearing is of vegetation of Plains and Hills, Ridges and Breakaways (clearing of vegetation units P4, P5, and H1 makes up 1,061 ha or 80% of all proposed clearing). Vegetation within the proposed clearing footprint is largely typical of that occurring in similar habitats elsewhere in the same section of the Hamersley and Fortescue subregions, or is considered relatively widespread in the Pilbara beyond the Proposal Area. The majority of vegetation proposed to be cleared was assessed to be in Good condition (71% of all mapped vegetation, ranging from Very Poor to Excellent condition) and has been historically impacted by grazing and trampling by domestic and feral animals, weed invasion, frequent fire and mining and exploration activities (Biota 2014a).

While 1,327 ha of vegetation is currently proposed to be cleared within the Proposal Area as part of the current mine layout, consisting of the pit, waste dumps, levee and support infrastructure, approval for clearing of up for 1,800 ha of the Proposal Area is being requested as part of the Proposal, to allow for flexibility with mine planning and development.

A total of 69 ha of vegetation is proposed to be cleared to support the development of the Proposal from within what is currently depicted as the Clearing Avoidance Area (CAA) within MS 914; however the current clearing requirement (prior to finalisation of detailed engineering designs) is approximately 51 ha within this area (proposed Restricted Clearing Area; RCA). The 69 ha is being requested as part of the Proposal to allow for flexibility to accommodate changes to engineering deigns. The majority of vegetation proposed for clearing within the RCA (96% or 49 ha of the total 51 ha) is of units C4 and F2 and not the higher local conservation value vegetation discussed in Section 14.2.2.3. Both of these units proposed to be cleared are associated with the floodplain of Weeli Wolli Creek and not the denser open forests of the creek itself.

Vegetation unit C4 is composed of *Eucalyptus victrix* open woodland over *Acacia citrinoviridis, A. pruinocarpa, Atalaya hemiglauca* low woodland over **Cenchrus ciliaris* tussock grassland and F2 represents floodplain vegetation comprised of *Acacia pruinocarpa, A. citrinoviridis* tall open shrubland over **Cenchrus ciliaris* tussock grassland. Neither of these units contains the Eucalyptus open forests characteristic of the riparian ecosystem at risk described by Kendrick (2003a; 2003b) and additionally they are mapped as being in Poor condition, comprising a tussock grass layer dominated by Buffel grass. A further 851 ha of C4 and 145 ha of F2 vegetation is represented within the RCA outside of the Proposal Area. Clearing of these units is unlikely to affect the integrity of the higher local conservation value vegetation that the RCA aims to protect.

Three vegetation units identified by Rio Tinto (2015a) to be of elevated significance are proposed to be directly affected by the Proposal:

C2/C1 - Thin strips of vegetation lining the low flow channel of: *Eucalyptus camaldulensis* subsp. *refulgens* scattered (to open woodland), over low open woodland (to low open forest generally dominated by saplings to young trees) of *Eucalyptus camaldulensis* subsp. *refulgens* and *Melaleuca argentea* (and to a lesser extent *E. victrix*), over scattered tall-shrubs/shrubs of *Melaleuca glomerata*, *Acacia coriacea* subsp. *pendens*, *Atalaya hemiglauca*, and *Melaleuca glomerata* over very open sedgeland of *Cyperus vaginatus* and other mixed sedges often accompanied by fringing strips of *Typha domingensis*. Clearing proposed 0.04 ha, mapped condition Good to Poor.

C2A - *Eucalyptus camaldulensis subsp. refulgens, E. victrix woodland, over Acacia coriacea subsp. Pendens and Atalaya hemiglauca scattered low trees, over Melaleuca glomerata and Acacia citrinoviridis tall open shrubland, over mixed shrubland/low shrubland typically dominated by Corchorus crozophorifolius and Tephrosia sp. Fortescue creeks and outcrops of Cenchrus ciliaris open tussock grassland.* Clearing proposed 0.55 ha, mapped condition Good to Poor.

C2B - *Eucalyptus victrix and E. camaldulensis subsp. refulgens open woodland, over E. victrix scattered low trees, over Acacia citrinoviridis, A. pruinocarpa, and Atalaya hemiglauca tall open shrubland, over Atalaya hemiglauca, Gossypium sturtianum and Corchorus crozophorifolius scattered shrubs over *Cenchrus ciliaris tussock grassland.* Clearing proposed 0.83 ha, mapped condition Poor.

These communities commonly occur along larger creek systems throughout the Hamersley subregion (the C2/C1 community to a lesser extent) and as only 1.43 ha is proposed to be cleared as part of the Proposal the impact is not considered significant at a local or regional scale. Additionally a further 579 ha of the higher significance C1 (including C1/C2-A, C1A, and C1B) and C2 (including C2/C1, C2A, C2Asb, C2B, and C2C) vegetation units within the RCA are not proposed to be cleared. It is also important to note that riparian communities in the vicinity of the Proposal Area have been affected by surplus water discharge into Weeli Wolli Creek from upstream discharge since 2007. The most significant change has been the appearance of *Melaleuca argentea* saplings/young trees which have been sustained by the presence of an unnatural, perennial stream flow (Rio Tinto 2015a). Within the Proposal Area, the C2/C1 community is representative of the key structural and compositional changes which have occurred due to the provision of perennial water flow in the low-flow channel.

Internal ground disturbance procedures will be followed prior to commencing clearing of vegetation (subject to relevant regulatory approvals). The boundaries of vegetation to be cleared will be clearly defined as spatial coordinates in a Global Positioning System, including within earthworks machinery, or in some instances (particularly areas of higher significance) with ground markings (e.g. flagging), thus ensuring that personnel are aware of clearing limits prior to commencement of ground-disturbing activities.

Table 20: Area of vegetation proposed to be cleared

	Total extent (ha) in Proposal Area	Extent (ha) proposed to be cleared	% of total extent in Proposal Area	Total extent (ha) in Revised Proposal Development Envelope	% of total extent in Revised Proposal Development Envelope
Vegetation of Major Creeklines and Tributaries					
C2/C1	11	<1	<1	32	<1
C2A	91	1	1	309	<1
C2B	37	<1	2	41	2
C2C	12	<1	3	175	<1
C3A	53	1	1	161	<1
C4	503	30	6	1,106	3
Vegetation of Minor creeklines, Floodplains and Valleys					
F1	49	26	54	414	6
F2	244	20	8	462	4
F3	29	3	11	260	1
F5	31	23	74	31	74
Vegetation of Hills, Ridges and Breakaways					
H1	628	238	38	2,823	8
H2	566	38	7	5,842	1
H5	11	4	35	28	14
Vegetation of Plains					
P1	38	<1	<1	396	<1
P2	50	4	8	1,063	<1
P3	167	52	31	167	31
P4	344	142	41	350	41
P5	1,247	680	54	1,536	44
P6	113	63	56	144	44
Total	**4,225**	**1,327**		**15,372**	

14.3.2 Potential loss of conservation listed flora species

14.3.2.1 Threatened (Declared Rare) Flora

The design of the conceptual layout (**Figure 4**) has been cognisant of the presence of *Lepidium catapycnon* populations in the Proposal Area. *L. catapycnon* was recorded in areas that were originally designated for waste dumps in earlier versions of the conceptual design. However, the Proponent configured the waste dumps to avoid known and recorded populations of *L. catapycnon*. Further, all recorded populations of *L. catapycnon* have currently been designated as 'areas of special protection from ground disturbance' and therefore excised from the ground disturbance footprint.

L. catapycnon is known from a number of locations in the Hamersley Range and extends broadly from Tom Price across to Newman (Biota 2014a). There are over 30 known populations of *L. catapycnon* through this area, including one population in Karijini National Park. The populations recorded within the Proposal Area are within the known range of *L. catapycnon* and do not represent a range extension or edge of range population. Eleven separate populations of *L. catapycnon* have been recorded in the wider Yandicoogina locality (Biota 2015a), all on hills and slopes. The populations within the Proposal Area are therefore unlikely to be either regionally or locally significant.

There is limited potential for *L. catapycnon* to be indirectly affected by changes to natural hydrological flows and runoff from waste dumps as the waste dumps are all on the downstream side of the recorded populations. Buffers of 50 m have been placed around populations to reduce the risk of accidental impacts from dumping of waste material.

14.3.2.2 Priority flora

Four records (37 individuals) of *Goodenia nuda* (Priority 4) will be impacted by the Proposal. *Goodenia nuda* is associated with clay substrates and has a broad distribution over a range of 500 km throughout the Pilbara bioregion and has been recorded from the broader Yandicoogina locality (190 individuals; Biota 2014a). Rio Tinto records show that *Goodenia nuda* has been recorded at 551 locations during Pilbara surveys, with 5,862 plants. The plant is a small, inconspicuous herb and it is therefore possible it occurs in other similar (floodplain) habitat elsewhere in the wider Yandicoogina locality. The loss of the individuals recorded from the Proposal Area is therefore not considered significant and would not alter the species' conservation status.

14.3.3 Effect of groundwater drawdown and discharge of surplus water on riparian vegetation

14.3.3.1 Existing altered hydrological environment

Riparian vegetation in the vicinity of the Proposal Area has been subject to the effects of groundwater drawdown and discharge of surplus groundwater by existing approved mining activities within the catchments of Marillana Creek since the mid 1990s and Weeli Wolli Creek since the mid 2000s. The presence of a permanent surface expression of discharge water in Weeli Wolli Creek (24-27 km downstream of the Hope Downs 1 discharge outlet) has in some sections of creek resulted in altered vegetation community structure, composition and health of the dominant riparian tree species *Eucalyptus victrix* and *E. camaldulensis* (Mattiske 2014; Rio Tinto 2015a; Eastham 2015). The surface water hydrology of Weeli Wolli Creek has changed from being an ephemeral system experiencing periodic (cyclonic) large flow events followed by extended dry periods to one of permanent surface flow, allowing increased recruitment, increased biomass and the establishment of riparian species (namely obligate phreatophytes such as *Melaleuca argentea*).

14.3.3.2 Drawdown

Groundwater modelling predicts that dewatering associated with the Proposal will lower the water table in the CID by approximately 50 m over two to three years (75 to 85 m bgl), with the water table remaining at that depth for the duration of mining (URS 2015). This drawdown would be below that of pre-mining levels and would translate to deficits in water availability for vegetation in the riparian zone (URS 2015). This will result in the disconnection of the current surface and groundwater systems within the low-flow channel of Weeli Wolli Creek, returning it to its more natural state (URS 2015). Perennial stream flow in the low-flow channel, and opportunities for flooding the adjacent riparian zone remain unchanged as a result of the Proposal (URS 2015). The low-flow channel was assumed to incorporate a 6 m zone that transmits perennial stream flow, and a 20 m corridor either side of this where the vegetation is able to access stream flow or pore water (46 m total corridor; URS 2015).

Groundwater monitoring data indicate that pre-mining depth to water tables within the Proposal Area CID occurred between 12 - 20 m below ground level, suggesting there would have been low dependency of the vegetation in this area on groundwater, and most plants would have been reliant on soil (pore) water instead (URS 2015). Limited historical water level data exists within the adjacent riparian zone, however historical vegetation data (Integrated Environmental Services 1981) does not identify the presence of obligate phreatophytes (strictly groundwater dependent) species in the vicinity of the Proposal and recent vegetation mapping within this area has identified a predominance of young trees of the only obligate phreatophyte recorded, *Melaleuca argentea* (URS 2015; Rio Tinto 2015a). The vast majority of these trees are most likely to have established relatively recently, following commencement of discharge of surplus water into Weeli Wolli Creek from Hope Downs 1 operations upstream and discharge from Yandi JSE. Mature *Eucalyptus camaldulensis* and *E. victrix* (facultative phreatophytes; URS 2015) present as the dominant overstorey layer would have previously met their ecological water requirements from both soil and groundwater depending on its availability under pre-mining conditions.

Refined riparian vegetation mapping (Rio Tinto 2015a) revealed that three vegetation units contained a co-dominant component of *M. argentea* in the vicinity of the Proposal Area. Of these three units the C1B community was determined to contain *M. argentea* populations possessing a structure and size class range indicative of a community likely to have existed prior to discharge. Three small areas of this vegetation occupying a combined 420 m stretch of creekline (6.3 ha) were mapped in the Proposal Area, near the southern section of the proposed pit. The remaining two units (C1/C2A and C2/C1) were considered to contain *M. argentea* populations that had only established due to the increase in surface water availability as a result of Hope Downs 1 discharge. *M. argentea* populations have been interpreted by Rio Tinto (2015a) to be augmented by the presence of surplus discharge within Weeli Wolli Creek since late 2006 and the stem diameters (= size/age class) of the main population are considered representative of young recruits (ranging from 5-10 cm, with scattered individuals with stem diameters of 10-20 cm; Rio Tinto 2015a, see **Plate 3**).

Source: Rio Tinto (2015a)

Plate 3: Stands of young *Melaleuca argentea* fringing the low-flow channel within the Proposal Area and likely to have established since the commencement of surface water discharge at Hope Downs 1, Weeli Wolli Creek

As groundwater levels within Weeli Wolli Creek are lowered in response to the dewatering required for the Proposal, individuals of *M. argentea* outside the low-flow channel and immediate banks (a strip of approximately 10-20m either side of the 6m low-flow channel zone) are likely to lose condition and die unless their ecological water requirements are met through rainfall/cyclone events (to supplement the pore water radiating out from the low-flow channel; **Table 21**). The majority of the *M. argentea* populations interpreted to be present pre-discharge (associated with the C1B community) are contained within this zone and are unlikely to be impacted by dewatering. The *M. argentea* populations which extend outside this zone, and which are therefore most likely to see impact (the C1/C2A and C2/C1 communities), are those interpreted as not being present pre-discharge. **Figure 55** shows vegetation (including *Melaleuca* communities) in relation to high and low-flow channels adjacent to the mine pit and levee structures. Mine pits have been successfully developed next to riparian vegetation communities in the existing Yandi Operations; **Plate 4** shows a photo of the riparian vegetation associated with Marillana Creek adjacent to the existing JSW pit wall (~60 m bgl) in October 2015.

Despite the potential for the younger, post discharge C1/C2A and C2/C1 communities to experience mortality within *M. argentea* populations, only a small percentage of these communities are likely to occur within the impact zone (beyond the banks adjacent to the low-flow channel; **Figure 55**). Therefore, as the majority of the *M. argentea* populations most likely to experience decline or death as a result of drawdown are considered to have been established and augmented by discharge from other approved mining activities in the catchment, an impact to these populations brought about by a return to a more 'natural' hydrological regime is not considered significant and hence no active mitigation is proposed.

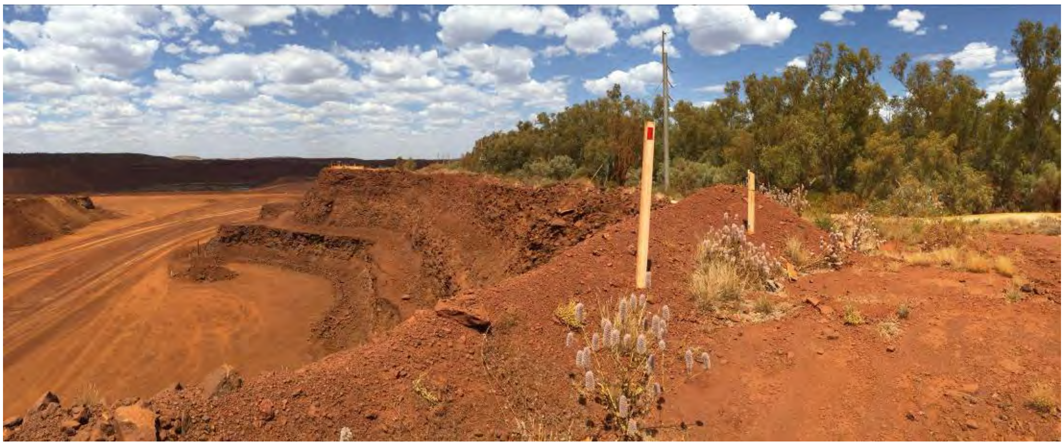

Plate 4: Marillana Creek riparian vegetation adjacent to the existing JSW pit wall.

Table 21: Possible responses of riparian tree species to groundwater drawdown associated with the Proposal

Change in depth to water table (m)	*Eucalyptus victrix*		*Eucalyptus camaldulensis*		*Melaleuca argentea*	
	Low-flow channel	**Incised channel**	**Low-flow channel**	**Incised channel**	**Low-flow channel**	**Incised channel***
<2	Little to no change	Little to no change	Little to no change	Little to no change	Little to no change	Reduced condition
2-5	Little to no change	Little to no change	Little to no change		Little to no change	Reduced condition and some potential for loss of foliage
5-10	Little to no change	Potential for reduced condition during extended periods without flood/overland flow	Little to no change	Potential for reduced condition during extended periods without flood/overland flow	Little to no change	Reduced condition, loss of foliage
10-15	Little to no change	reduced condition during extended periods without flood/overland flow	Little to no change	reduced condition with potential for foliage loss during extended periods without flood/overland flow	Little to no change	Complete loss of foliage, potential for fatality
15-20	Little to no change	reduced condition during extended periods without flood/overland flow	Little to no change	Loss of foliage, potential limb loss, and some potential for fatality during extended periods without flood/overland flow especially in enhanced vegetation	Little to no change	Fatality likely
>20	Little to no change	Reduced condition and foliage loss during extended periods without flood/overland flow	Little to no change	Loss of foliage, potential limb loss, and potential for fatality during extended periods without flood/overland flow especially in enhanced vegetation	Little to no change	Fatality likely

* If present

Adapted from URS (2015)

Eucalyptus camaldulensis and *E. victrix* woodland communities are considered to be facultative phreatophytes (relying on soil and groundwater to differing degrees depending on their availability and the local setting in which individual plants have become established). They are also likely to be impacted by groundwater drawdown associated with the Proposal if they have become dependent on surplus water associated with Hope Downs 1. The magnitude of this impact will depend on the rate of drawdown, the extent and frequency of surface water inputs and the ability of individual trees to access stored soil water as the groundwater declines. Monitoring of riparian eucalypts at Hope Downs 1 suggests the dominant riparian eucalypt species are resilient to drawdown if surface water (irrigation, rainfall, stream flow and overland flow) availability remains unaffected (Eastham 2015). Impacts are most likely to be seen once the water table drops below 5 m (the observed range of fluctuation after recharge events) and will be dependent on differences in adaptability of stands of vegetation to respond to sources and supply of water (URS 2015).

While flood regimes will be maintained in the creekline, overland flow within the floodplain zone will be diminished in an 8 km section adjacent to Weeli Wolli Creek where drainage tributaries from the east are being temporarily diverted around the Proposal mining operation via a diversion drain (that re-joins Weeli Wolli Creek further downstream). Modelling suggests that the baseline contribution of this surface flow amounts to approximately 2.5% of the local Weeli Wolli Creek catchment in the Proposal Area. Surface flow will be maintained on the western side of the creek and within the creek itself. Trees on the eastern side of Weeli Wolli Creek may experience increased drought stress as groundwater levels drop below pre-mining levels of 12 - 20 m with the reduction of overland surface water inputs. However, regular creekline flood events are more effective at supplying surface water inputs to this zone.

Figure 56 presents the risk (using the methodology outlined in URS, 2015) to the relevant riparian woodland communities of declining water availability within the riparian zone (based on 2019 drawdown predictions) and shows that an approximately 3 km stretch of vegetation is at medium – high risk and approximately 2.8 km at high risk of decline due to reduced water availability. A further 5 km is at medium risk. Within these stretches of creek it is expected that there will be deaths of *M. argentea* where it is present beyond the low-flow channel and immediately adjacent banks. Additionally, within these stretches of creek, it is expected that there will be decline of *E. camaldulensis* especially during periods of drought, with some deaths possible (beyond that typically expected to occur under natural climatic variability). *E. victrix* will decline in condition, again particularly during periods of drought where soil pore water is not being replenished as a result of rainfall and stream flow events.

The current health of some eucalypts due to waterlogging associated with surplus water discharge in Weeli Wolli Creek combined with additional stress of groundwater drawdown may cause rapid decline of some trees in this section of creek due to cumulative stresses (Eastham 2015). Similarly trees with enhanced canopies due to surplus water may be sensitive to groundwater decline; these localised impacts will depend on the position of individual trees in relation to the current and predicted water table depth. Areas of the creekline vegetation which have more recently established in areas of artificially elevated water table levels are generally immature and dominated by eucalypt and Melaleuca saplings and young individuals. These populations are expected to show significant decline and death as water levels are drawn down.

The dewatering activities associated with the Proposal are likely to produce losses of individual trees within the Weeli Wolli Creek riparian zone. It is expected that the potential for losses is greatest in those areas currently experiencing the greatest access to soil moisture, such as within and adjacent to the low-flow channel. However, the current perennial flow will be maintained within the low-flow channel of Weeli Wolli Creek in the vicinity of the Proposal by the continuation of discharge from Hope Downs 1 and is expected to circumvent a significant proportion of this potential for tree death. Recruitment within and adjacent to the perennial flow zone is likely to remain elevated for the duration of discharge and during wetter periods (cyclone/flood events), which may assist with offset the remaining losses which may be attributed to dewatering activities).

It is expected that the creek system will revert to a system similar to its ephemeral pre-mining state without active restoration through natural process such as cyclones and resultant flood events which provide optimum conditions for the establishment and survival of new propagules. Landscape-scale ecosystem processes such as nutrient cycling, flooding, fire and recruitment will remain unaffected by the Proposal.

14.3.3.3 Discharge

Approximately 50 GL/y of surplus water is proposed to be discharged from a new discharge outlet, adjacent to the existing discharge outlet (DO9) as a result of developing the Proposal, with the total discharge from the Revised Proposal being approximately 78 GL/y. Surface water modelling indicates that the alluvial aquifer and fractured Brockman Iron Formation bedrock in the downstream reaches of Weeli Wolli Creek could accommodate the maximum predicted discharge rate at DO9 without exceeding MS 914 condition 6-3, which limits the perennial surface water wetting front to 17 km downstream from the Marillana and Weeli Wolli Creek confluence.

Experience from the existing Yandi Operations and work undertaken by Eastham (2015) suggests that prolonged surface water discharge could result in:

- Artificial recruitment of riparian vegetation
- Increasing the leaf area index and biomass of vegetation exposed to higher water availability
- Decreasing biomass and waterlogging stress in areas exposed to prolonged soil saturation, resulting in tree health decline or death
- Drought stress in samplings unable to re-adjust to the withdrawal of artificial water supply on cessation of discharge
- Changes in vegetation structure including an enhanced potential for weed invasion

Discharge increases water availability in the unsaturated zone of the downstream creek bed alluvium, and can result in persistent waterlogged conditions in the soil profile within channel sections. The potential effects include tree health decline in established trees due to prolonged saturation of root systems, enhanced recruitment of new trees and the establishment of waterlogging tolerant species including sedges and rushes.

Monitoring of responses in eucalypt foliage cover to discharges into Weeli Wolli Creek indicate variable impacts of discharge on tree health. The Proponent’s riparian vegetation health monitoring program suggests that individual tree responses range from no discernible impact to severe stress or tree death in extreme cases. Foliage cover has displayed negative responses to discharge rates particularly at higher volumes at the existing Yandi Operations, with the greater impact on foliage cover related to shallower (artificially elevated) water tables in the alluvium (Eastham 2015).

Relationships between foliage cover and depth to water showed statistical reductions in foliage cover with rising water levels at some sites in Weeli Wolli Creek adjacent to the proposed pit, however, the response of individual trees at a site was not uniform, and at most of the sites there were some trees that increased their foliage cover. This finding indicates that a proportion of trees at each site likely occupy an ecological niche which has allowed them to maintain or increase their canopy (Eastham 2015). Trees occurring at higher elevations tended to maintain or increase foliage cover at some, but not all, sites.

Localised impacts around the discharge outlet and within the low-flow channel of the downstream reaches of Marillana Creek are most likely to experience waterlogging, which may result in declining health or death of some species, particularly *E. victrix,* and particularly if located within lower elevations of the creek bed such as directly within the low-flow or on lower elevations of the incised channel such as the scoured bed zones fringing the low-flow channel. Further downstream in Weeli Wolli Creek, the impacts will be largely restricted to the low-flow channel and lower scoured bed sections of the incised channel, and are likely to reduce with distance further downstream as surplus water infiltrates into the alluvial aquifer. Impacts will also include increased vegetation biomass as a result of increased vigour and associated recruitment by riparian species.

Hydrological modelling and infiltration tests predict that by maintaining the additional discharge from DO9, the surplus water wetting front will remain within the 17km footprint approved under MS914, and hence the impact footprint will be constrained to this section of the creekline. Given the wetting front is predicted to be within existing approved limits, it is considered that there will be negligible impacts on Fortescue Marsh due to a minor decrease in catchment area. However, if the discharge location were to be shifted further downstream, there is risk of extending the wetting footprint within Weeli Wolli Creek and towards the Fortescue Marsh.

14.3.3.4 Management of riparian systems

Drawdown can potentially reduce the availably of groundwater to species able to access this water source. Most Pilbara flora do not utilise groundwater but use stored soil moisture (derived from surface inputs) to meet their water use requirements. Riparian systems of the Pilbara bioregion are subjected to extremely seasonal and variable hydrologic regimes, in which stream flow typically occurs following cyclonic rainfall events. In the Proposal Area, the hydrological connection along Weeli Wolli Creek will be maintained throughout the development of the Proposal, which will allow the natural flood flows to persist and replenish the riparian system. Concurrently, discharge flows from Hope Downs 1 are modelled to continue to persist within the low-flow channel adjacent to the proposed PBS pit, which will assist in managing localised impacts from drawdown as a result of implementing the Proposal. As a result, additional long term supplementary irrigation of Weeli Wolli Creek adjacent to the Proposal is considered limited in its potential effectiveness to further mitigate potential groundwater drawdown impacts on the riparian system.

Historically, the Proponent and other mining companies in the region have sought to manage surplus water by discharging directly into creeklines. This approach has met with varying levels of success, and it can be argued that the approach has also generated alternate ecosystem impacts, for example artificially generating permanent pools, waterlogging of existing healthy systems; and artificially enhancing biomass and recruitment. Permanent supplementary irrigation via discharge as an approach to negate the effects of groundwater drawdown during mining could result in the continuation of surface water flows along the low-flow channel of Weeli Wolli Creek and potentially maintain an artificially augmented system, which may not necessarily effectively mitigate the potential impacts on the riparian systems.

Creek ecosystem health observations at existing mining operations in the area suggest that local environmental conditions other than the groundwater level (i.e. topographic position, soil type and surface water runoff) can influence local soil water availability and thus offset the degree of impact experienced by individual vegetation communities due to dewatering. Consequently, managing the impact of dewatering on the environment through discharge spurs would is not proposed at this stage.

To enable the most effective management of the riparian system for the Proposal, a detailed study is being undertaken to further understand plant-water requirements, and refine appropriate management measures. Management measures may include forms of temporary irrigation within targeted mature parts of the riparian system, with the aim to allow the system to adapt and gradually return to the lower pre-mining water levels that are predicted to persist following cessation of mining and discharge in the area. It is considered that this approach will avoid unnecessarily maintaining younger (artificial) parts of the system by ongoing irrigation, which inevitably would not survive after cessation of mining and discharge. This approach aims to align with the adaptive management framework and includes:

- investigations to resolve local environmental (baseline) conditions;
- ongoing monitoring and investigations, until a causative link between dewatering drawdown and changes in ecosystem health can be determined; and
- design of mitigation solution options, targeted to deliver localised outcomes, to enable timely implementation if mining related water availability is determined to contribute to a significant decline in ecosystem health.

This approach was successfully applied for the management of potential impacts to the Mt Bruce Flats PEC as part of the Marandoo below water table operation; where, as a consequence of the management approach, it was demonstrated that water availability in the woodland was not linked to groundwater elevation and irrigation of the PEC was not required to maintain the persistence of the long term community.

The proposed program to determine appropriate management would include:

1. Investigative study to be undertaken as part of the Proposal Feasibility Study.

   - Refined hydrogeological sampling and geochemical analysis.
   - Installation of long term water monitoring bores at tree health monitoring sites and areas identified as higher risk.
   - In situ neutron probe measurements to determine spatial and in situ variability in soil water content.
   - Refined definition of baseline conditions.

- Riparian zone environmental risk assessment.

2. Development of mitigation solutions based on the findings of the investigation with a detailed plan for implementation should mitigation be necessary. This may include options for targeted irrigation in mature riparian areas considered to be of high local value and at high risk of impact due to groundwater drawdown.

3. Continuation and refinement of the existing operational monitoring network including:

- Ecosystem health.
- Groundwater levels.
- Ecological water availability.

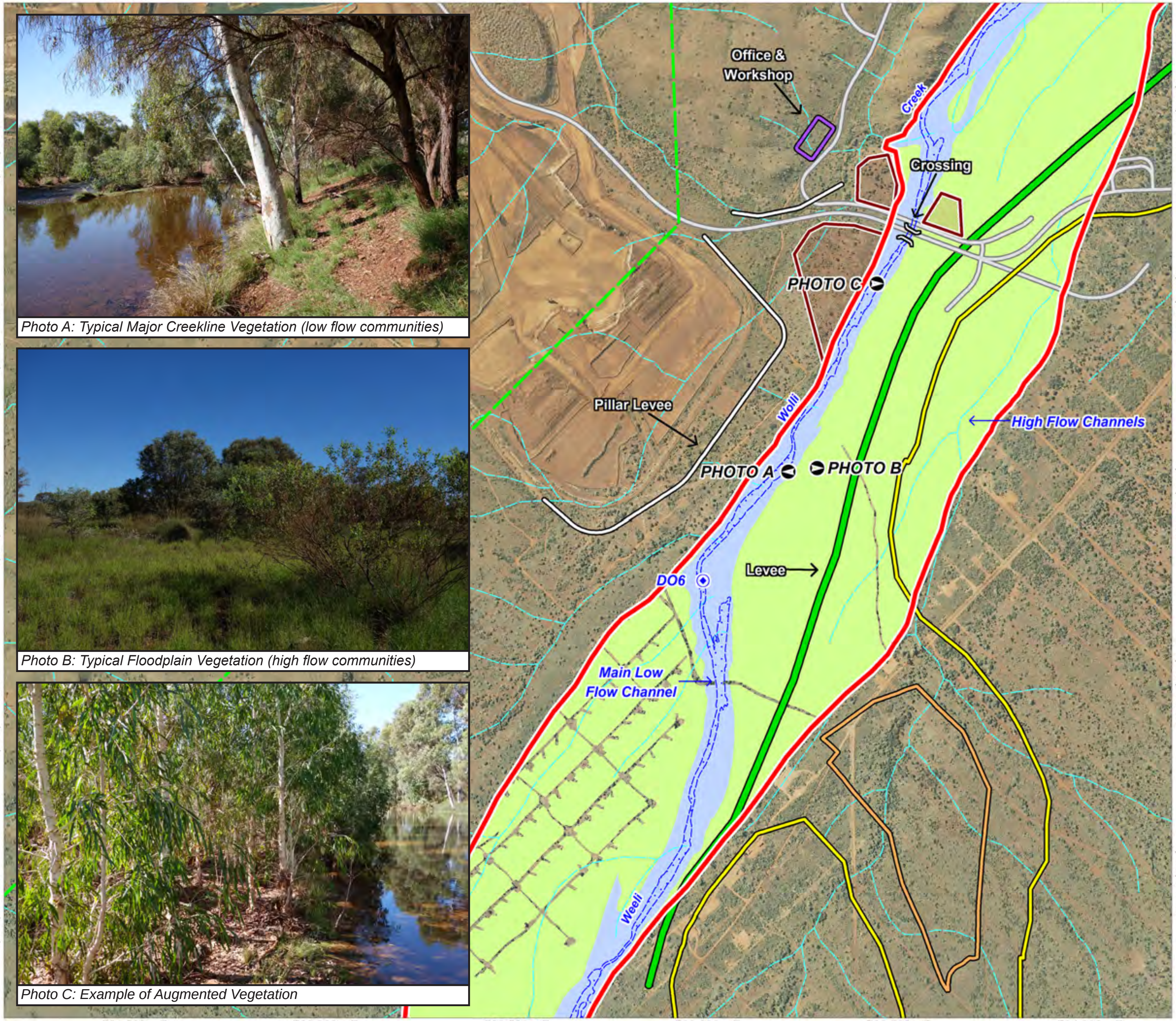

Photo A: Typical Major Creekline Vegetation (low flow communities)

Photo B: Typical Floodplain Vegetation (high flow communities)

Photo C: Example of Augmented Vegetation

LEGEND

- Proposal Area
- Clearing Avoidance Area (MS914) (2012)
- Discharge Outlet
- Low Flow Channel
- High Flow Channel

Conceptual Mine Layout

- Mine Pit
- Topsoil Stockpile
- Office & Workshop
- Crossing Drainage Management
- Levee
- Pillar Levee
- HV & LV Road

Riparian Zone Vegetation

- Vegetation of Major Creeklines
- Vegetation of Minor Creeklines and Floodways

N

SCALE

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Rio Tinto

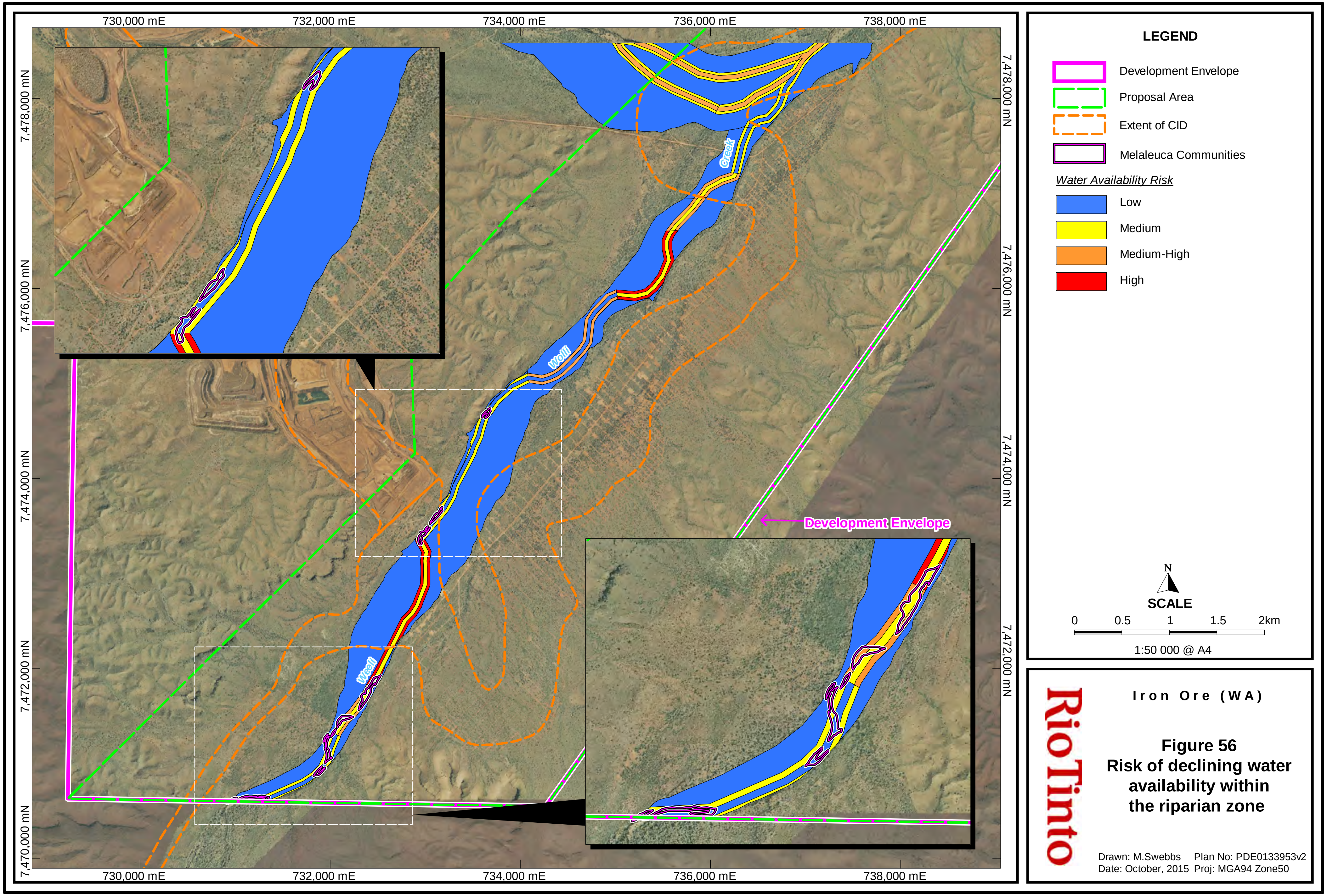
Iron Ore (WA)

Figure 55
Broad Riparian vegetation associations in relation to high and low flow channels and mining infrastructure

Drawn: M.Swebbs
Date: Oct, 2015

Plan No: PDE0136053v1
Proj: MGA94 Zone50

Geospatial Information and Mapping



Geospatial Information and Mapping

14.3.4 Introduction and/or spread of weeds

Weeds can spread into natural environments by many vectors, including wind, water, and the movement of soils, people, vehicles, machinery and fauna (including native animals and livestock). The most relevant of these in relation to the Proposal is vehicle and earth movements, and discharge activities. Weeds are often able to rapidly invade locations subject to disturbance, land clearing and/or altered fire regimes, and altered hydrological regimes. This can result in smothering and replacement of native plants and domination and simplification of natural ecosystems.

The most common areas within the Proposal in which weeds were recorded were creeklines and floodplains. The most commonly recorded weeds were **Cenchrus ciliaris* and **C. setiger* which in many areas formed a continuous tussock grassland community resulting in low numbers of native understorey species along the banks of Weeli Wolli and Marillana Creeks. These species have the potential to spread further with cattle activity, water movement and clearing (Biota 2014a). Despite this fact it is noted that within the key habitats available on Marillana and Weeli Wolli Creeks, only a small areal extent remains un-colonised by these species.

Limited clearing will occur in these communities as part of the Proposal, however, weed management measures will be implemented in accordance with Yandicoogina Weed Action Plan **(Appendix 4**) to minimise the risk of weed introduction and spread. Some of the key actions that will be implemented are:

- Vehicle and equipment hygiene practices.
- Weed monitoring.
- Periodic weed control.

14.3.5 Effects of dust

Dust deposition on vegetation from the Proposal is likely to be restricted to immediately adjacent vegetation and will be mitigated by periodic high rainfall events, which would remove built-up materials on leaves. As per much of the vegetation in the Pilbara, native vegetation in the area is also expected to be reasonably tolerant to dust deposition and would not be at risk of significant physiological impacts. Research conducted at West Angelas mine site, 60 km to the west of the Proposal, showed no detectable negative impact of dust on plant function for a number of different leaf types (Butler 2009). Background dust levels in the vicinity of the Proposal Area are high relative to urban areas in the south west of WA. Located in the arid Pilbara region, dust lift off occurs naturally from sparsely vegetated landscapes.

Dust deposition on vegetation has not been identified as a key environmental issue in the wider Yandicoogina locality and to date management has been as per standard Rio Tinto practices. The ore being mined as part of the Proposal is below water table and as such has a high moisture content. Additionally, there is sufficient surplus water for dust suppression if required.

The Proposal will be managed in accordance with the Yandi Operations MMP and the E12 Standard (Air Quality Protection), which includes the following management measures:

- using existing tracks where possible;

- implementing speed limits to reduce dust generation;
- minimising clearing and conducting rehabilitation; and
- water application (heavily trafficked areas, stockpiles etc.).

14.4 Cumulative impacts

14.4.1 Cumulative impacts to riparian vegetation

A preliminary assessment of cumulative impacts to potentially groundwater dependent riparian vegetation (herein defined as vegetation supporting *Eucalyptus camaldulensis* and/or *E. victrix* and/or *Melaleuca argentea*) was conducted based on a review of the potential impacts of the Proposal (Rio Tinto), the existing Yandi Operations and 19 other projects identified as being potentially relevant based on their location in the Upper Fortescue River Catchment (three Rio Tinto and 17 third party projects; **Table 22**).

Of the projects reviewed, insufficient information was available in the documentation reviewed for some projects to enable their inclusion in the cumulative impact assessment (**Table 22**). Further, it was not possible based on the information available at the time of the review to determine the extent of overlap (if any) between areas of groundwater dependent vegetation mapped for different projects.

Of the approximately 14,946 ha of potentially groundwater dependent riparian vegetation mapped for the projects considered (including the Proposal), up to 2,159 ha will be disturbed (including areas cleared and areas subject to potentially significant impacts due to groundwater drawdown), which represents approximately 14% of the mapped extent (**Table 22**).

Table 22: Assessment of potential cumulative impacts to riparian vegetation in the Upper Fortescue River Catchment

Project	Baseline	Potential impact to riparian vegetation	Reference
Past and present actions			
FMG Christmas Creek Mine - Water Management Scheme (EP Act Assessment No. 1873; EPBC Act Ref. 2010/5706)	938 ha	82 ha	ENV (2010); FMG (2010a); FMG (2011)
FMG Cloudbreak Iron Ore Mine (EP Act Assessment No. 1577; EPBC Act Ref. 2005/2205)	824 ha	119 ha	Environ Australia (2005a)
FMG Cloudbreak Life of Mine (EP Act Assessment No. 1848; EPBC Act Ref. 2010/5696)	1,429 ha	473 ha	ENV (2010); FMG (2012)
Hamersley HMS's Hope Downs 1 Iron Ore Mine Expansion (EP Act Assessment No. 1308)	161 ha	10 ha	Ecologia (1997); Hope Downs Management Services Pty Ltd (2000)
Rio Tinto (managed) Hope Downs 4 Iron Ore Mine (EP Act Assessment No. 1738; EPBC Act Ref. 2008/4636)	914 ha	28 ha	This document

Project	Baseline	Potential impact to riparian vegetation	Reference
FMG IO Direct Shipping Iron Ore Project (Not Assessed – Public Advice Given under the EP Act)	NA	NA	Only the EPA (2012c) public advice was available at the time of assessment. Insufficient information was provided in that advice to enable the IO Direct Shipping Iron Ore Project to be included in the cumulative impact assessment
Iron Ore Holdings Iron Valley Iron Ore Project (EP Act Assessment No. 1905; EPBC Act Ref. 2012/6458)	114 ha	0 ha	URS (2012)
BHP Jinidi Iron Ore Mine (EP Act Assessment No. 1904; EPBC Act Ref. 2012/6299)	NA	NA	Both *E. camaldulensis* and *E. victrix* were present in the Jinidi Iron Ore Mine Project area (vegetation type 1a); however the area of vegetation supporting these species was not provided in the documentation reviewed (BHP 2011)
Rio Tinto Koodaideri Iron Ore Mine (EP Act Assessment No. 1933; EPBC Act Ref. 2012/6422)	543 ha	16 ha	ELA (2013)
BHP Marillana Creek (Yandi; EP Act Assessment No. 1555)	NA	NA	Groundwater dependent vegetation supporting *E. camaldulensis* and *E. victrix* was recorded in the Marillana Creek (Yandi) Project area; however, the area of such was not quantified in the documentation reviewed (EPA 2005)
Brockman Marillana Iron Ore Project (EP Act Assessment No. 1781; EPBC Act Ref. 2011/5892)	308 ha	19 ha	Brockman Resources (undated)
BHP Mining Area C (EP Act Assessment No. 1108)	NA	NA	Both *E. camaldulensis* and *E. victrix* were present in the Mining Area C Project area (vegetation type 13); however the area of vegetation supporting

Project	Baseline	Potential impact to riparian vegetation	Reference
			these species was not provided in the documentation reviewed (Woodward-Clyde 1997)
Mineral Resources Phil's Creek Iron Ore Mine (EPBC Act Ref. 2009/5107)	NA	NA	Vegetation type C1 supported both *E. camaldulensis* and *E. victrix*; however, details were not provided in the documentation reviewed on the area mapped and area proposed to be disturbed (Mattiske 2008c; URS 2009)
FMG Pilbara Iron Ore and Infrastructure Project - Railway Stage A (EP Act Assessment No. 1505)	NA	NA	Insufficient information was provided in the documentation reviewed to enable inclusion of this project in the cumulative impact assessment (FMG 2010b)
FMG Pilbara Iron Ore and Infrastructure Project - Railway Stage B (EP Act Assessment No. 1520; EPBC Act Ref. 2004/1897)	NA	NA	Both *E. camaldulensis* and *E. victrix* were present in the Pilbara Iron Ore and Infrastructure Project - Railway Stage B Project area; however, the area of vegetation types supporting these species was not provided in the documentation reviewed (Environ Australia 2005b)
Roy Hill Roy Hill 1 Iron Ore Mining Project Stage 1 (EP Act Assessment No. 1589; EPBC Act Ref. 2008/4624)	2,587 ha	568 ha	EPA (2009b); Roy Hill (2009)
Roy Hill Roy Hill 1 Iron Ore Mining Project Stage 2 (EP Act Assessment No. 1822; EPBC Act Ref. 2008/4624)	2,591 ha	353 ha	EPA (2009b)

Project	Baseline	Potential impact to riparian vegetation	Reference
Rio Tinto Yandicoogina Iron Ore Project, comprising: • Junction Central (EP Act Assessment No. 809 & 946) • Junction South East (EP Act Assessment No. 1590) • Junction South West and Oxbow (EP Act Assessment No. 1726; EPBC Act Ref. 2011/5815)	1,836 ha	67 ha	This document
Anticipated project actions			
Rio Tinto Proposal (this assessment)	791 ha	69 ha	This document
Reasonably foreseeable future actions			
FMG Christmas Creek Expansion Project (EP Act Assessment No. 1989; EPBC Act Ref. 2013/7055)	1,910 ha	355 ha	FMG (2015)
FMG Nyidinghu Iron Ore Project (EP Act Assessment No. 1068; EPBC Act Ref. 2013/6945)	NA	NA	FMG (2013)
Cumulative impact			
Refer above	14,946 ha	2,159	Refer above

* Area disturbed includes the area cleared and the area potentially significantly affected by groundwater drawdown. NA: Not available.

14.5 Key management actions

Flora and vegetation values in the Proposal Area will be protected through implementation of measures in accordance with the Yandicoogina Weed Action Plan; the E11 Standard: Water Quality Protection; the E14 Standard: Land Disturbance and Rehabilitation Control; the Yandicoogina Closure Plan; and the MMP which includes Water Discharge Management and Monitoring, as well as Vegetation and Groundwater Dependent Ecosystems Management and Monitoring. Key management measures include:

- Ongoing monitoring of the health and cover of riparian vegetation within the Revised Proposal Development Envelope and drawdown and discharge footprints using a number of techniques, along with their associated trigger and threshold levels including:
    - o DCP monitoring; which measures canopy foliage density of mature riparian eucalypts. Foliage density in eucalypts is correlated with plant available water in accordance with the principle of ecological optimality (O'Grady et al. 2011; Ellis & Hatton 2008); and is regarded as a reliable indicator of water related stressors such as drought;

- Digital Multi-Spectral Imagery (DMSI) remote sensing of riparian vegetation; which provides a quantitative measure of change in vegetation condition based on a multiple spectral indexes;
- Riparian vegetation monitoring; involving direct measurement of vegetation attributes (*e.g.* structure and composition) in transects within the riparian vegetation communities;

- Ongoing monitoring and management of weeds, including established baseline and reference sites; implementing vehicle hygiene procedures; and targeted control.
- Maintaining a Clearing Restricted Area around the Marillana and Weeli Wolli Creeklines to limit clearing within riparian vegetation zones.
- Limiting the pit encroachment into edge of floodplain within less significant shrubland communities of the riparian zone and avoiding riparian woodland vegetation.
- Maintaining major creekline floodflows and minimising erosion on the creeklines by limiting the disturbance within the creeklines, and undertaking surface water modelling and geomorphological assessments on infrastructure required within the creeklines.
- Maintaining creekline discharge upstream of the Proposal to partially negate the potential impacts of groundwater drawdown.
- Monitoring surface water discharge extent within Weeli Wolli Creek.
- Monitoring discharge water quality, including pH, TDS, TSS and a range of analytes.
- Monitoring groundwater levels within monitoring bores to establish causative links between groundwater levels and tree health.
- Weed monitoring and management.

Disturbed areas will be rehabilitated following completion of mining. Refer to Section 17 for further details regarding rehabilitation and closure.

14.5.1 Status of existing Yandi Operations management

The ESD prepared by the EPA required provision of information on the current status and outcomes of the riparian vegetation management actions required by MS 914 Condition 7 – Riparian Vegetation, and Condition 8 – Weeds. A summary, based on the 2014 Annual Compliance Assessment Report, is outlined in the sections below.

14.5.1.1 Riparian vegetation

The Yandicoogina Surface Water Discharge and Groundwater Dependent Ecosystems Monitoring and Management Plan has been prepared and approved by OEPA. The outcome-based conditions identified in regard to riparian vegetation have been met, specifically:

- Water abstraction did not cause clearing or loss of vegetation or groundwater dependent ecosystems outside of prescribed zones.
- Dewatering discharge did not cause clearing or loss of vegetation or groundwater dependent ecosystems outside of prescribed zones.

- No irreversible impact occurred to riparian vegetation or groundwater dependent ecosystems within prescribed zones.

Monitoring and investigations using vegetation transects, visual qualitative assessments and a review of correlative environmental parameters confirmed that trigger levels for 'no impact' and 'no irreversible impact' had not been exceeded and therefore no contingency actions have been required to be implemented.

Overall, the Digital Canopy Photography and transect monitoring indicated some areas of riparian vegetation that were showing signs of stress (including foliage cover less than baseline data) while other areas showed increased foliage cover. The results from the DMSI align with DCP and vegetation transect results, showing variation in condition across both Marillana and Weeli Wolli Creeks. Some individual trees around the low-flow channels show reduced condition when compared to baseline, however, the overall green-ness indicates high recruitment rates of eucalypts and other strata.

14.5.1.2 Weeds

Weed monitoring sites have been developed in consultation with Parks and Wildlife and accepted by OEPA. Monitoring undertaken in 2014 showed that weed coverage in all monitored areas was lower than baseline cover.

14.6 Predicted outcome

A total of up to 1,800 ha of flora and vegetation will be required to be cleared for the Proposal. A range of measures have been or will be implemented to reduce potential impacts to flora and vegetation values (**Table 23**).

Table 23: **Mitigation hierarchy for flora and vegetation values**

Mitigation measure	Description
Avoidance	Re-designed waste rock dumps to avoid recorded *L. catapycnon* populations.
Minimisation	Clearing will be minimised to that required for safe construction and operation. Optimising waste dump designs and mine plan to minimise overall waste dump ex-pit clearing. Maintaining a Clearing Restricted Area which limits clearing of riparian vegetation, as far as practicable, to that required for key infrastructure to enable development of the Proposal (such as creek crossing points). Clearing of significant riparian vegetation communities containing mature Melaleuca communities avoided. Pit encroachment into edge of floodplain is located within less significant shrubland communities of the riparian zone. Limited physical disturbance to the low-flow channel (for infrastructure crossings only). Low flows in Weeli Wolli Creek will be maintained to support phreatophytic vegetation. Discharge location and wetting front extent designed to limit wetting front extent beyond existing approved 17km limit from the Marillana – Weeli Wolli confluence.
Rehabilitation	Disturbed areas will be rehabilitated using local native vegetation species, consistent with the Yandicoogina Closure Plan. Key functional creek elements retained (e.g. flood pathways, vegetation seed bank) to support natural rehabilitation upon closure.

After the mitigation hierarchy has been applied, it is expected that the Proposal will result in the following residual outcomes in relation to flora and vegetation:

- Clearing of up to 1,800 ha flora and vegetation (including 69 ha riparian zone vegetation).
- Stress and loss of some riparian vegetation associated with dewatering activities (drawdown), particularly more groundwater dependant vegetation and younger recruitment/augmented areas of riparian vegetation sustained by pre-existing discharge, with the vegetation expected to return to a more 'natural' state (i.e. pre-mining).
- Loss of some riparian vegetation associated with surplus water discharge, particularly waterlogging affects and the establishment of waterlogging tolerant species including sedges and rushes, though overall impacts will be limited to the currently approved footprint limit within MS 914 (17 km downstream from confluence of Marillana and Weeli Wolli Creeks).
- No loss of known and recorded individuals of *Lepidium catapycnon* (Hamersley Lepidium); redesign of the waste dumps has avoided recorded individuals and they have been designated 'areas of special protection from ground disturbance' and therefore excluded from the ground disturbance footprint.
- Removal of some individuals of Priority 4 flora species (*Goodenia nuda*), though it is recorded throughout the Pilbara and it is considered that this will not alter the species' conservation status.
- Rehabilitation of areas disturbed by the Proposal, consistent with the draft Yandicoogina Closure Plan.

Consistent with current guidelines and EPA approaches, the clearing of up to 1,731 ha of native vegetation in Good to Excellent condition and 69 ha riparian zone vegetation[4] within the Proposal Area will be offset as part of the Proposal (Section 18).

[4] For the purposes of the offset calculation, riparian zone vegetation is classified as vegetation units within the riparian zone comprising C-coded and F2 coded vegetation located within the RCA.

15. Terrestrial fauna

15.1 Key statutory requirements, environmental policy and guidance

15.1.1 EPA objective

The EPA has applied the following objective for the Proposal to its assessment of terrestrial vertebrate and short range endemic invertebrate fauna:

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

15.1.2 Regulatory framework

The following legislation is relevant to the Proposal with respect to the protection of terrestrial fauna values and the above EPA objective:

- *Wildlife Conservation Act 1950* (WA).
- *Conservation and Land Management Act 1984* (WA).
- *Environmental Protection Act 1986* (WA).
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).

15.1.3 Relevant guidelines and policy

The following guidelines and international agreements are relevant to the Proposal with respect to the protection of terrestrial vertebrate, short range endemic invertebrate and aquatic fauna and the above EPA objective:

- EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002).
- EPA Guidance Statement No. 20: Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in WA (EPA 2009a).
- EPA Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in WA (EPA 2004d).
- Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA and DEC 2010).
- Survey Guidelines for Australia's Threatened Bats (DEWHA 2010).
- Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011a).
- Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011b).
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ 2000).
- Pilbara Water in Mining Guideline Report No.34 (DoW 2009).
- Japan-Australia (JAMBA), China-Australia (CAMBA) and Republic of Korea-Australia (ROKAMBA) Migratory Bird Agreements.

- The Convention on the Conservation of Migratory Species and Wild Animals (also known as the Bonn Convention).

15.2 Description of terrestrial vertebrate fauna

15.2.1 Terrestrial fauna surveys

There have been five previous vertebrate fauna and invertebrate SRE surveys overlapping or conducted in the Proposal Area (**Table 24** and **Figure 57**; surveys have been given codes for ease of recognition):

- Yandi Expansion Project - Conservation Significant Vegetation, Flora, Fauna and Fauna Habitat Assessment (JSE; Biota 2005).
- Yandicoogina Targeted Northern Quoll Survey (YNQ; Biota 2009).
- Yandicoogina Expansion Billiard Deposit Fauna Survey (BIL; Biota 2011).
- Pocket and Billiards South Level 2 Seasonal Fauna Survey (PBS; Biota 2014c, 2014e).
- Yandi Billiards Targeted Northern Quoll Survey (YBNQ; Biota 2014d).

Sampling methodology differed among the surveys, depending on the target fauna group. However, surveys typically included the following sampling methods:

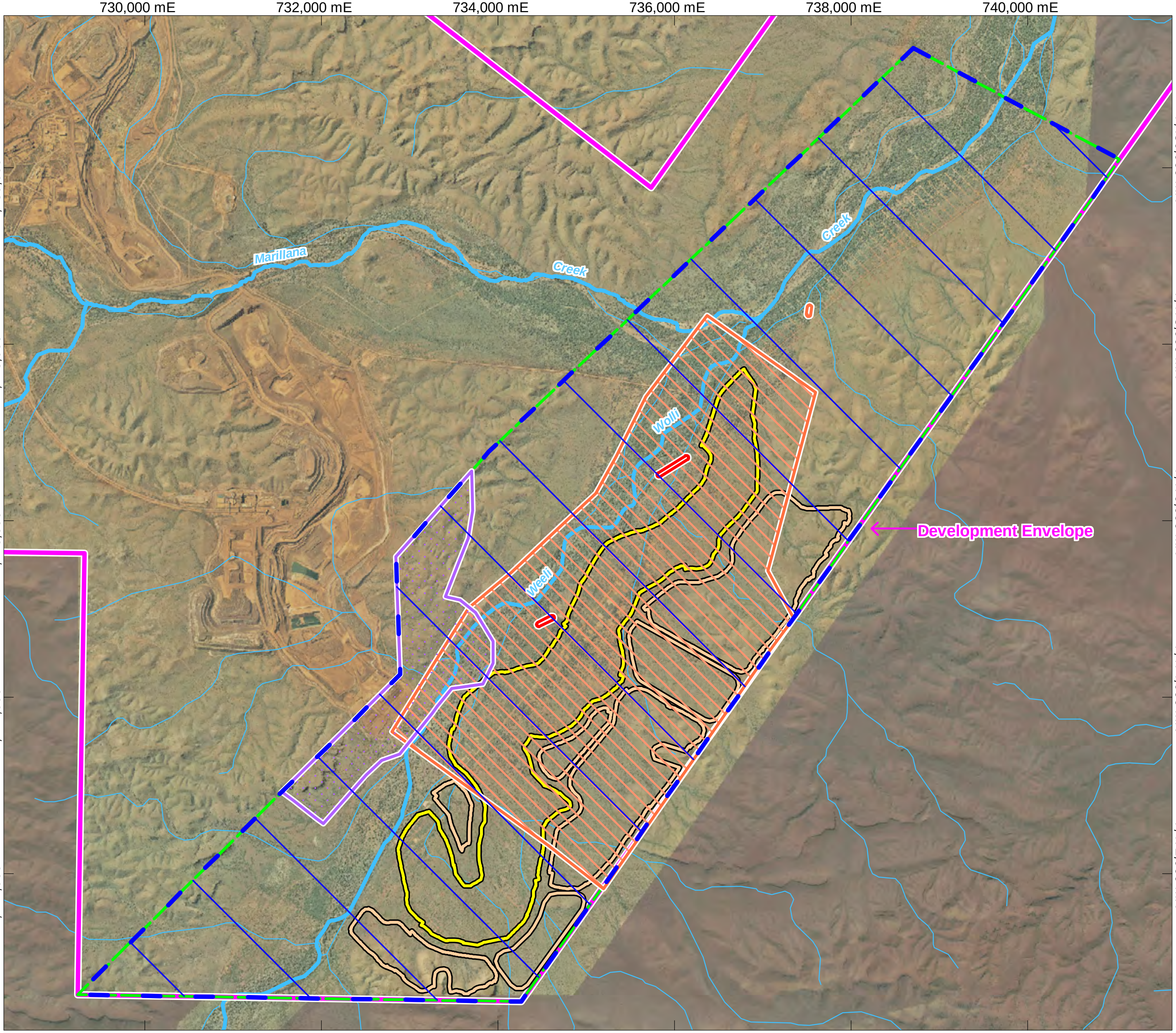
- Systematic sampling for non-volant mammals, reptiles, amphibians and SRE fauna via pitfall and funnel trapping grids and medium and large Elliott trap transects.
- Systematic volant mammal (bat) sampling via harp nets.
- Systematic avifauna surveys.

A range of non-systematic techniques were also used to identify animals not commonly recorded through trapping. These techniques included:

- Searching of specific habitats (targeted surveys).
- Identification of road kills and other animal remains.
- Opportunistic sightings and records.
- Secondary signs including tracks, scats and diggings.
- Motion camera trapping.
- Nocturnal searches.
- Echolocation call recorders such as Anabat SD2 and Song Meter SM2 for bat sampling.
- Audio recording for night birds and amphibian calls using the Song Meter SM2.

The location of systematic and non-systematic trapping sites within the Proposal Area is shown in **Figure 58**.

The description of fauna values has been adapted from the Biota survey reports (2005, 2009, 2011, 2014c, 2014d, 2014e) unless otherwise stated. Biota desktop reports (2010, 2013, 2014f, 2015b) have also been referenced.



LEGEND

- Development Envelope
- Proposal Area
- Conceptual Mine Pit
- Conceptual Waste Dump / Stockpile
- Major; Minor Watercourse

Previous Fauna Surveys

- JSE Biota 2005b
- BIL Biota 2011a
- YNQ Biota 2009a
- YBNQ Biota 2014a, 2014h PBS Biota 2014a, 2014c

N

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Rio Tinto

Iron Ore (WA)

Figure 57
Previous terrestrial fauna surveys in the Proposal Area

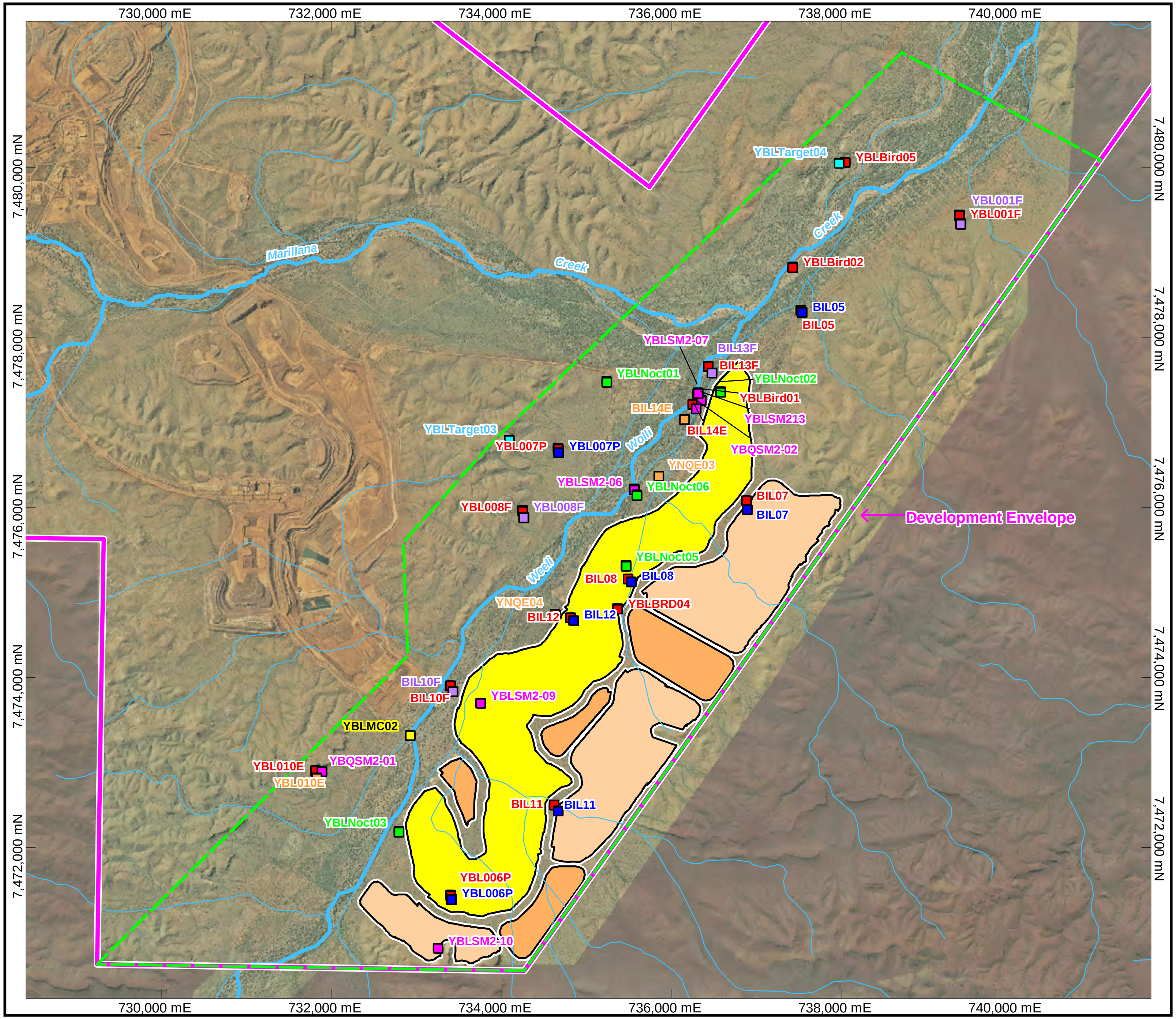
Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0133310v2
Proj: MGA94 Zone50

Geospatial Information and Mapping

Table 24: Summary of previous fauna surveys that overlap the Proposal Area

Survey (Reference)	Survey Code (from Biota 2015b)	Survey Dates	Fauna Groups Targeted	No. of Sampling Sites in Proposal Area	Conservation Significant Species Recorded During Survey (not necessarily in Proposal Area)	Survey Limitations and Constraints
Yandi JSE Project - Targeted Conservation Significant Vegetation, Flora, Fauna and Fauna Habitat Assessment (Biota 2005)	JSE	30/08/04-03/09/04	Invertebrate SRE	3 invertebrate (targeted)	• Nil.	• Single phase survey. • Large proportion of the study area was recently burnt. • Dry conditions discouraged activity in many invertebrate groups. • Vertebrate field survey was not conducted.
Yandicoogina Expansion Billiard Deposit Fauna Survey (Biota 2011)	BIL	05/07/08-12/07/08 04/03/10-07/03/2010 (invertebrate SRE only)	Vertebrate fauna Invertebrate SRE	8 vertebrate 8 avifauna 1 bat 9 invertebrate (4 targeted, 5 systematic)	• Rainbow Bee-eater (Sch 3, Migratory). • Western Pebble-mound Mouse (P4).	• Single phase vertebrate survey. • Not all sections of the study area could be sampled equally due to limited access.
Yandicoogina Targeted Northern Quoll Survey (Biota 2009)	YNQ	06/10/09-12/10/09	Northern Quoll	2 vertebrate	• Nil.	• Single phase survey. • Sampling was targeted at the Northern Quoll. • Collection of other taxa was mostly opportunistic.
Yandicoogina Pocket and Billiard South Level 2 Seasonal Fauna Survey (Biota 2014c,e)	PBS	Phase I: 08/03/14-18/03/14 Phase II: 10/09/14-19/09/14	Vertebrate fauna Invertebrate SRE	11 vertebrate 23 invertebrate (2 systematic, 21 targeted) 8 bat 10 avifauna	• Pilbara Olive Python, (Sch 1, V). • Fork-tailed Swift (Sch 3, Migratory). • Eastern Great Egret (Sch 3, Migratory). • Rainbow Bee-eater (Sch 3, Migratory). • Brush-tailed Mulgara (P4). • Western Pebble-mound Mouse (P4). • Chocolate Wattle Bat (no formal listing). • Three potential SREs: Idiopidae sp. I53, Nemesiidae sp. N42 and Nemesiidae sp. N44.	• Survey did not equally sample all areas of the target area, instead concentrated on areas that have previously been under represented during surveys. • Non-systematic sampling also undertaken.
Yandi Billiards Targeted Northern Quoll Survey (Biota 2014d)	YBNQ	05/08/14-13/08/14	Northern Quoll Invertebrate SRE Volant mammals	5 vertebrate 1 invertebrate (targeted) 6 bat	• A single potential Northern Quoll scat was found; however molecular sequencing was unable to determine its origin.	• Single phase survey. • Sampling was predominately targeted at the Northern Quoll.

***** Not necessary in the Proposal Area



LEGEND

- Development Envelope
- Proposal Area
- Conceptual Mine Pit
- Conceptual Waste Dump
- Conceptual Topsoil / Subsoil Stockpile
- Major; Minor Watercourse

Vertebrate Trapping Sites

- Avifauna
- Elliott
- Funnel
- Motion Camera
- Nocturnal
- Pitfall
- Bat SongMeter
- Targeted

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RioTinto

Iron Ore (WA)

Figure 58
The location of systematic and non-systematic trapping sites within the Proposal Area

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0133316v2
Proj: MGA94 Zone50

Geospatial Information and Mapping

15.2.2 Terrestrial fauna habitats

Five fauna habitats were identified in the Proposal Area by Biota (2014c). These habitats were based on a combination of larger landform patterns (floodplains, hills etc.) and smaller landform elements (breakaways, slopes etc.), on the basis that fauna utilise many components of a landform, and are not specific to a certain element. Fauna habitats are described in **Table 25** shown in **Figure 59** and consist of:

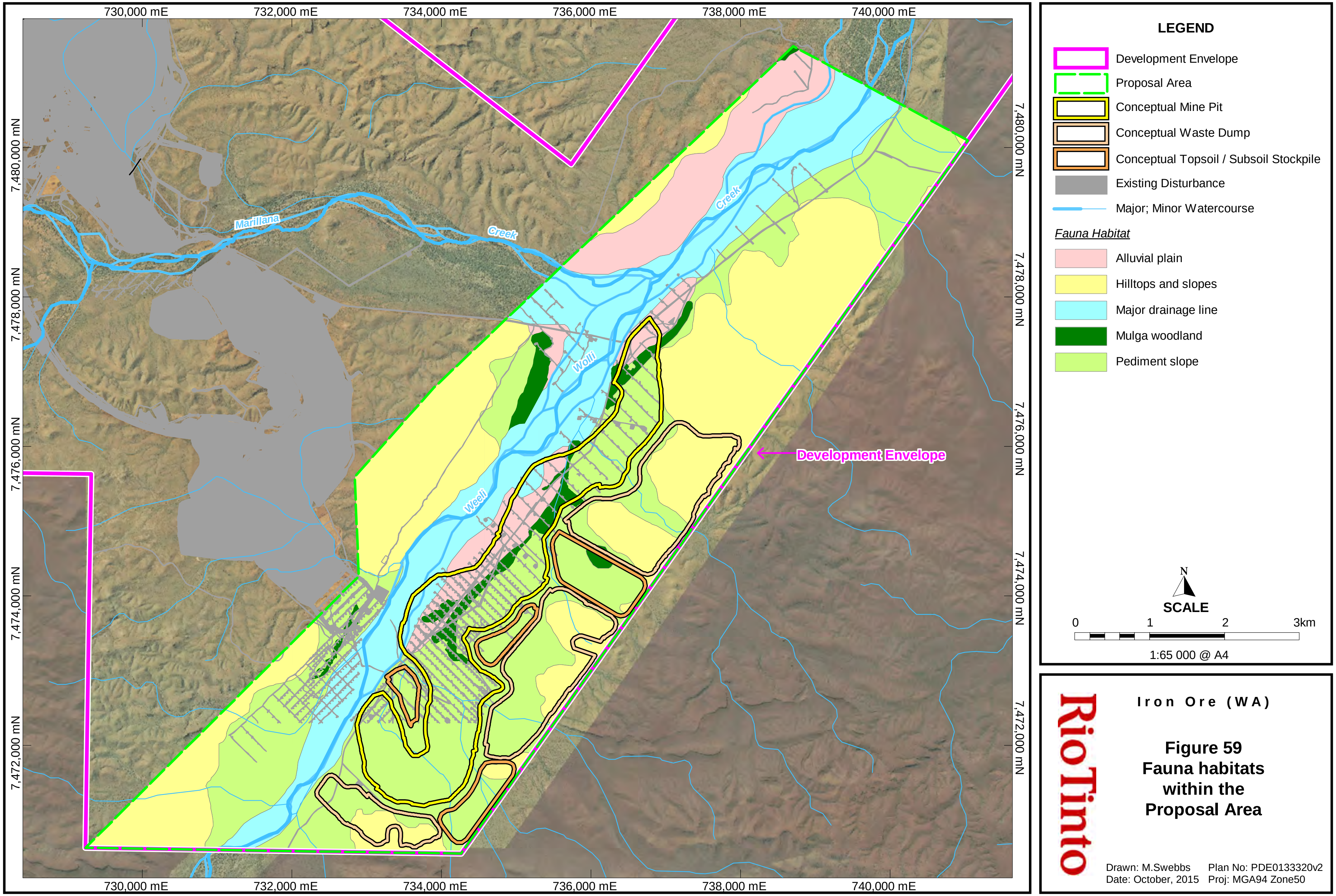
- Alluvial Plain (Flood Plain).
- Mulga woodland.
- Hilltops and Slopes.
- Pediment Slope.
- Major Drainage Line.

Disturbed areas within the Proposal Area were also mapped.

Table 25: Landforms and descriptions of fauna habitats mapped within the Proposal Area

Landform Pattern	Fauna Habitat	Description	Current Area within the Proposal Area (ha)
Flats	Alluvial Plain (Flood Plain)	An area of land adjacent to a drainage line that stretches from the banks of its channel to the base of the enclosing valley walls. It experiences flooding during periods of high discharge but does not experience a strong current.	402
Flats	Mulga Woodland	Mulga woodlands in Proposal Area occur on areas of alluvial plain. They are delineated as a discrete fauna habitat because they support a distinct fauna assemblage not present in other habitats within the Proposal Area.	111
Hilltops and Slopes	Hilltops and Slopes	Hilltops and slopes make up much of the Proposal Area and consist of a number of landform elements, notably (from highest to lowest elevation): Crests, Free Faces, Breakaways (not always present), Transitional Slopes and Foot Slopes.	1,434
Hilltops and Slopes	Pediment Slope	The large, gently inclined lower slopes below hills underlain by bedrock at varying depths. Pediments in the Proposal Area vary in width and exhibit sharp breaks of slope between the pediment and the steeper hillside above them. Water passes across the pediment by laminar sheet flow, but if this is disturbed, the flow becomes turbulent and gullies develop.	1,542
Drainage	Major Drainage Line	A linear, sinuous open depression forming the floor of the major drainage channel (Weeli Wolli Creek) that is eroded or aggraded (built-up) by stream flow. In the Proposal Area this supports taller eucalypts, dense shrublands and reedbeds around water pools that are semi-permanent due to upstream mine dewatering.	859
Disturbed		Areas of disturbed land originating from clearing.	138

Source: Biota (2014c)



Rio Tinto

Iron Ore (WA)

Figure 59
Fauna habitats within the Proposal Area

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0133320v2
Proj: MGA94 Zone50

Geospatial Information and Mapping

15.2.3 Terrestrial fauna occurrence

Of the 249 vertebrate fauna species that could potentially occur in the vicinity of the Proposal Area (based on a desktop review of database searches and the results of previous surveys in the general locality; Biota 2013), 147 species have been recorded within the Proposal Area (Biota 2015b, 2014c). The following numbers of species were recorded from each vertebrate fauna group:

- 10 native non-volant mammals;
- 3 introduced non-volant mammals;
- 5 volant mammals (bats);
- 78 birds;
- 48 reptiles; and
- 3 amphibians.

15.2.4 Terrestrial vertebrate fauna species of conservation significance

Six conservation listed species have been recorded in the Proposal Area, including four species listed under the EPBC Act and WC Act and one species listed in the Parks and Wildlife Priority Fauna List (**Table 26, Figure 60** and **Figure 61**). An additional species, the Chocolate Wattled Bat (*Chalinolobus morio*), while currently not conservation listed under Commonwealth or State legislation, is of regional significance as it is geographically restricted within the Pilbara region to Weeli Wolli Creek and Marillana Creek (Biota 2014c).

The locations of the records of these species within the Proposal Area are shown in **Figure 61**.

Table 26: Number of individuals of conservation significant terrestrial vertebrate fauna species found within the Proposal Area

Common Name	Species Name	Conservation Status		Number of individuals recorded/survey	
		State	Commonwealth	BIL	PBS
Pilbara Olive Python	*Liasis olivaceus barroni*	Schedule 1	Vulnerable	0	1
Fork-tailed Swift	*Apus pacificus*	Schedule 3	Migratory	0	9
Eastern Great Egret	*Ardea modesta*	Schedule 3	Migratory	0	1
Rainbow Bee-eater	*Merops ornatus*	Schedule 3	Migratory	21	42
Western Pebble-mound Mouse	*Pseudomys chapmani*	Priority 4	-	1	0 (9 mounds)
Chocolate Wattled Bat	*Chalinolobus morio*	-	-	0	1

Note: Survey codes are explained in Table 24.

Source: Biota (2015b). An additional seven Western Pebble-mound Mouse mound records were recorded in the Proposal Area opportunistically during a Rare Flora survey in 2014.

NatureMap, EPBC Act Protected Matters Search Tool (PMST) and Atlas of Living Australia (ALA), species distributions and habitat preference suggest a further 17 conservation significant species may potentially occur.

Species identified through these means have been further assessed to determine their likelihood of occurrence within the Proposal Area (**Table 27**). The assessment took into account results of field surveys undertaken within the Proposal Area and the wider Revised Proposal Development Envelope, along with existing data for the broader region; the habitat requirements and known distribution of each species and professional judgement from technical report authors. The likelihood of occurrence has been determined as follows (Biota 2014c):

Recorded: The species has been recorded in the Proposal Area during recent or previous surveys.

Likely: The species has a high probability of occurring in the Proposal Area based on records in the Revised Proposal Development Envelope or within 20 km to the Proposal Area. The specific or suitable habitat is present in the Proposal Area.

Has potential: The species has a medium probability of occurring in the Proposal Area based on existing records within 40 km. However, depending on the species habitat preferences:

- a small amount of the specific habitat is present in the Proposal Area;
- only some suitable general habitat is present; or
- suitable habitat is present, but the species is recorded infrequently in the locality.

Unlikely: The species has a low to very low probability of occurring in the Proposal Area based on its known distribution, habitat preference and/or historical records. Depending on the species habitat preferences:

- the specific habitat is absent from the Proposal Area;
- suitable habitat is present, however there are no existing records of the species from the locality; or
- some suitable habitat is present, however the species is recorded very infrequently in the locality.

Would not occur: The species would not occur in the Proposal Area. This is due to its restricted range, or absence of specific habitat that the species is linked to strongly.

Based on the likelihood of occurrence, the following species are considered likely to occur in the Proposal Area:

- Pilbara Leaf-nosed Bat, *Rhinonicteris aurantius* (Vulnerable, Schedule 1).
- Common Greenshank, *Tringa nebularia* (Migratory, Schedule 3).
- Peregrine Falcon, *Falco peregrinus* (Schedule 4).
- Blind Snake, *Anilios ganei* (Priority 1).
- Pilbara Barking Gecko, *Underwoodisaurus seorsus* (Priority 2).
- Brush-tailed Mulgara, *Dasycercus blythi* (Priority 4).

- Ghost Bat, *Macroderma gigas* (Priority 4).

The following species were considered to have potential to occur:

- Northern Quoll, *Dasyurus hallucatus* (Endangered, Schedule 1).
- Grey Falcon, *Falco hypoleucos* (Schedule 1).
- Australian Painted Snipe, *Rostratula australis* (Schedule 1).
- Cattle Egret, *Ardea ibis* (Migratory, Schedule 3).

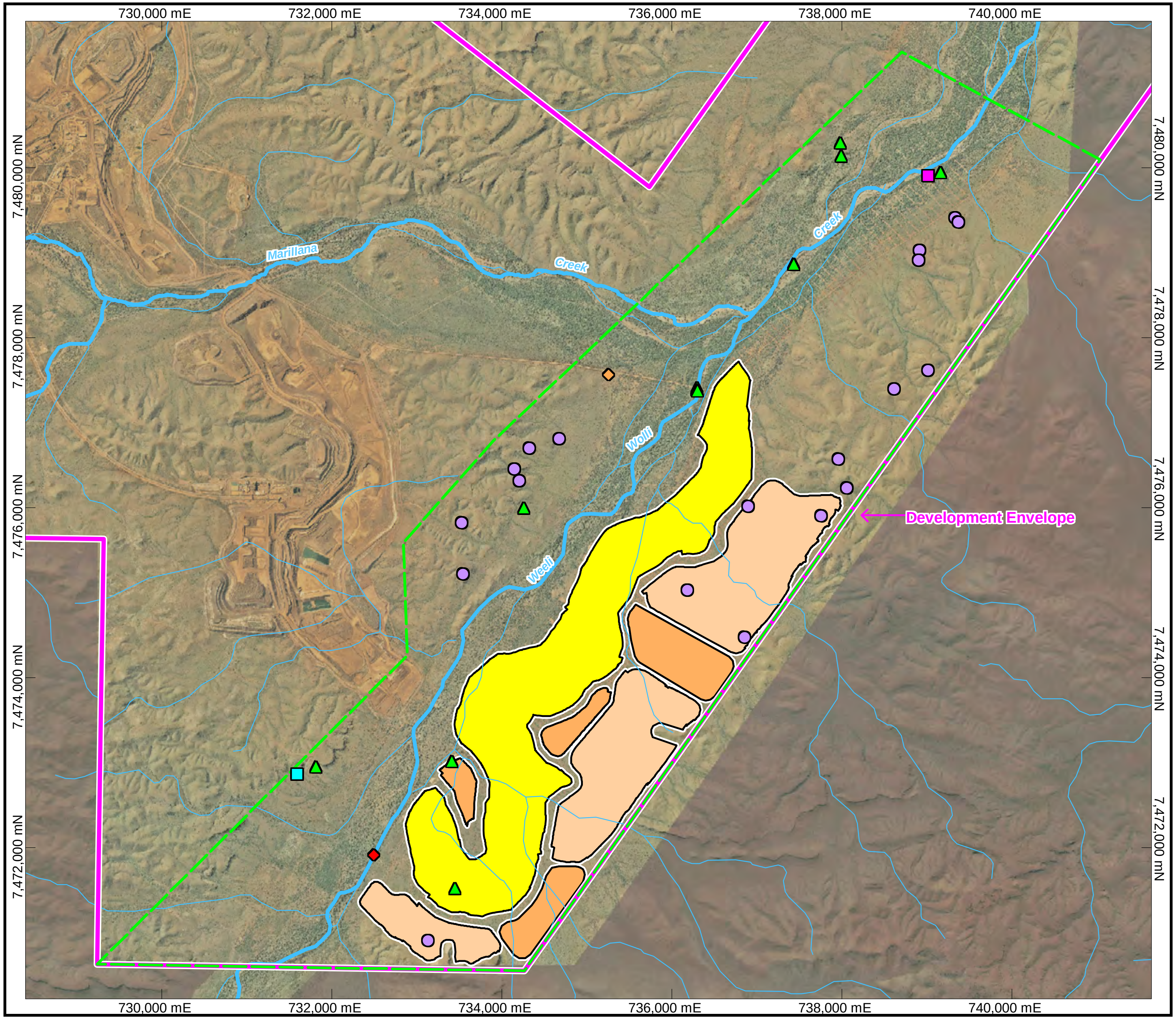
The following species were considered to be unlikely to occur:

- Night Parrot, *Pezoporus occidentalis* (Endangered, Schedule 1).
- Bilby, *Macrotis lagotis* (Vulnerable, Schedule 1).
- Oriental Plover, *Charadrius veredus* (Migratory, Schedule 3).
- Long-tailed Dunnart, *Sminthopsis longicaudata* (Priority 4).
- Short-tailed Mouse, *Leggadina lakedownensis* (Priority 4).

One species was considered to not occur in the Proposal Area:

- Northern Marsupial Mole, *Notoryctes caurinus* (Endangered, Schedule 1).

There is a history of taxonomic confusion regarding the genus *Dasycercus*. The most recent analysis has resulted in the recognition of two species in Australia, the Crest-tailed Mulgara (*D. cristicauda*) and the Brush-tailed Mulgara (*D. blythi*). Due to habitat preferences and distribution of Brush-tailed Mulgara, it was assumed that the burrows recorded in close proximity to the Proposal Area belonged to this species; however, the identification has yet to be confirmed due to a lack of direct captures (Biota 2014c). For the purposes of this PER, it has been assumed that Brush-tailed Mulgara is the species present in the vicinity of the Proposal Area.



LEGEND

- Development Envelope
- Proposal Area
- Conceptual Mine Pit
- Conceptual Waste Dump
- Conceptual Topsoil / Subsoil Stockpile
- Major; Minor Watercourse

Conservation significant terrestrial vertebrate fauna

- Eastern Great Egret
- Pilbara Olive Python
- Rainbow Bee-eater
- Western Pebble-mound Mouse
- Chocolate Wattled Bat
- Fork-tailed Swift

N

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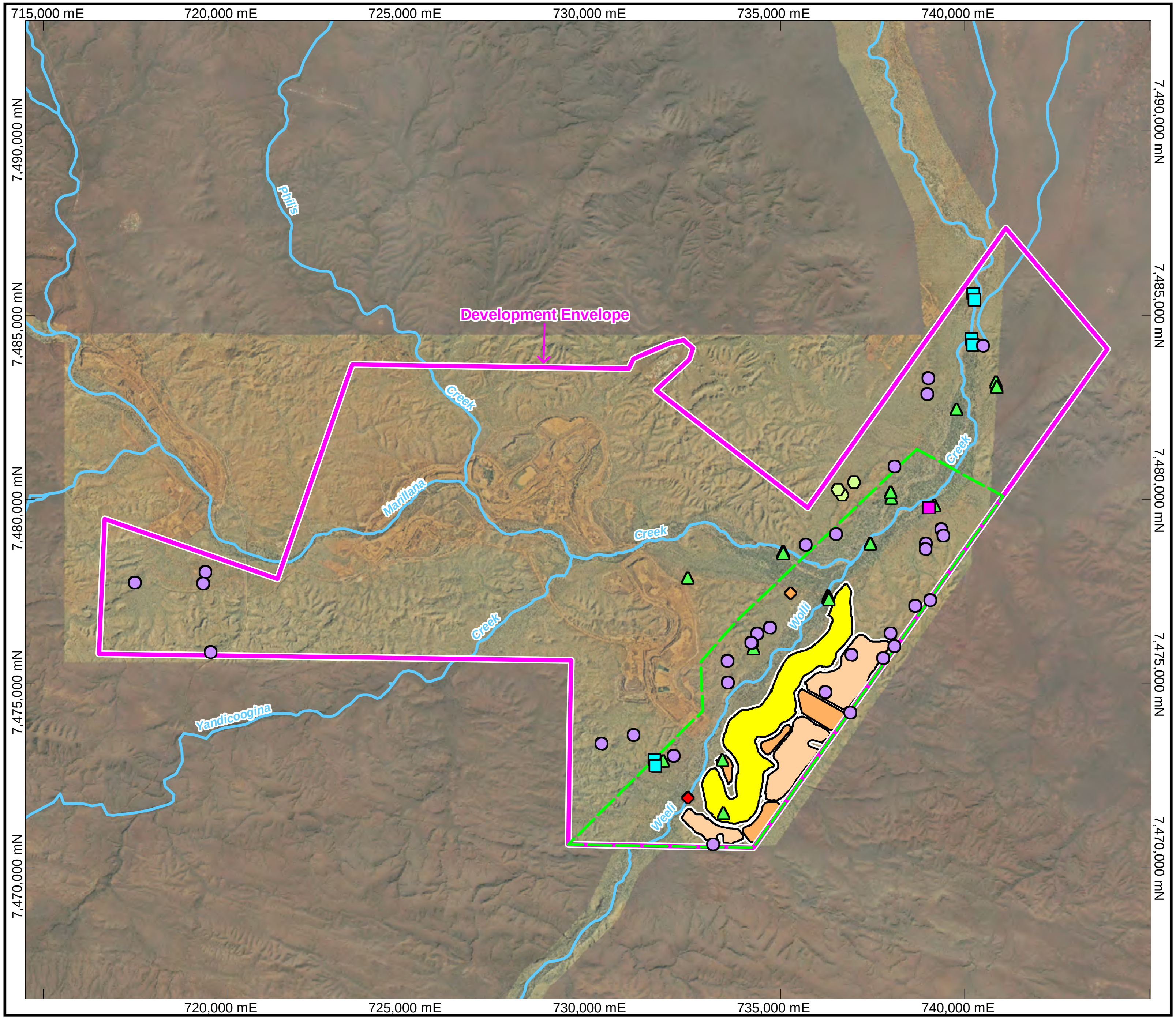
Rio Tinto

Iron Ore (WA)

Figure 60
Locations of conservation significant fauna records within the Proposal Area

Drawn: M.Swebbs Plan No: PDE0133323v2
Date: October, 2015 Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

- Development Envelope
- Proposal Area
- Conceptual Mine Pit
- Conceptual Waste Dump
- Conceptual Topsoil / Subsoil Stockpile

Conservation significant terrestrial vertebrate fauna

- Eastern Great Egret
- Pilbara Olive Python
- Rainbow Bee-eater
- Western Pebble-mound Mouse
- Chocolate Wattled Bat
- Brushed-tailed Mulgara
- Fork-tailed Swift

N

SCALE

0 2 4 6km

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RioTinto

Iron Ore (WA)

Figure 61
Locations of conservation significant terrestrial fauna in the Revised Proposal Development Envelope

Drawn: M.Swebbs Plan No: PDE0133381v2
Date: October, 2015 Proj: MGA94 Zone50

Geospatial Information and Mapping

Table 27: Likelihood of occurrence of conservation significant terrestrial fauna in the Proposal Area based on database searches, known distribution and presence of potential habitat

Name	Conservation Status		Nature Map (<40 km)	PMST	ALA (<40 km)	Biota Records within 10 km (see Biota 2014c)	Preferred habitat	Habitat available in Proposal Area?	Likelihood of occurrence
	State	Commonwealth							
Night Parrot *Pezoporus occidentalis*	Schedule 1	Endangered	N	Y	N	No	Dense, low vegetation often associated with *Triodia* hummock grasslands and areas dominated by samphire	Y	Unlikely
Northern Marsupial Mole *Notoryctes caurinus*	Schedule 1	Endangered	N	Y	N	No	Well vegetated sand dunes and sandy soils	N	Would not occur
Northern Quoll *Dasyurus hallucatus*	Schedule 1	Endangered	Y	Y	N	Yes	Rocky habitats, ridges and free faces particular when in contact with dense vegetation along drainage area, and from boulder tours of the Abydos-Woodstock Plain	Y	Has potential
Bilby *Macrotis lagotis*	Schedule 1	Vulnerable	N	Y	N	No	Sandy soils covered with spinifex grassland (mainly *Triodia basedowii*), with an over-storey of low shrubs dominated by *Acacia* species	Y	Unlikely
Pilbara Leaf-nosed Bat *Rhinonicteris aurantius*	Schedule 1	Vulnerable	Y	Y	N	Yes	Breakaways adjacent to large drainage lines, deep caves in BIF ranges	Y (foraging)	Likely
Australian Painted Snipe *Rostratula australis*	Schedule 1	-	Y	Y	N	No	Wetland areas with dense screening vegetation	Y	Has potential
Grey Falcon *Falco hypoleucos*	Schedule 1	-	N	N	Y	No	Most common in lightly wooded coastal and riverine plains, although it is found in a wide range of arid zone habitats	Y	Has potential
Cattle Egret *Ardea ibis*	Schedule 3	Migratory	N	Y	N	No	Standing shallow freshwater	Y	Has potential
Common Greenshank *Tringa nebularia*	Schedule 3	Migratory	Y	N	N	Yes	Sheltered coastal habitats and terrestrial ephemeral wetlands	Y	Likely

Name	Conservation Status		Nature Map (<40 km)	PMST	ALA (<40 km)	Biota Records within 10 km (see Biota 2014c)	Preferred habitat	Habitat available in Proposal Area?	Likelihood of occurrence
	State	Commonwealth							
Oriental Plover *Charadrius veredus*	Schedule 3	Migratory	N	Y	N	No	Open plains, bare rolling country, muddy or sandy wastes near inland swamps or tidal mudflats, bare claypans, margins of coastal marshes, grassy airfields, lawns and coastal dunes	Y	Unlikely
Peregrine Falcon *Falco peregrinus*	Schedule 4	-	Y	N	Y	Yes	Wide range of habitats including forest, woodlands, wetlands and open country	Y	Likely
Blind Snake *Anilios ganei*	Priority 1	-	Y	N	Y	Yes	Occurs in a wide variety of habitats	Y	Likely
Pilbara Barking Gecko *Underwoodisaurus seorsus*	Priority 2	-	Y	N	N	Yes	Rocky ridges, slopes and gullies	Y	Likely
Brush-tailed Mulgara *Dasycercus blythi*	Priority 4	-	Y	N	N	Yes	Sand plain and gibber plain	Y	Likely
Ghost Bat *Macroderma gigas*	Priority 4	-	Y	N	Y	Yes	Breakaways adjacent to large drainage lines, deep caves in BIF ranges	Y (foraging)	Likely
Long-tailed Dunnart *Sminthopsis longicaudata*	Priority 4	-	N	N	N	Yes	Plateaux near breakaways and screes, and rugged boulder strewn screes, often in areas with little vegetation	Y	Unlikely
Short-tailed Mouse *Leggadina lakedownensis*	Priority 4	-	N	N	N	Yes	Cracking clay, native grasslands and surrounding habitat	N	Unlikely

Adapted from Biota (2014c)

15.3 Description of short range endemic invertebrate fauna

Short range endemic (SRE) species are those that display naturally restricted distributions (less than 10,000 km^2) and are therefore at greater risk of population extinctions than more widely distributed taxa (EPA 2009a). Taxa that exhibit short range endemism are generally characterised by poor dispersal, low growth rates and low fecundity. They are commonly reliant on habitat types that are discontinuous, and are often confined to fragmented 'refugial' habitats, having persisted from a time when moist conditions were more evenly distributed throughout the Australian landscape (Harvey 2002). SRE invertebrate species are historically poorly studied and, in many cases, lack formal descriptions or adequate taxonomic frameworks. Extensive, reliable taxonomic evaluations of many orders have only relatively recently commenced, and the availability of literature relevant to SREs is thus relatively scarce (Harvey 2002).

SRE invertebrate species are a relevant factor to consider during EIA, as their restricted distribution leaves them vulnerable to changes in conservation due to habitat loss (EPA 2009a).

Consultation was undertaken with the WA Museum to identify specific invertebrate groups to target in the area as those most likely to support SRE fauna (Biota 2015b). These comprised:

- Mygalomorphae (trapdoor spiders).
- Diplopoda (millipedes).
- Scorpionida (scorpions).
- Pulmonata (land snails).
- Pseudoscorpiones (pseudoscorpions).

15.3.1 Short range endemic invertebrate fauna surveys

Surveys and assessment of the SRE invertebrate fauna of the Proposal Area have been undertaken.

Field surveys were conducted in accordance with EPA Guidance Statement No. 20: "Guidelines for the Assessment of SRE Invertebrate Fauna for Environmental Impact in Western Australia" (EPA 2009a). SREs were systematically sampled via pit trap lines (seven study sites within the Proposal Area) during the Proposal surveys. Three non-systematic (targeted searching) invertebrate fauna surveys were also undertaken in the broader Revised Proposal Development Envelope, with 25 sites located within the Proposal Area. All surveys undertaken within the Proposal Area are summarised in **Table 24**. In addition, opportunistic searches were also undertaken during an earlier survey in the Proposal Area in 2009; the exact search effort was not recorded (Biota 2015b). Systematic and targeted sampling sites are presented in **Figure 62**. SRE data from a recent SRE survey conducted by Biota for BHP that overlapped the Proposal Area has also been included (records are lodged with the WAM; survey code JML; Biota 2015b).

Pit-trapping sites were selected to provide representative sampling for terrestrial fauna within the range of land systems and habitats present; SRE fauna were collected as by-catch (refer to Sections 5.4 and 6.3.1). In addition to pit-trapping, the surveys used a variety of targeted search methods to collect potential SREs (Biota 2014c, 2015b), including:

- overturning and searching under rocks and in rock crevices;
- raking soil and leaf litter;
- sieving soil and leaf litter;
- excavating leaf litter and soil around the base of spinifex (*Triodia* spp.) hummocks (land snails only);
- searching on trees and beneath bark (pseudoscorpions only); and
- visually locating burrows (mygalomorph spiders only).

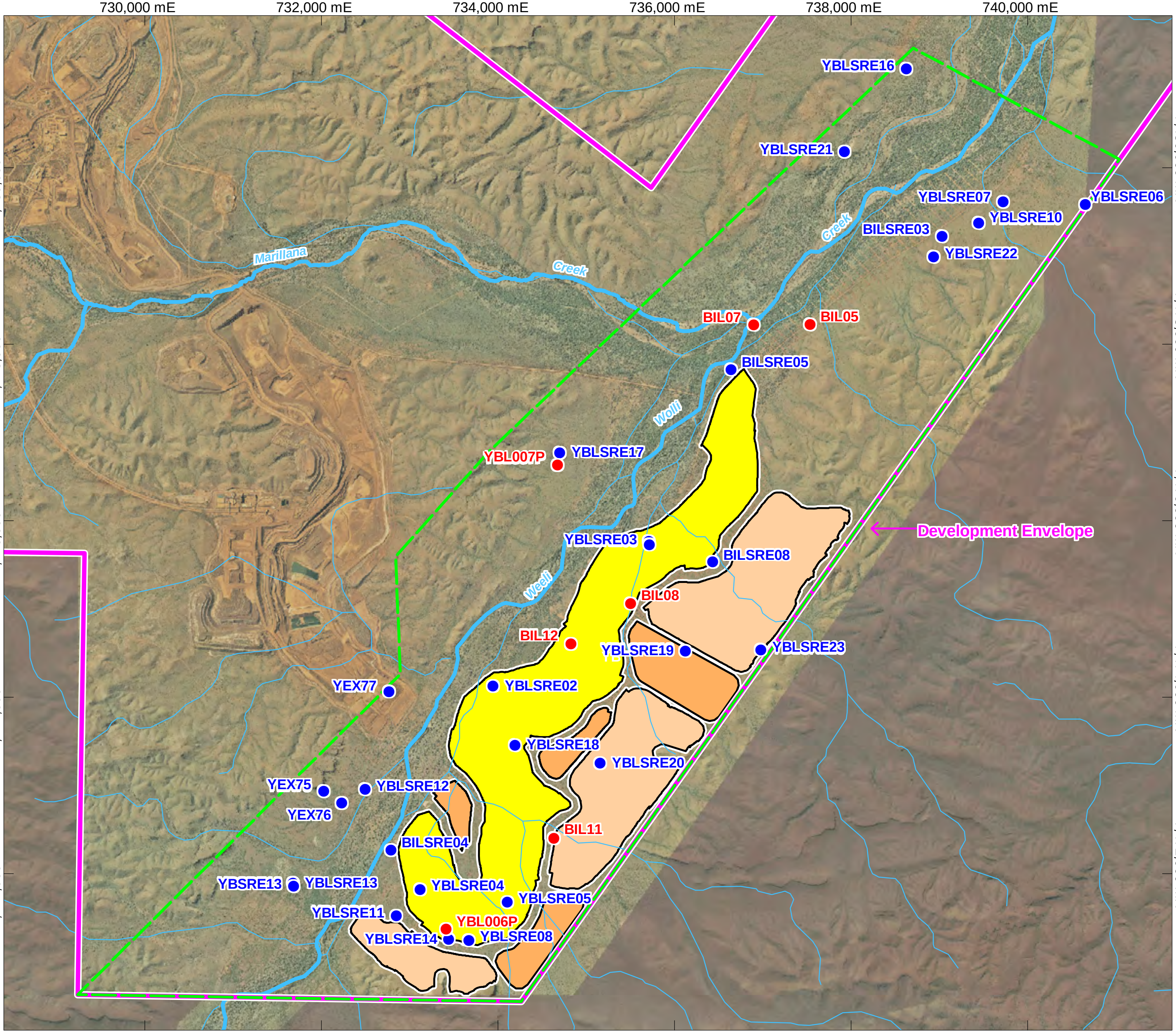
Specimens from all taxonomic groups were lodged with the WA Museum for morphological identification. Molecular (DNA) analysis was used to infer relationships within the mygalomorph spiders and putative species boundaries.

Species recorded in these surveys that have a known distribution exceeding 10,000 km^2 were considered to be non-SRE species, while those with a distribution of less than 10,000 km^2 were considered 'potential SREs'. The criteria used to determine the SRE status of putative species recorded are detailed in Biota (2014c). Some taxa were determined as being of uncertain SRE status due to a lack of available data and taxonomic framework.

15.3.2 Short range endemic invertebrate fauna habitats

Four land system units are found within the Proposal Area; the Newman, River, Boolgeeda and McKay (**Table 5**). All land systems were sampled for SREs during the targeted search surveys and by pit-trapping lines.

SREs were targeted in a variety of landforms (such as drainage lines, hills and slopes and flats) and microhabitats (like large spinifex hummocks, Mulga groves, bark, leaf litter, soil and rock piles) that are known to be prospective.



LEGEND

- Development Envelope
- Proposal Area
- Conceptual Mine Pit
- Conceptual Waste Dump
- Conceptual Topsoil / Subsoil Stockpile
- Major; Minor Watercourse

SRE Sampling Sites

- Targeted
- Systematic

N

SCALE

0 1 2 3km

1:65 000 @ A4

Rio Tinto

Iron Ore (WA)

Figure 62
SRE targeted and systematic sampling sites within the Proposal Area

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0133364v2
Proj: MGA94 (Zone 50)

Geospatial Information and Mapping

15.3.3 Short range endemic invertebrate fauna occurrence

Twenty potential SRE specimens were collected from within the Proposal Area (Biota 2015b). Genetic analysis determined six putative species (**Table 28**); five from two families of mygalomorph spiders (Idiopidae and Nemesiidae), and one pseudoscorpion specimen from the genus *Beieroipium* (family Olpiidae). All species have been previously recorded outside the Proposal Area. Four of the mygalomorph spider putative species are considered potential SREs, as their known distribution is less than 10,000 km^2:

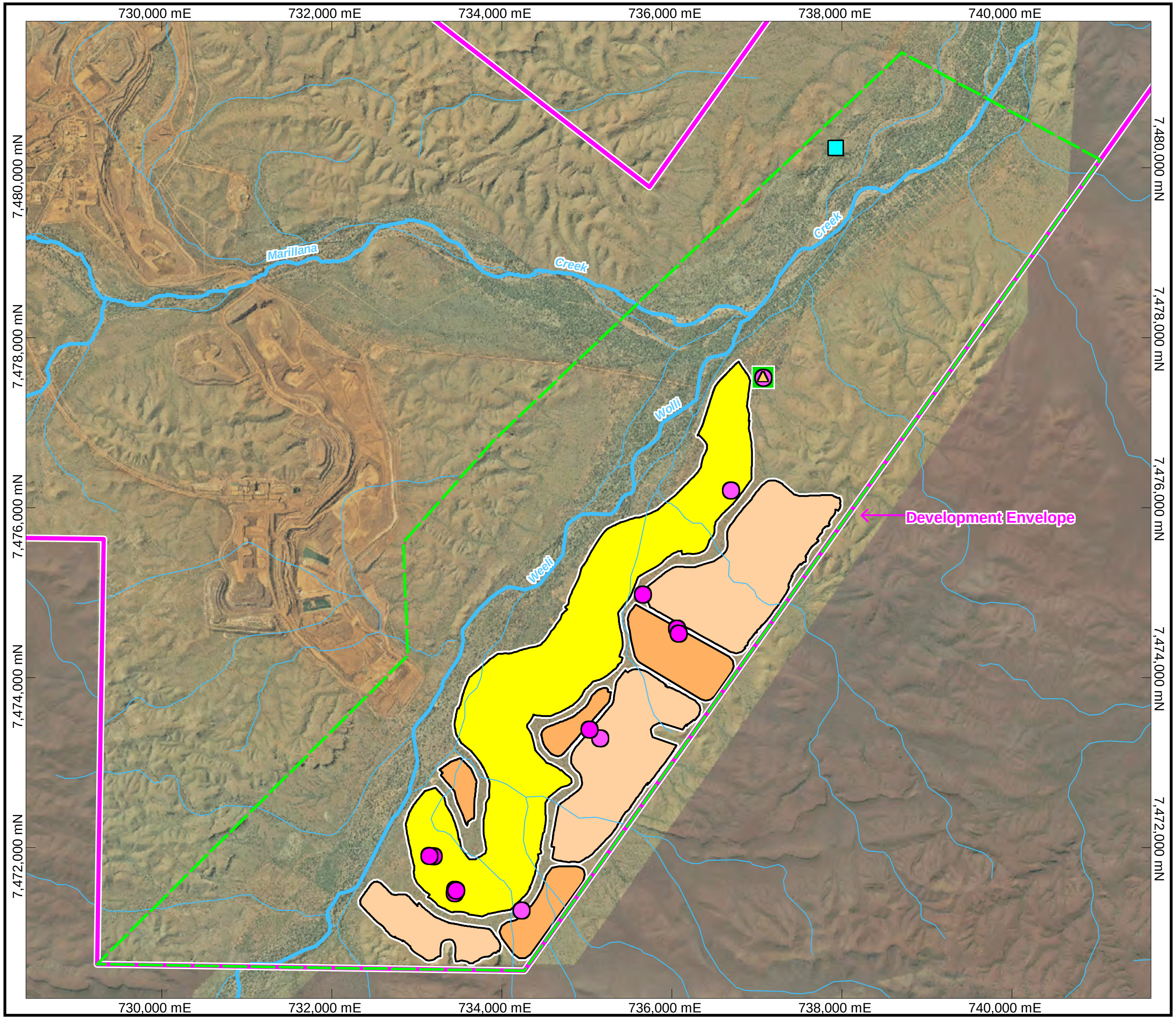
- Idiopidae sp.I1 and I9; and
- Nemesiidae sp. N42 and N44.

The distribution of some putative species is uncertain in olpiid pseudoscorpions due to limited taxonomic resolution. The SRE status of some Olpiidae taxa is therefore also uncertain, however the characteristics of this family's dispersal mechanism (phoretic, or animal-assisted dispersal) mean *Beierolpium* sp. is not considered likely to represent an SRE (Biota 2015b). **Figure 63** shows the locations of the potential SRE species within the Proposal Area. All four potential SRE species have been recorded outside of the Proposal Area (Biota 2015b).

Table 28: **Summary of potential SREs found within the Proposal Area**

Invertebrate Group Family	Taxon	No. of Specimens	Land Systems Represented	Survey Code	SRE Status	Occurs Outside Proposal Area?
Pseudoscorpions						
Olpiidae	*Beierolpium* sp.	1	River	PBS	Unlikely to be a SRE	Unknown
Mygalomorph Spiders						
Idiopidae	Idiopidae sp. I1	2	River	JML	Potential SRE	Yes
	Idiopidae sp. I9	1	River	JML	Potential SRE	Yes
Nemesiidae	Nemesiidae sp. N16	6	Boolgeeda, McKay, River	PBS/JML	Not an SRE	Yes
	Nemesiidae sp. N42	1	Boolgeeda, River	PBS/JML	Potential SRE	Yes
	Nemesiidae sp. N44	9	Boolgeeda, Newman, River	PBS/JML	Potential SRE	Yes

Table from Biota (2015b), adjusted with data from Biota (2014c)



LEGEND

Development Envelope
Proposal Area
Conceptual Mine Pit
Conceptual Waste Dump
Conceptual Topsoil / Subsoil Stockpile
Major; Minor Watercourse

SRE Invertebrate Fauna

Nemesiidae sp. N42
Nemesiidae sp. N44
Idiopidae sp.I1
Idiopidae sp.I9

N

SCALE

0 1 2 3km

1:65 000 @ A4

Rio Tinto

Iron Ore (WA)

Figure 63
Distribution of potential SRE invertebrate species within the Proposal Area

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0133368v2
Proj: MGA94 (Zone 50)

Geospatial Information and Mapping

15.4 Description of aquatic fauna

15.4.1 Aquatic fauna surveys

Aquatic fauna surveys have been conducted biannually (wet and dry season) since September 2007 by Wetland Research and Management (WRM 2015a, 2015b) in Marillana Creek and Weeli Wolli Creek, with additional sites added in October 2008 and May 2009. The results of the September/October 2013 (late dry) and April/May 2014 (late wet) surveys are presented in Section 15.4.3 below. Fourteen sampling sites were located within the Proposal Area; three sites in Marillana Creek (MAR2-7 - MAR2-9) and ten sites in Weeli Wolli Creek (WW3-3 - WW3-6 and WW4-1, WW4-3 - WW4-6 and WW4-8; **Figure 64**).

The Marillana Creek sites (Marillana Reach Two; MAR-Two) were located downstream of the Yandi Operations D09, as far as the reach of the perennial surface water flows. The Weeli Wolli Creek Reach Three (WW-Three) sites were located upstream of the junction of Marillana Creek, as far as the Yandi Operations D06, with the Reach Four (WW-Four) sites located downstream of the Marillana Creek confluence, towards the Fortescue Marsh.

Aquatic microinvertebrates, macroinvertebrates and fish species were targeted, with survey methods including mesh pond netting, seine netting, gill nets, dip nets and electrofishing. Hyporheic fauna were sampled using the Karaman-Chappuis method. Fish were identified in the field, then released alive; aquatic invertebrates were preserved in 70% ethanol for later identification.

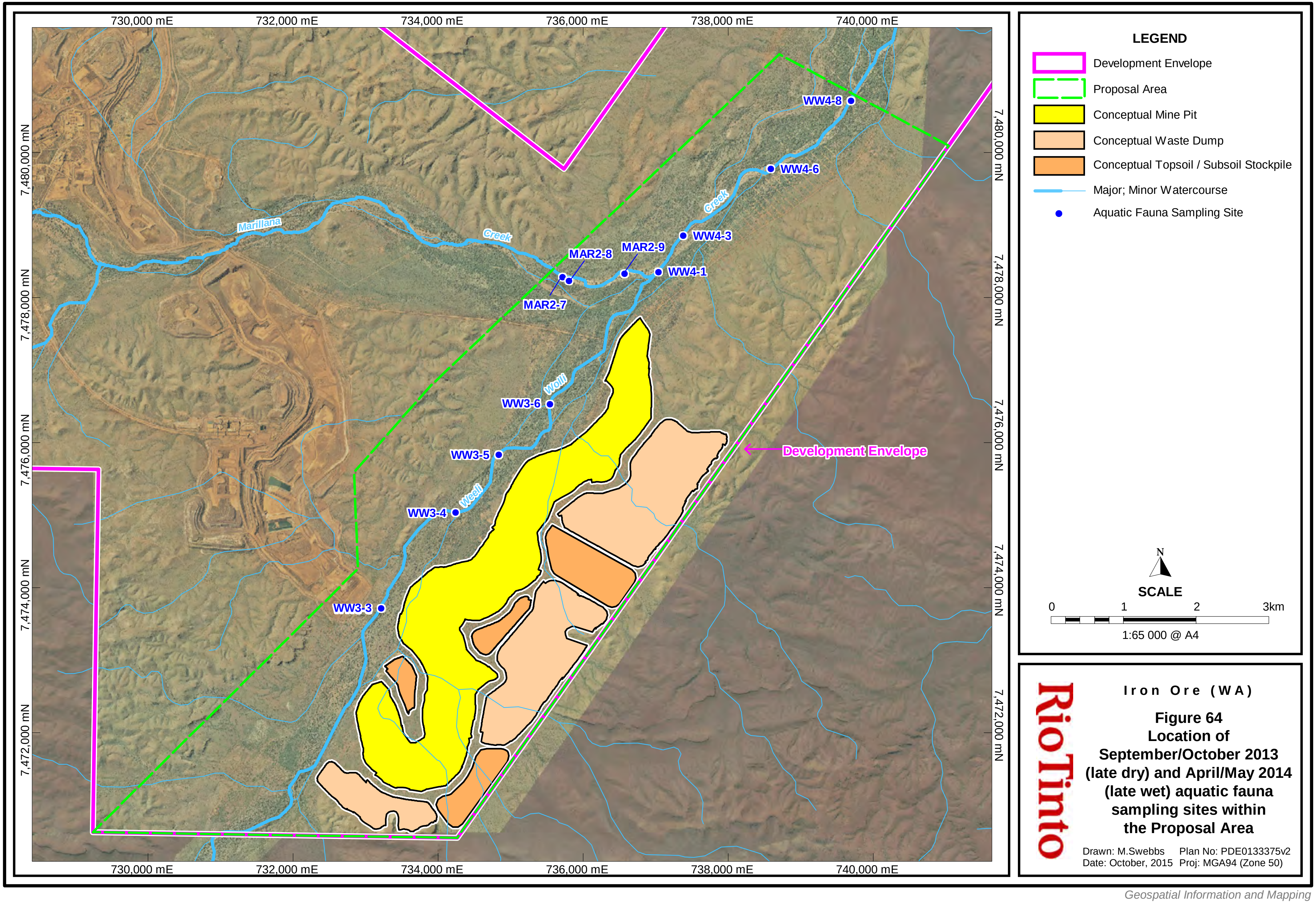
Dissolved oxygen, water temperature and pH were measured in the field, and water samples were collected for laboratory analysis to determine major ions, alkalinity, dissolved metals and nutrients.

15.4.2 Aquatic fauna habitats

The aquatic fauna were sampled from a variety of microhabitats (as per WRM 2015a, 2015b):

- Microinvertebrates (i.e. zooplankton); in the water column.
- Hyporheic fauna; in alluvial gravels adjacent to the water's edge.
- Benthic macroinvertebrates; riffle habitat (selected to allow comparisons between sites).
- Fish; in the water column, with shallow areas where there was little vegetation or large woody debris targeted for smaller species and juveniles.

During the field surveys, habitat characteristics of each site were recorded, including parameters such as substrate composition, cover by inorganic sediment, submerged macrophyte, floating macrophyte, emergent macrophyte, algae, large woody debris, detritus, roots and trailing vegetation.



730,000 mE
732,000 mE
734,000 mE
736,000 mE
738,000 mE
740,000 mE
7,480,000 mN
7,478,000 mN
7,476,000 mN
7,474,000 mN
7,472,000 mN
Marillana
Creek
Creek
Weeli
Wolli
WW4-8
WW4-6
WW4-3
MAR2-8
MAR2-9
WW4-1
MAR2-7
WW3-6
WW3-5
WW3-4
WW3-3
Development Envelope
LEGEND
Development Envelope
Proposal Area
Conceptual Mine Pit
Conceptual Waste Dump
Conceptual Topsoil / Subsoil Stockpile
Major; Minor Watercourse
Aquatic Fauna Sampling Site
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Rio Tinto
Iron Ore (WA)
Figure 64
Location of
September/October 2013
(late dry) and April/May 2014
(late wet) aquatic fauna
sampling sites within
the Proposal Area
Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0133375v2
Proj: MGA94 (Zone 50)
Geospatial Information and Mapping

15.4.3 Aquatic fauna occurrence

15.4.3.1 Microinvertebrates

A total of 108 microinvertebrate taxa were recorded from the Marillana sites (n=70) and Weeli Wolli Creek Reach Three sites (n=40) and Reach Four sites (n=66) during the late dry and late wet surveys (WRM 2015a, 2015b). The microinvertebrate taxa consisted of Protista, Rotifera, Copepoda, Cladocera (water fleas) and Ostracoda (seed shrimp), and were more prolific during the wet season sampling.

Six endemic or rare microinvertebrate species were collected during the most recent surveys, and are summarised below (WRM 2015a,2015b).

- *Lecane noobijupi* is an endemic WA rotifer. It was originally described from specimens collected in south west WA, but has since been recorded from multiple locations within the Pilbara region. It was recorded at sites MAR2-8, WW3-3 and WW4-1.

- *Nebela penardiana* was recorded at all WW-Three sites within the Proposal Area. Weeli Wolli Creek is the only known location of this protist within WA, and the second record of this species in Australia.

- *Lecane* 'bulloid' n. sp. has similar morphology to *Lecane noobijupi*, but is larger than *L. bulla*. This morphotype is endemic to WA, and was recorded at site WW4-5.

- *Cephalodella* n. sp. did not conform to any described species and is likely to be a new species. It was collected from WW4-4, and represents the first record of this taxon.

- *Heterolepadella heterostyla* is a rarely collected rotifer, but is thought to have a cosmopolitan distribution. It is usually found in stagnant waters, and has also been collected from the nearby Mindy Mindy Creek. It was recorded at site MAR2-9.

- *Australoeucyclops karaytugi* is an endemic Australian cyclopoid copepod. It has previously been collected in the Pilbara from Fortescue Marsh and southern Weeli Wolli Creek, upstream of Hope Downs 1. It was collected from site MAR2-9.

15.4.3.2 Hyporheic fauna

The hyporheic zone is the region where riverine surface water and groundwater combine (Boulton 2001). Hyporheic fauna are aquatic invertebrates that reside in the alluvium below the streambed where water percolates through spaces between the rocks and cobbles (WRM 2015a). All taxa recorded from hyporheic samples were classified by WRM (2015a) using categories described by Boulton (2001):

- Stygobite: obligate groundwater species, with special adaptations to survive in this habitat.

- Permanent hyporheos stygophiles: species living on or near the surface of the ground that can occur in both surface and groundwater, but are a permanent inhabitant of the hyporheos.

- Occasional hyporheos stygophiles: these species use the hyporheic zone seasonally or during early life history stages.
- Possible hyporheic species: these species require further research to determine their status.

Stygoxene are species that appear rarely and apparently at random in groundwater habitats, either by accident or seeking refuge during flood or drought. They are not specialised for groundwater habitats, and are not considered to be part of hyporheos fauna.

A total of 113 taxa were recorded from hyporheic samples from the Marillana sites (n=52) and Weeli Wolli Creek Reach Three sites (n=62) and Reach Four sites (n=87) during the late dry and late wet surveys (WRM 2015a, 2015b). Of the 113 taxa collected, 6% were stygobites, 13% were considered occasional hyporheos stygophiles and 11% were considered to be possible hyporheic taxa. All sites within the Proposal Area were considered to support taxa that were restricted to the hyporheic zone; these taxa are described in WRM (2015a, b), and include a number of undescribed species that are new to science. Five stygobitic amphipod and isopod species were also considered to be potential SREs:

- Paramelitidae sp. D (equivalent to Paramelitidae Genus 2 sp. B3), recorded at MAR2-8 and WW3-4.
- Paramelitidae sp. B (equivalent to Paramelitidae Genus 2 sp. B2), recorded at all sites with the exception of WW4-4 and WW4-5.
- *Chydaekata* sp., recorded at sites WW3-3, WW3-4, WW3-5, WW4-1, WW4-3.
- *Maarrka weeliwolli*, recorded from sites WW3-5, WW3-6, WW4-1, WW4-3 and WW4-4.
- *Pygolabis weeliwolli*, recorded at site WW3-5.

The amphipod *Maarrka weeliwolli* and the isopod *Pygolabis weeliwolli* appear to be restricted to Marillana Creek and Weeli Wolli Creek (WRM 2015b). The other three taxa have been collected from outside these creek systems.

15.4.3.3 Macroinvertebrates

A total of 141 macroinvertebrate taxa were recorded were recorded from the Marillana sites (n=116) and Weeli Wolli Creek Reach Three sites (n=65) and Reach Four sites (n=87) during the late dry and late wet surveys (WRM 2015a, 2015b). Macroinvertebrate taxa richness was greatest at sites MAR2-9 during the late dry and WW4-8 during the late wet sampling (n=50), while site MAR2-8 recorded the least taxa (n=20; late dry sampling), and was correlated with stream size, flow duration, habitat heterogeneity and macrophyte abundance (WRM 2015a).

Recorded taxonomic richness in the wet season has increased at Marillana Creek since surveying began in 2008. This is likely to be due to surface water discharge from the existing Yandi Operations, which has altered the aquatic fauna habitat to increase habitat size, heterogeneity and flows (WRM 2015a).

Seven of the macroinvertebrate taxa from the Proposal Area are considered Pilbara endemics, including the four stygobitic amphipod species also recorded in the hyporheic zone (see '*Hyporheic fauna*' above). The additional three species are summarised below.

- *Nannophlebia injibandi* (Pilbara Archtail Dragonfly); while this species has a relatively broad distribution throughout the Pilbara, it is not commonly recorded. It was observed at sites WW4-1, WW4-3, WW4-4, WW4-6 and WW4-8 during the most recent surveys.
- *Eurysticta coolawanyah* (Pilbara Pin Damselfly) is currently listed on the IUCN Redlist as Near Threatened (Hawking 2009); though WRM (2015a) suggest the conservation status of this species should be downgraded due to the addition of new records throughout the Pilbara. This species was recorded at site WW3-2.
- *Tiporus tambreyi*; a Pilbara endemic, this beetle appears to be common throughout the region. It was recorded at site MAR2-9.

15.4.3.4 Fish

A total of 4,455 freshwater fish samples were recorded from the Marillana sites (n=474) and Weeli Wolli Creek Reach Three sites (n=1297) and Reach Four sites (n=2684) during the late dry and late wet surveys (WRM 2015a, 2015b); 72% of these samples were recorded during the late wet survey.

Of the 12 known species of freshwater fish of the Fortescue River system, three were recorded in the Proposal Area:

- *Leiopotherapon unicolor* (Spangled Perch);
- *Neosilurus* sp. (Pilbara Tandan); and
- *Melanotaenia australis* (Western Rainbowfish).

The Western Rainbowfish was the most commonly observed species, consisting of 76% of all records. The Spangled Perch and Pilbara Tandan were recorded in lower numbers at Weeli Wolli Creek sites during the dry season (WW-Three, n=75; WW-Four, n=70) in comparison to the wet season (WW-Three, n=336; WW-Four, n=492), likely due to less suitable habitat being available during this season.

The sites at WW-Four appeared to be a nursery and recruitment zone for both Western Rainbowfish and Pilbara Tandan, as significantly higher proportions of new recruits recorded from these sites than in comparison to the WW-Three sites (WRM 2015b).

15.5 Assessment of potential impact, mitigation and residual impact

The EPA has listed the following potential impacts for the Proposal in relation to terrestrial fauna:

- habitat removal and fragmentation due to vegetation clearing; and
- indirect impacts that may occur through altered fire regimes, groundwater drawdown and discharge of surplus water, altered water regimes, changes to feral animal populations, the introduction or increase in spread of weed species, noise and light spill.

15.5.1 Impacts to fauna species of conservation significance

Five conservation listed species were recorded in the Proposal Area, with an additional 11 species assessed as likely, or potentially occurring. Impacts to these species are discussed below. The Chocolate Wattled Bat (*Chalinolobus morio*), while currently not conservation listed under Commonwealth or State legislation, has also been included in the assessment. While common through much of its Australian range, the isolated Pilbara population is geographically restricted (Biota 2014c).

15.5.1.1 Threatened species (EPBC Act/WC Act Schedule 1 listed)

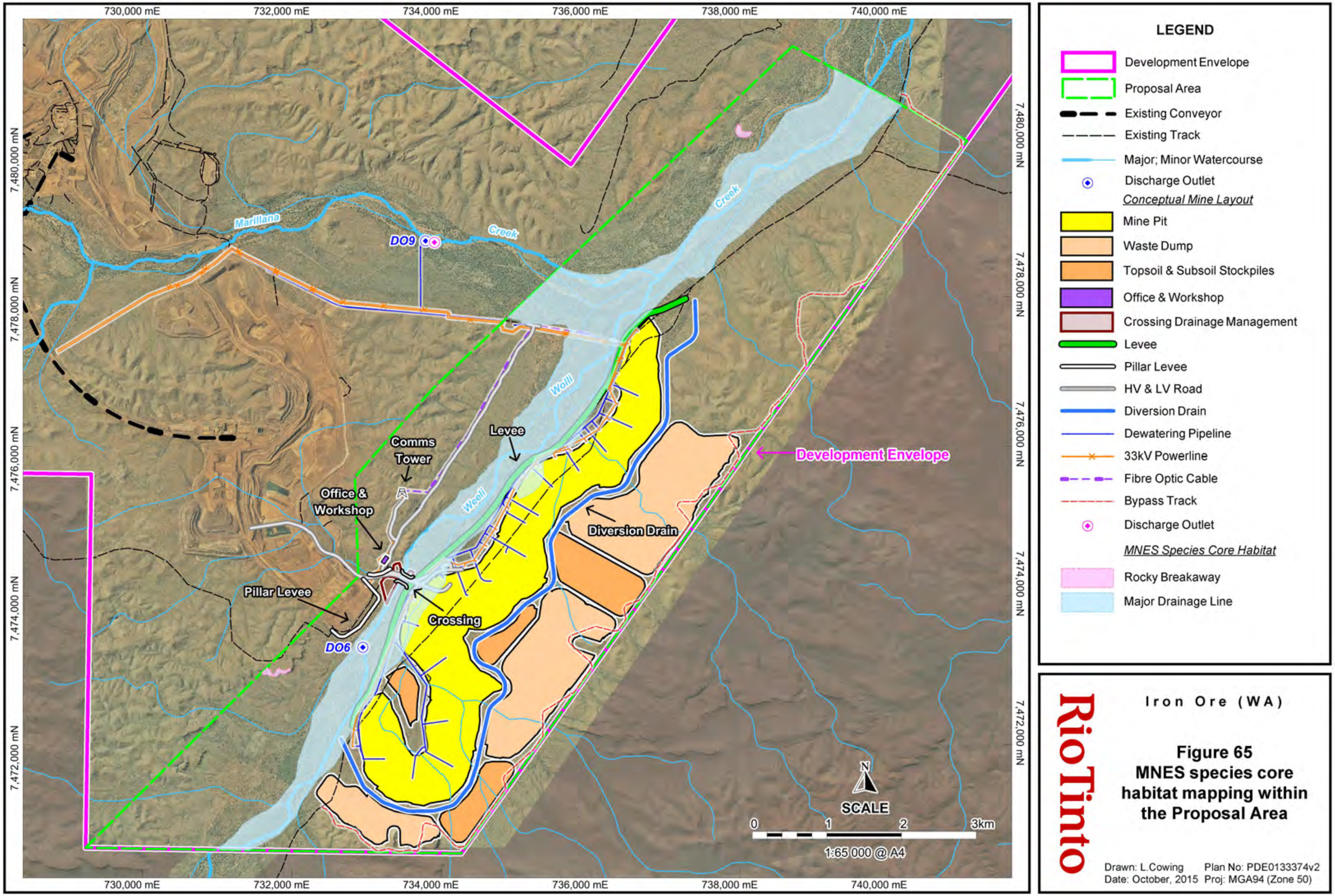
Pilbara Olive Python (*Liasis olivaceus barroni*) - Schedule 1, Vulnerable (Recorded)

A single Pilbara Olive Python was recorded opportunistically swimming downstream in Weeli Wolli Creek during a nocturnal search (site YBLNoct04) during the 2014 survey (Biota 2014c). This species is known from 17 locations in the Pilbara, and appears relatively common in the vicinity of the Proposal Area, with records from Hope Downs (21 km southwest), Flat Rocks (37 km west) and Koodaideri (38 km north west; Biota 2014c). This species has also been recorded in the Revised Proposal Development Envelope previously, with several sightings made at the existing Yandi Operations, and in Marillana Creek (Biota 2014c).

Core habitat for the Pilbara Olive Python includes gorges, escarpments, rocky outcrops and water holes where it may hunt and/or seek shelter in caves, beneath boulders, in pools of water and occasionally in trees overhanging water (DoE 2015b). It is often associated with ephemeral or permanent water, which is an indicator of high quality habitat for the species. However, the species may also be recorded in rocky habitats some distance from these features, especially during cooler months (Doughty et al. 2011). These landforms are not uncommon within the Pilbara bioregion. Pilbara Olive Pythons have also been observed using post-mining landforms and other man-made water sources, such as pit lakes, sewerage treatment ponds and recreational lakes. Individuals have been recorded utilising overburden heaps and railway embankments at mine sites (Pearson 2003).

This species may have a large home range, with estimations between 88 and 449 ha (DoE 2015b). Within the Proposal Area, its core habitat is likely to comprise of the major riverine systems of Marillana and Weeli Wolli Creeks. There is 872.8 ha of core habitat for the Pilbara Olive Python within the Proposal Area (Biota 2014f; **Figure 65**).

Habitat loss associated with mining developments is a recognised threat to the persistence of the Pilbara Olive Python (DoE 2015b). The Proposal has the potential to directly affect habitat utilised by the Pilbara Olive Python as a result of clearing and ground disturbance. The site of the recorded observation (see **Figure 60**) and the majority of this habitat occur outside the proposed mine pit and waste dump locations for the Proposal (Biota 2014f). Approximately 87 ha of Major Drainage Line habitat within the Proposal Area (10% of the core habitat available in the Proposal Area) is proposed to be cleared as part of the Proposal. While some core habitat will be removed, 90% of this habitat will remain undisturbed within the Proposal Area. Additional habitat is also available outside the Proposal Area to the north and south in Weeli Wolli Creek and nearby at Marillana Creek. The Pilbara Olive Python has also been observed utilising man-made habitats at Mesa J Iron Ore Mine near Pannawonica (Pearson 2003), and it is possible this species will utilise similar areas within the Proposal Area.



RioTinto

Iron Ore (WA)

Figure 65
MNES species core habitat mapping within the Proposal Area

Drawn: L.Cowing
Date: October, 2015
Plan No: PDE0133374v2
Proj: MGA94 (Zone 50)

Altered hydrological regimes as a result of the Proposal are not expected to result in a significant indirect loss of habitat for the Pilbara Olive Python. Perennial stream flow in the Weeli Wolli Creek low-flow channel will continue during the life of the Proposal, and opportunities for flooding the adjacent riparian zone remain unchanged as a result of the Proposal (URS 2015).

Vehicle movements associated with construction and operation phases of the Proposal have the potential to harm Pilbara Olive Python individuals or their prey (DoE 2015b). Speed limits will be enforced on all roads within the Proposal Area to reduce the risk of impact to Pilbara Olive Python individuals and other fauna. Training and induction of personnel will ensure that all staff are made aware of significant species at risk from vehicle strikes. Predation by feral foxes and cats are also a risk to the Pilbara Olive Python (particularly juveniles; DoE 2015b) and will be managed within the Proposal Area during construction and operation phases of the Proposal. These management actions will be in accordance with the Yandi SSMP addendum (**Appendix 4**).

While the Proposal will cause some loss of core habitat via vegetation clearing, and impacts to the local population via loss of individuals due to vehicle collisions and predation by feral animals, the overall impact to this species will be low. It is considered unlikely that the conservation status of the Pilbara Olive Python will be affected as a result of the Proposal. Potential cumulative impacts to the Pilbara Olive Python are discussed in Section 15.6.2.

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*) – Schedule 1, Vulnerable (Likely)

The Pilbara Leaf-nosed Bat was not recorded in the Proposal Area (Biota 2015b). The closest record of this species is from a single call recorded approximately 7 km north west of the Proposal Area (Biota 2014c). The Pilbara Leaf-nosed Bat is the Pilbara form of the Orange Leaf-nosed Bat, which occurs as two disjunct populations in Australia – one only in the Pilbara bioregion and the other across northern Australia, from the Kimberley in Western Australia to western Queensland. In the Pilbara there are three sub-populations, the eastern Pilbara, Hamersley Range and upper Gascoyne.

The Pilbara Leaf-nosed Bat occurs in colonies, which vary in size from tens to thousands of individuals, concentrated around significant roosting sites, which are often associated with disused mining infrastructure. Most of the known natural roosting sites coincide with areas of current or future interest for mining development; hence mining activities are an identified threat to Pilbara populations of the species (DoE 2015b).

The occurrence of pools of water is a critical component of the Pilbara Leaf-nosed Bat's foraging habitat. Roosting sites may occur in rocky breakaways, scarps and gorges as these areas have the greatest potential to support relatively warm humid microclimates. Foraging habitats also include these habitats, and may also include riparian vegetation and hummock grasslands (DoE 2015b).

The major drainage channels of the Marillana-Weeli Wolli Creek system in the Proposal Area may provide foraging opportunities for the Pilbara Leaf-nosed Bat, although due to the absence of suitable roost caves in close proximity to the Proposal Area, this habitat is not considered core (Biota 2014c). A colony of Pilbara Leaf-nosed Bats occurs within the Koodaideri Iron Ore Mine area, approximately 40 km north west of the Proposal Area. It is assumed that individuals can move distances up to 60 km, although not necessarily overnight (DoE 2015b). Therefore the species is considered likely to occur within the

Proposal Area, but only on an occasional foraging basis. Changes to the groundwater regime as a result of the Proposal may alter the suitability of foraging habitat for the species, as some riparian tree species are expected to be lost over the life of the Proposal (see Section 14). The loss of some of this habitat through altered hydrological processes and clearing may have localised impacts to the Pilbara Leaf-nosed Bat, however, the Proposal is not anticipated to affect the conservation status of this species.

Northern Quoll (*Dasyurus hallucatus*) – Schedule 1, Endangered (Potential)

The Northern Quoll is the smallest quoll species. This species has been recorded in all four of the Pilbara subregions, with the majority of the records occurring in the north and north west of the bioregion, in the Hamersley and Chichester subregions (Biota 2010). The Northern Quoll is a short lived mammal, with both sexes maturing at 11 months of age. Males frequently do not survive after their first breeding season, and females usually do not live longer than 2-3 years. They are opportunistic omnivores, and have been recorded consuming invertebrates, fruit and flowers, mammals, birds, bird eggs, frogs, road kills and from rubbish bins (DoE 2015b).

There have been two anecdotal sightings of Northern Quoll individuals at the existing Yandi Operations warehouse over a one month period in 2009 (Biota 2009), and an individual found at the nearby Yandi Operations village in 2013. However, these represent the only sightings within the existing Yandi Operations in the past 19 years, and come from a nearby higher elevation area encompassing landforms more suitable for the species than the Proposal Area (Biota 2014d). It is thought these individuals may have been temporarily foraging in the Revised Proposal Development Envelope, or that this small local population may have declined (Biota 2009).

There are three records of the Northern Quoll within 15 km of the Proposal Area, which were recorded in 2010 (Biota 2013). Since then, surveys undertaken have not recorded the species, with over 10,000 Elliott trap nights in the Revised Proposal Development Envelope, and two Targeted Northern Quoll surveys within the Proposal Area (Biota 2014d). In addition, recent habitat mapping indicates there is very limited core habitat for the Northern Quoll in the Proposal Area (4.4 ha), consisting of two small areas of rocky breakaway habitat at the periphery of the Proposal Area, outside the proposed mine pit and waste dumps (Biota 2014f; **Figure 65**). Core habitat for the Northern Quoll is considered to be rocky gorges, rocky free face and hills usually of high relief, with secondary habitat associated with drainage lines used for denning (DoE 2015b).

It is considered extremely unlikely that a significant population of the Northern Quoll is present in the Proposal Area; and any interactions of this species within the Proposal Area would be limited to dispersing individuals (Biota 2014d). Habitat clearing and fragmentation as a consequence of mining is a threat to the Northern Quoll (DoE 2015), however, due to the limited core habitat and the low likelihood of Northern Quoll presence in the Proposal Area, the Proposal is not predicted to significantly affect the conservation status of this species.

Grey Falcon (*Falco peregrinus*) – Schedule 1 (Potential)

The Grey Falcon is endemic to Australia, typically found in the arid and semi-arid interiors. It is a wide-ranging species and hunts smaller birds in a range of habitats (Morcombe 2007). The Grey Falcon may occur within the Proposal Area; it has been recorded within 40 km (ALA database search). This species is not considered likely to rely on any particular habitat type present within the Proposal Area. It may use the Proposal Area to hunt occasionally, and has the potential to breed in the taller eucalypts associated with the Weeli Wolli Creek (Biota 2014c). Potential breeding habitat may be reduced within the Proposal Area as a result of groundwater drawdown causing deaths to tree species within the riparian zone (see Section 14). As the Grey Falcon has a low density and broad distribution in the Pilbara, it is unlikely the Proposal will result in any significant impacts on the conservation status of this species.

Australian Painted Snipe (*Rostratula australis*) – Schedule 1 (Potential)

The Australian Painted Snipe is a wader, and has been recorded in wetlands across Australia. It is considered to occur in a single, contiguous breeding population, with population estimates ranging between a few hundred to five thousand individuals (DoE 2015b).

The Australian Painted Snipe has been observed within 40 km of the Proposal Area at the Fortescue Marsh (NatureMap database). This species may potentially occur within the Proposal Area as suitable shallow, fresh water wetlands are present year-round, however it has not been previously recorded (Biota 2014c).

The reduction of riparian habitat as a result of the Proposal could cause a local impact to individuals of this species if present within the Proposal Area. However, given the NatureMap record at the Fortescue Marsh is the only record of this species in this database within 400 km of the Proposal Area, and the availability of suitable habitat outside the Proposal Area in both creeks and the Fortescue Marsh, the conservation status of the Australian Painted Snipe is unlikely to be affected by the Proposal.

15.5.1.2 Migratory species (EPBC Act)

Eastern Great Egret (*Ardea modesta*) - Schedule 3, Migratory (Recorded)

The Eastern Great Egret is a migratory waterbird that is likely to utilise the Fortescue Marsh on an occasional basis, which is located 40 km north of the Proposal Area. In 2014 a single opportunistic observation of one individual flying near Weeli Wolli Creek was made outside of the proposed mine footprint (Biota 2014c). This species is widespread across Australia and occurs in a range of wetland habitats, predominately in shallow waters (DoE 2015b). The low number of observations of this species indicates the Eastern Great Egret only utilises the Proposal Area on an occasional, transient basis. As a result, it is considered unlikely the Proposal will affect the conservation status of this species.

Fork-tailed Swift (*Apus pacificus*) – Schedule 3, Migratory (Recorded)

The Fork-tailed Swift is a common migrant throughout the Pilbara between October and April (Morcombe 2007) and is exclusively aerial in Australia, occurring here as a non-breeding visitor (Johnstone and Storr 1998).

This species potentially utilises the Proposal Area for aerial foraging during the migratory period. An opportunistic observation of nine Fork-tailed Swift individuals flying overhead of the Proposal Area was recorded on one occasion (Biota 2014c). Due to the wide range of the Fork-tailed Swift and its aerial nature, it is unlikely that the Proposal will significantly affect the conservation status of this species.

Rainbow Bee-eater (*Merops ornatus*) - Schedule 3, Migratory (Recorded)

Rainbow Bee-eaters are commonly found during the summer throughout most of southern Australia excluding Tasmania (Barrett et al. 2003). They migrate north at the onset of cooler weather in autumn, spending the winter in northern Australia, New Guinea, and some of the southern islands of Indonesia. It is thought that many populations in northern Australia are sedentary (Boland 2004). They occur in a wide range of habitats including open woodlands, shrublands, beaches, dunes, cliffs, mangroves, woodlands and parks and private gardens (Boland 2004), preferring areas near water and sandy substrates. This species requires these sandy substrates to build nest burrows (Higgins 1999).

The Rainbow Bee-eater was observed on numerous occasions opportunistically and while conducting systematic avifauna surveys throughout the Proposal Area (Biota 2014c). This species is common in the Pilbara and is either a breeding resident or non-breeding visitor to the Proposal Area, with the tall trees of Weeli Wolli Creek providing suitable foraging habitat (Biota 2014c). Some of this habitat may potentially be affected as a result of clearing and groundwater drawdown and discharge caused by mine pit dewatering for the Proposal. This species nests in sandy soils in burrows; no evidence of nesting was found within the Proposal Area (Biota 2014c). This migratory species has a broad distribution across Australia, and has over 11,000 records within Western Australia on the NatureMap database. It is very common and widespread in the Pilbara bioregion and is unlikely to be reliant on the habitats within the Proposal Area. As such, it is unlikely that the Proposal will significantly affect the conservation status of this species.

Common Greenshank (*Tringa nebularia*) - Schedule 3, Migratory (Likely)

The Common Greenshank is a wader, and can be observed singly or in small to large flocks, occasionally numbering in the hundreds. This species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia; however, it does not breed in Australia (DoE 2015b). It is likely to occur within the Proposal Area, as it has previously been recorded within 10 km (Biota 2014c). In Australia, threats to this species include habitat loss and modification, introduced species, pollution and disturbance by humans (DoE 2015b). Given the presence of suitable habitat outside the Proposal Area, the conservation status of this species is unlikely to be affected by the Proposal.

Cattle Egret (*Ardea ibis*) - Schedule 3, Migratory (Potential)

The Cattle Egret is a migratory waterbird that is considered widespread and common across its range (DoE 2015b). It is found in temperate and tropical grasslands, woodlands and terrestrial wetlands, and is likely to utilise the Fortescue Marsh on an occasional basis. Due to the proximity of the Proposal Area to the Marsh, it is possible that this species may occur, utilising the damp grasslands neighbouring Weeli Wolli Creek after flooding. However, this would only be on an occasional, transient basis and therefore the conservation status of this species is unlikely to be affected by the Proposal.

15.5.1.3 Schedule 4 species (WC Act)

Peregrine Falcon (*Falco peregrinus*) – Schedule 4 (Likely)

The Peregrine Falcon has an almost cosmopolitan distribution and inhabits a wide range of habitats, including cliffs, rocky outcrops and rocky coastal islands; however, it will use trees to nest where cliffs are not available. It is uncommon, and is usually found in pairs or as single individuals. This species has been recorded once inside the Revised Proposal Development Envelope, outside the Proposal Area; and the individuals recorded were likely to have been transitory or foraging. It is considered likely to occur within the Proposal Area.

The large trees adjacent to Weeli Wolli Creek may provide potential habitat for nesting and foraging by the Peregrine Falcon (Biota 2014c). Some of this habitat may be affected by the Proposal as a result of groundwater drawdown, discharge and vegetation clearing. However, as suitable habitat for the Peregrine Falcon is present outside the Proposal Area, it is unlikely that the Proposal will significantly affect the conservation status of this species.

15.5.1.4 Priority listed species

Blind Snake (*Anilios ganei*) - Priority 1 (Likely)

The Blind Snake is distributed over much of the Pilbara region; however it is poorly collected (Biota 2014c), and is known only from 41 records in Western Australia on the NatureMap database. This species has been recorded in moist gorges and gullies, Mulga Woodlands and rocky scree slopes (Biota 2014c). It has been observed within 10 km of the Proposal Area and as suitable habitat is present, it is considered likely to occur within the Proposal Area (Biota 2014c).

Potential impacts to the Blind Snake as a result of the Proposal include habitat loss and direct mortality of individuals. Up to 1,138 ha of potentially suitable habitat, consisting of Mulga Woodlands, Slopes and Hills and Pediment Slope habitat within the Proposal Area is expected to be cleared as a result of the Proposal. There are few records of this species, which could be due to difficulties in successfully sampling individuals or a naturally low abundance despite their wide distribution in the region. If present in the Proposal Area, the Proposal could result in localised impacts to this species. However, given its wide distribution (over 400 km), and the low number of records in the vicinity of the Proposal Area, the conservation status of this species is unlikely to be significantly affected by the Proposal.

Pilbara Barking Gecko (*Underwoodisaurus seorsus*) - Priority 2 (Likely)

The Pilbara Barking Gecko is a Hamersley Range endemic that was recently discovered in 2006. It is a large carphodactylid gecko, with a large head, long slender limbs and digits, and long tail terminating in a point (Doughty and Oliver 2011). The known distribution of this species extends from north of Tom Price to West Angelas mine in the south east. The Pilbara Barking Gecko is found in rocky areas, with some observations associated with major gullies and rocky gorges (Doughty and Oliver 2011). This species is classified as Priority 2, based on its relatively small distribution and rarity. It has been recorded nearby to the Proposal Area (Biota 2014c), and as suitable rocky slope habitat is present, it is considered likely to occur (Biota 2014c).

A total of 1,075 ha of Slopes and Hills and Pediment Slope habitat within the Proposal Area may be cleared as a result of the Proposal; localised impacts to Pilbara Barking Gecko as a result of the Proposal include direct mortality and loss of habitat due to vegetation clearing. If present in the Proposal Area, the Proposal could result in localised impacts to this species. However, there is extensive habitat available to this species in the vicinity of the Proposal Area and in the wider locality, thus the Proposal is unlikely to significantly affect the conservation status of this species.

Western Pebble-mound Mouse (*Pseudomys chapmani*) - Priority 4 (Recorded)

The Western Pebble-mound Mouse is endemic to the central and eastern Pilbara; it has a broad distribution in within this area and is considered quite common. This species builds mounds of small stones covering 0.5-0.9 m^2, and frequents stony hillsides with hummock grasslands (Biota 2014c). The Western Pebble-mound Mouse was the most frequently recorded mammal during surveys in the Proposal Area, with pebble mounds recorded at 18 locations (Rio Tinto database). One individual was also trapped at site BIL07 (Biota 2011). The majority of mounds appeared active (Biota 2014c).

It is anticipated five known mounds will be directly impacted by clearing for the Proposal footprint (**Figure 60)**. Threats to the Pebble-mound Mouse as a result of the Proposal include direct mortality and habitat loss due to vegetation clearing. A total of 1,075 ha of Slopes and Hills and Pediment Slope habitat within the Proposal Area may be cleared as a result of the Proposal.

However, this species is broadly distributed in the Hamersley and Chichester subregions of the Pilbara bioregion and is commonly recorded, with over 850 records within the Pilbara Bioregion on NatureMap. Extensive suitable habitat is present outside of the Proposal Area, and it is unlikely that the Proposal will affect the conservation status of this species (Biota 2011).

Brush-tailed Mulgara (*Dasycercus blythi*) – Priority 4 (Likely)

The Brush-tailed Mulgara is a medium sized solitary carnivorous marsupial. It has a characteristic tail, with a fat base and black hairs, hence the common name ‘Brush-tail’. This species is found in sand plain, sand dune and gibber plain (rock and pebble covered flat plains) habitat (Pavey et al. 2011). There is a history of taxonomic confusion between *Dasycercus cristicauda* and *D. blythi*; this is discussed further in Section 15.2.4.

Mulgara burrows were recorded at three sites in the north eastern section of the PBS study area (Biota 2014c), in close proximity to each other in Minor Alluvial Fans and Hills and Slopes habitat. The burrows were recorded approximately 800 – 960 m from the Proposal Area, however no animals were observed. These burrows were thought to be inactive, due to a lack of scats, tracks or fresh diggings. Despite the lack of recent activity, Biota (2014c) considers the Mulgara to have been recently present in the area; however the individuals may have relocated to areas with new resources. Previous surveys in this area have recorded live individuals (S Ford pers. obs., cited in Biota 2014c). No burrows or individuals of this species have been identified within the Proposal Area to date; however suitable habitat is present.

The Proposal has the potential to cause direct mortality to individuals and will result in potential habitat loss due to vegetation clearing. However, this species has a wide distribution across the Pilbara on NatureMap, and suitable habitat is present outside the Proposal Area. It is therefore unlikely the Proposal will affect the conservation status of this species.

Ghost Bat (*Macroderma gigas*) - Priority 4 (Likely)

The Ghost Bat occurs in a wide range of habitats and has a fragmented distribution caused by the availability of suitable roost sites in caves and mines. The transient day roosts or feeding sites of Ghost Bats are often shallow overhangs and crevices with microclimates similar to ambient conditions, whereas roosts for breeding activity (maternity roost) have a relative humidity of above 80% (Armstrong and Anstee 2000). For this bat species to persist, a productive foraging area (usually containing riparian vegetation) within 5-10 km of their maternity roost site is preferable (Biologic 2014). The Ghost Bat occurs in all four Pilbara subregions, and McKenzie and Bullen (2009) suggest this species is more common that previously supposed.

This bat species is likely to utilise the Proposal Area for foraging. There has been one recorded sighting of an animal flying over the Revised Proposal Development Envelope in 1998 (Biota 2013), and a cave containing scats was recorded 9 km south of the Proposal Area (Biota 2014c). No potential roost caves for any conservation significant bat species were located within the Proposal Area. However, due to the presence of riparian vegetation and a nearby recorded sighting and scats, this carnivorous predator may utilise the Proposal Area occasionally for foraging on small mammals, birds, reptiles and insects. As the Proposal Area does not contain any known roost caves, and given the large home ranges of this species, it is unlikely the Proposal will significantly affect the Ghost Bat.

15.5.1.5 Other species

Chocolate Wattled Bat (C*halinolobus morio*) - (Recorded)

The Chocolate Wattled Bat is a microbat that is found in a range of habitats throughout Australia. This species roosts in tree hollows, man-made structures and caves. They feed almost exclusively on moths, which they catch by flying below the tree canopy (ALA 2015).

The Chocolate Wattled Bat is not currently listed under Commonwealth or State legislation. While common through much of its range in southern and eastern Australia, it is currently only known in the Pilbara from the productive riparian environment of the Weeli Wolli-Marillana Creek System (McKenzie and Bullen 2009). Extensive sampling throughout this region and the neighbouring bioregions of the Gascoyne and Murchison have failed to detect it elsewhere (McKenzie and Bullen 2009). It is possible that the isolated Pilbara population is genetically distinct; however this has not been tested. The microbat assemblage of the Priority 1 Weeli Wolli Spring Community PEC, located upstream from the Proposal Area, has been identified as an environmental value for Weeli Wolli Creek in an Environmental Values Statement (**Appendix 1**) by the Proponent.

A Chocolate Wattled Bat was recorded from one survey site within the Proposal Area (site YBQSM2-05; **Figure 60)**. This record is adjacent to the south west border of the Proposal Area at the entrance of a small cave close to Weeli Wolli Creek (Biota 2014c). There are an additional two records of this species to the north of the Proposal Area.

The clearing and degradation of riparian vegetation within the Proposal Area could impact this species. Approximately 85.9 ha of Major Drainage Line habitat is anticipated to cleared due to the Proposal, with additional potential breeding habitat reduced within the Proposal Area as a result of groundwater drawdown and discharge causing stress or mortality to tree species within the riparian zone (see Section 14). It is possible that their range extent may be temporarily increased due to increased water availability from discharge. However, at a community level, these effects are unlikely to significantly affect the broader riparian habitat and suitable breeding and foraging habitat is present outside the Revised Proposal Development Envelope, including the Weeli Wolli Spring, and will not be threatened by the Proposal. Consequently, the Proposal is considered unlikely to significantly affect the Chocolate Wattled Bat population in Weeli Wolli and Marillana Creeks.

15.5.2 Habitat removal and fragmentation

15.5.2.1 Terrestrial vertebrate fauna

Clearing of terrestrial fauna habitat is required to facilitate construction of the mine and associated infrastructure. Clearing will result in up to 1,800[5] ha of terrestrial fauna habitat loss within the Proposal Area, including up to 69 ha of riparian zone vegetation. The proposed clearing will potentially result in the loss of the following fauna habitats:

- 85.9 ha of Major Drainage Line;
- 308.1 ha of Hilltops and Slopes;
- 767.0 ha of Pediment Slope;
- 102.4 ha of Alluvial Plain (Flood Plain); and
- 63.3 ha of Mulga woodland.

Approximately 87 ha of core habitat will be lost within the Proposal Area for the EPBC Act/WC Act Schedule 1 listed species the Pilbara Olive Python (**Figure 65**). Five additional conservation significant species have been recorded within the Proposal Area; aside from one record of a Rainbow Bee-eater at site YBL006P, the records of the Western Pebble-mound Mouse are the only species recorded within the proposed mine pit and waste dump locations (**Figure 60**).

Impacts to fauna habitats from vegetation clearing will be managed through the implementation of measures described in the Significant Species Management Guideline and in the Yandicoogina MMP (**Appendix 4**). Habitat clearing will be restricted to the Proposal Area and will be the minimum necessary for safe construction and operation of the Proposal. Clearing will be undertaken progressively to allow mobile fauna movement into contiguous habitat beyond the clearing area. Native fauna encountered on-site (including during clearing) will be avoided. A dedicated fauna relocation specialist/carer will be available on-site at all times to safely relocate any fauna encountered.

The proposed mine pit and waste dumps will fragment fauna habitat with the Proposal Area, with an approximate 8 km almost continuous stretch of habitat removed to the east of Weeli Wolli Creek, of up to 2.6 km in width. This habitat is primarily associated with the hills and slopes landform. Some fauna groups will be affected more than others based on their movement modes and patterns (flight versus ground moving and long versus short range movements), with the proposed mine pit and waste dumps potentially causing a barrier to dispersion for non-aerial species.

The Proposal Area contains fauna habitats that are consistent with the surrounding landscape. Based on the distribution of land systems, fauna habitats occurring in the Proposal Area are likely to be well represented in the surrounding area, and connectivity will remain with the intact habitats outside the Proposal Area.

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[5] The total disturbance to fauna habitat is 1,327 ha, however the Proponent is seeking approval for overall disturbance of up to 1,800 ha to accommodate for detailed design of mining operations and infrastructure.

15.5.2.2 SRE invertebrate fauna

Loss of SRE invertebrate fauna habitat will occur as a result of clearing to facilitate construction of the mine pit, waste dumps and associated infrastructure. Clearing will result in the direct removal of up to 1,800[6] ha of fauna habitat within the Proposal Area. With the exception of one site, all recorded Nemesiidae sp. N44 locations within the Proposal Area will be disturbed (see **Figure 63**).

However, all four predicted SRE taxa, Idiopidae sp.I1 and I9 and Nemesiidae sp. N42 and N44, have been recorded outside the Proposal Area. These species have been recorded in multiple land systems and substrate types, suggesting they not restrained to a specific landscape-scale habitat unit. Therefore the probability that these mygalomorph spiders possess a narrow spatial distribution is lower, and thus it is less likely that vegetation clearing within the Proposal Area will adversely affect these species (Biota 2015b).

Habitat clearing will be restricted to the Proposal Area and will be the minimum necessary for safe construction and operation of the Proposal. Clearing areas are well-defined and demarcated on the ground to ensure that operators clear only what is necessary. Upon mine closure, the Proposal Area will be rehabilitated to contain a wide variety of fauna habitats, many that will be appropriate for SRE invertebrate fauna species.

15.5.2.3 Aquatic fauna

Minimal aquatic fauna habitat associated with Weeli Wolli and Marillana Creeks will be lost or fragmented as a result of the Proposal, as habitat and surface water flows will be retained. Therefore the associated aquatic fauna habitat and its ecological values will be retained.

15.5.3 Indirect impacts

Indirect impacts from the Proposal may modify or disturb fauna habitats leading to changes in fauna behaviour and movement patterns and/or disruption to nesting and roosting habitats. These potential modes of impact include light, dust and noise emissions, altered fire and water regimes, and the introduction and/or spread of weeds and feral animals.

15.5.3.1 Altered Hydrological Regime

Surface water will continue to be discharged as part of the Proposal and from Hope Downs 1 operations during the life of the Proposal, with the reach of the surface water footprint between 5 and 9 km downstream of the Weeli Wolli Creek and Marillana Creek confluence. Therefore the current perennial stream flow in the Weeli Wolli Creek low-flow channel will continue during the life of the Proposal, and opportunities for flooding the adjacent riparian zone remaining unchanged as a result of the Proposal (URS 2015).

However, the Proposal will alter the groundwater and surface water system, potentially resulting in degradation of fauna habitat. Up to 10 km of riparian vegetation will be exposed to the effects of groundwater drawdown, which is likely to cause some tree mortality in riparian zones adjacent to Weeli Wolli Creek during the mining operations (see Section 14 for further details).

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[6] The total disturbance to fauna habitat is 1,327 ha, however the Proponent is seeking approval for overall disturbance of up to 1,800 ha to accommodate for detailed design of mining operations and infrastructure.

There is no evidence that current surface water discharges associated with the JSE, JSW and Oxbow development have adversely affected aquatic fauna taxa richness of microinvertebrates, hyporheic invertebrates or macroinvertebrates to date (WRM 2015a). Any changes to the surface water flows of Weeli Wolli Creek, such as water quality, flow velocity, increased turbidity and water depth, have the potential to cause local impacts to aquatic fauna. The Proposal will require direct disturbance to a section of the Weeli Wolli Creek floodplain adjacent to the pit, as well as the construction of flood protection levees within the floodplain of the creek. Disruption to the existing surface water flows along Weeli Wolli Creek due to the construction of the levee will be negligible during low-flow events.

As the magnitude of the flow increases, changes to the flow regime will increase due to greater constriction and obstruction of flows imposed by the infrastructure along the creek (URS 2015). This will reduce the width of the creekline floodflows, and may potentially cause increased erosion and turbidity downstream (WRM 2015a). Further details on the impacts and management of surface and groundwater are discussed in Section 13. Aquatic fauna will continue to be monitored over the life of the Proposal to quantify the impact, if any, from the Proposal (WRM 2015a, 2015b).

15.5.3.2 Altered Fire Regimes

Fire prevention measures will be implemented in accordance with the Proponent's standard operating procedures. Fire monitoring will be undertaken annually to assess the condition of firebreaks and the condition, layout and use of all hydrocarbon storage areas and other ignition sources, to identify any potential on-site fire risks.

15.5.3.3 Light, Dust and Noise

Light, dust and noise emissions from construction and mining activities can affect native fauna by deterring individuals from their habitats and subsequently altering species' foraging, roosting or breeding behaviour in the area immediately around the source of light, dust and noise. These impacts will be mitigated for EPBC Act listed threatened species in the SSMP and Yandi SSMP addendum (**Appendix 4**).

Impacts on fauna due to light emissions will be managed by implementing lighting controls, including, where appropriate, minimising light broadcast, installing sodium lights, using yellow-coloured lights at night, using motion sensors to limit the unnecessary light, and installing reflectors in strategic locations to deter bats from operational areas.

15.5.3.4 Introduced Species

Ground disturbance and poor waste management can result in the increase in numbers or introduction of weeds or feral animals, increasing predation of, or competition with, native fauna. These impacts will be mitigated in the Yandicoogina Weed Action Plan and for EPBC Act listed threatened species in the SSMP and Yandi SSMP addendum (**Appendix 4**).

15.6 Cumulative impacts

15.6.1 Cumulative impacts to the Chocolate Wattled Bat

A preliminary assessment of cumulative impacts to the Chocolate Wattled Bat was conducted based on a review of the potential impacts of the Proposal, the existing Yandi Operations and six other projects identified as being potentially relevant based on their location in the Weeli Wolli Creek or Marillana Creek sub-catchments of the Upper Fortescue River Catchment (**Figure 24**).

The Chocolate Wattled Bat is currently known to occur in the Pilbara only in the productive riparian environment of the Weeli Wolli-Marillana Creek System (McKenzie and Bullen 2009). Therefore, the preliminary assessment of cumulative impacts to this species has been based on potential impacts to riparian vegetation within the Weeli Wolli Creek and Marillana Creek sub-catchments.

The Chocolate Wattled Bat has been recorded at only one of the projects considered, being the Proposal (this Proposal; **Table 29**). The area of potential Chocolate Wattled Bat habitat (riparian vegetation) has been quantified for three of the projects considered (including this Proposal; **Table 29**). The three projects for which habitat has been quantified were included in this preliminary assessment of cumulative impacts to the Chocolate Wattled Bat.

Of the approximately 859 ha of potential Major Drainage Line habitat for the Chocolate Wattled Bat occurring in the Proposal Area, up to 85.9 ha will be cleared for the Proposal. This represents approximately 10% of the extent of this habitat in the Proposal Area. Taken together with the remaining projects for which habitat has been quantified, the cumulative impact is a loss of up to 1,463 ha of potential Chocolate Wattled Bat habitat, which represents approximately 5.6% of the 2,902 ha of riparian habitat mapped across the four projects (**Table 29**).

Table 29: Assessment of potential cumulative impacts to Chocolate Wattled Bat habitat

Project	Species occurrence	Area riparian habitat mapped	Area riparian habitat disturbed	Reference
Past and present actions				
Hamersley HMS's Hope Downs 1 Iron Ore Mine Expansion (EP Act Assessment No. 1308)	Not recorded	161 ha	10 ha	Ecologia (1997); Hope Downs Management Services Pty Ltd (2000)
Iron Ore Holdings Iron Valley Iron Ore Project (EP Act Assessment No. 1905; EPBC Act Ref. 2012/6458)	Not recorded	114 ha	0 ha	URS (2012)
BHP Jinidi Iron Ore Mine (EP Act Assessment No. 1904; EPBC Act Ref. 2012/6299)	Not recorded	NA	NA	Both *E. camaldulensis* and *E. victrix* were present in the Jinidi Iron Ore Mine Project area (vegetation type 1a); however the area of vegetation supporting these species was not provided in the documentation reviewed (BHP 2011; Biologic 2011)
BHP Marillana Creek (Yandi; EP Act Assessment No. 1555)	Unable to assess; insufficient	NA	NA	Groundwater dependent vegetation supporting *E.*

Project	Species occurrence	Area riparian habitat mapped	Area riparian habitat disturbed	Reference
	information provided in documentation reviewed			*camaldulensis* and *E. victrix* was recorded in the Marillana Creek (Yandi) Project area; however, the area of such was not quantified in the documentation reviewed (EPA 2005)
BHP Mining Area C (EP Act Assessment No. 1108)	Not recorded	NA	NA	Both *E. camaldulensis* and *E. victrix* were present in the Mining Area C Project area (vegetation type 13); however the area of vegetation supporting these species was not provided in the documentation reviewed (Woodward-Clyde 1997)
Mineral Resources Phil's Creek Iron Ore Mine (EPBC Act Ref. 2009/5107)	Not recorded	NA	NA	Vegetation type C1 supported both *E. camaldulensis* and *E. victrix*; however, details were not provided in the documentation reviewed on the area mapped and area proposed to be disturbed (Mattiske 2008c; URS 2009; Western Wildlife 2009)
Rio Tinto Yandicoogina Iron Ore Project, comprising: • Junction Central (EP Act Assessment No. 809 & 946) • Junction South East (EP Act Assessment No. 1590) • Junction South West and Oxbow (EP Act Assessment No. 1726; EPBC Act Ref. 2011/5815)	Not recorded	1,836 ha	67 ha	This document
Anticipated project actions				
Rio Tinto Yandi PBS Proposal (this assessment)	Recorded	859 ha	87 ha	This document

Project	Species occurrence	Area riparian habitat mapped	Area riparian habitat disturbed	Reference
Reasonably foreseeable future actions				
NA – none located in the Weeli Wolli Creek or Marillana Creek sub-catchments				
Cumulative impact				
Four projects: • Hamersley HMS's Hope Downs 1 Iron Ore Mine Expansion • Iron Ore Holdings Iron Valley Iron Ore Project • Rio Tinto Yandicoogina Iron Ore Project, comprising Junction Central, Junction south East, and Junction South West and Oxbow • Rio Tinto Yandi PBS Proposal (this assessment)	Refer above	2,902 ha	163 ha	Refer above

15.6.2 Cumulative impacts to the Pilbara Olive Python

A preliminary assessment of cumulative impacts to the Pilbara Olive Python was conducted based on a review of the potential impacts of the Proposal, the existing Yandi Operations and 19 other projects identified as being potentially relevant based on their location in the Upper Fortescue River Catchment (**Figure 24**).

The Pilbara Olive Python has been recorded at 12 of the projects considered (including this Proposal) and the area of potential Pilbara Olive Python habitat has been quantified for seven of the projects considered (including this Proposal; **Table 30**). The projects for which habitat has been quantified were included in this preliminary assessment of cumulative impacts to the Pilbara Olive Python.

Of the approximately 873 ha of potential habitat for the Pilbara Olive Python occurring in the Proposal Area, up to 87 ha will be cleared for the Proposal. This represents approximately 10% of the extent of this habitat in the Proposal Area. Taken together with the remaining projects for which habitat has been quantified, the cumulative impact is a loss of up to 5,447 ha of potential Pilbara Olive Python habitat, which represents approximately 15% of the 37,376 ha of habitat mapped across the seven projects (**Table 30**).

Table 30: Assessment of potential cumulative impacts to Pilbara Olive Python habitat

Project	Species occurrence	Area Pilbara Olive Python habitat mapped	Area Pilbara Olive Python habitat disturbed	Reference
Past and present actions				
FMG Christmas Creek Mine - Water Management Scheme (EP Act Assessment No. 1873; EPBC Act Ref. 2010/5706)	Not recorded	Not quantified	Not quantified	ENV (2010); FMG (2010a); FMG (2011)
FMG Cloudbreak Iron Ore Mine (EP Act Assessment No. 1577; EPBC Act Ref. 2005/2205)	Not recorded	Not quantified	Not quantified	Environ Australia (2005a)
FMG Cloudbreak Life of Mine (EP Act Assessment No. 1848; EPBC Act Ref. 2010/5696)	Not recorded	Not quantified	Not quantified	ENV (2010); FMG (2012)
Hamersley HMS's Hope Downs 1 Iron Ore Mine Expansion (EP Act Assessment No. 1308)	Recorded	11,348 ha	1,181 ha	Ecologia (1997); Hope Downs Management Services Pty Ltd (2000); this document
Rio Tinto (managed) Hope Downs 4 Iron Ore Mine (EP Act Assessment No. 1738; EPBC Act Ref. 2008/4636)	Not recorded	5,986 ha	914 ha	Mattiske (2008a; 2008b); Strategen (2010); this document
FMG IO Direct Shipping Iron Ore Project (Not Assessed – Public Advice Given under the EP Act)	Unable to assess; insufficient information provided in documentation	Unable to assess; insufficient information provided in documentation	Unable to assess; insufficient information provided in documentation	EPA (2012c)
Iron Ore Holdings Iron Valley Iron Ore Project (EP Act Assessment No. 1905; EPBC Act Ref. 2012/6458)	Not recorded	333 ha	105 ha	URS (2012)
BHP Jinidi Iron Ore Mine (EP Act Assessment No. 1904; EPBC Act Ref. 2012/6299)	Recorded	Not quantified	Not quantified	BHP (2011)

Project	Species occurrence	Area Pilbara Olive Python habitat mapped	Area Pilbara Olive Python habitat disturbed	Reference
Rio Tinto Koodaideri Iron Ore Mine (EP Act Assessment No. 1933; EPBC Act Ref. 2012/6422)	Recorded	729 ha	166 ha	ELA (2013)
BHP Marillana Creek (Yandi; EP Act Assessment No. 1555)	Recorded	Not quantified	Not quantified	EPA (2005)
Brockman Marillana Iron Ore Project (EP Act Assessment No. 1781; EPBC Act Ref. 2011/5892)	Recorded	Not quantified	Not quantified	Brockman Resources (undated)
BHP Mining Area C (EP Act Assessment No. 1108)	Not recorded	Not quantified	Not quantified	Woodward-Clyde (1997)
Mineral Resources Phil's Creek Iron Ore Mine (EPBC Act Ref. 2009/5107)	Recorded	Not quantified	Not quantified	Mattiske (2008c); URS (2009)
FMG Pilbara Iron Ore and Infrastructure Project - Railway Stage A (EP Act Assessment No. 1505)	Recorded	Not quantified	Not quantified	FMG (2010b)
FMG Pilbara Iron Ore and Infrastructure Project - Railway Stage B (EP Act Assessment No. 1520; EPBC Act Ref. 2004/1897)	Recorded	Not quantified	Not quantified	Environ Australia (2005b)
Roy Hill Roy Hill 1 Iron Ore Mining Project Stage 1 (EP Act Assessment No. 1589; EPBC Act Ref. 2008/4624)	Recorded	Not quantified	Not quantified	Roy Hill (2009)
Roy Hill Roy Hill 1 Iron Ore Mining Project Stage 2 (EP Act Assessment No. 1822; EPBC Act Ref. 2008/4624)	Recorded	Not quantified	Not quantified	EPA (2009b)
Rio Tinto Yandicoogina Iron Ore Project, comprising: • Junction Central (EP Act Assessment No. 809 & 946) • Junction South East (EP Act Assessment No. 1590) • Junction South West and Oxbow (EP Act Assessment No. 1726; EPBC Act Ref. 2011/5815)	Not recorded	9,434 ha	1,877	This document

Project	Species occurrence	Area Pilbara Olive Python habitat mapped	Area Pilbara Olive Python habitat disturbed	Reference
Anticipated project actions				
Rio Tinto Yandi PBS Proposal (this assessment)	Recorded	873 ha	87 ha	This document
Reasonably foreseeable future actions				
FMG Christmas Creek Expansion Project (EP Act Assessment No. 1989; EPBC Act Ref. 2013/7055)	Recorded	8,673 ha	1,117 ha	FMG (2015)
FMG Nyidinghu Iron Ore Project (EP Act Assessment No. 1068; EPBC Act Ref. 2013/6945)	Not recorded	Not quantified	Not quantified	FMG (2013)
Cumulative impact				
Seven projects: • Hamersley HMS Hope Downs 1 Iron Ore Mine Expansion • Rio Tinto (managed) Hope Downs 4 Iron Ore Mine • Iron Ore Holdings Iron Valley Iron Ore Project • Rio Tinto Koodaideri Iron Ore Mine and Infrastructure Project • Rio Tinto Yandicoogina Iron Ore Project, comprising Junction Central, Junction South East, and Junction South West and Oxbow • Rio Tinto Yandi PBS Proposal (this assessment) • FMG Christmas Creek Expansion Project	Refer above	37,376 ha	5,447 ha	Refer above

15.6.3 Cumulative impacts to potential Short Range Endemic invertebrates

A preliminary assessment of cumulative impacts was conducted for each of the four potential SRE invertebrate taxa recorded in the Proposal Area, being Nemesiidae sp. N42, Nemesiidae sp. N44, Idiopidae sp. I1 and Idiopidae sp. I9. Of these four taxa, only Nemesiidae sp. N44 has been recorded in the indicative disturbance footprint; the remaining three taxa have been recorded in the Proposal Area outside the indicative disturbance footprint.

The preliminary assessment of cumulative impacts to the four potential SRE invertebrate taxa was based on a review of the potential impacts of the Proposal and the existing Yandi Operations. The assessment considered each species' currently known distribution based on currently known records, and the extent of this distribution located in the Proposal Area and the Revised Proposal Development Envelope.

15.6.3.1 Nemesiidae sp. N42

The currently known distribution of Nemesiidae sp. N42 is approximately 11,300 ha. Of this, approximately 1,439 ha (13%) is located in the Revised Proposal Development Envelope, including less than 1 ha (<1%) in the Proposal Area.

15.6.3.2 Nemesiidae sp. N44

The currently known distribution of Nemesiidae sp. N44 is approximately 2,600 ha. Of this, approximately 1,638 ha (63%) is located in the Revised Proposal Development Envelope, all of which (63%) is in the Proposal Area.

15.6.3.3 Idiopidae sp. I1

The currently known distribution of Idiopidae sp. I1 is approximately 255,900 ha. Of this, approximately 18,606 ha (7%) is located in the Revised Proposal Development Envelope, including approximately 4,231 ha (2%) in the Proposal Area.

15.6.3.4 Idiopidae sp. I9

The currently known distribution of Idiopidae sp. I9 is approximately 6,500 ha. Of this, approximately 157 ha (2%) is located in the Revised Proposal Development Envelope, including approximately 50 ha (<1) in the Proposal Area.

15.7 Key management actions

Potential impacts to fauna values will be mitigated through the implementation of measures described in the SSMP and the E14 Standard (Land Disturbance and Rehabilitation Control). Measures relating to rehabilitation of disturbed areas will be implemented in accordance with the Yandicoogina Closure Plan.

Key measures in the SSMP (including the Yandi SSMP addendum) and Yandi Operations site measures include:

- Baseline surveys (following EPA Guidance Statements) will be completed in all areas with planned mining developments and infrastructure.
- Ensure any sightings or potential records of MNES encountered by the workforce during clearing operations are reported to site Environmental Advisors and are recorded in a register. Site environmental inductions and educational posters should include information to raise awareness of MNES species and specify protocols for reporting sightings.
- Location of MNES and their habitats identified within and adjacent to the Proponent's project boundaries will be recorded on the Rio Tinto GIS database.

- Targeted surveys will be undertaken to identify any significant species, habitat or communities for any new projects/developments. Methods will be investigated to minimise or avoid the clearing of significant species if identified. Riparian vegetation will be managed as per the Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan.
- Proposed clearing and disturbance will be assessed through the internal approvals coordination process. This internal process will ensure:
    - disturbance remains within approved boundaries;
    - clearing is minimised to meet specific demands;
    - planned clearing is adjusted where possible to avoid disturbance of significant areas; and
    - planned clearing meets legal obligations.
- All areas to be cleared will be demarcated prior to disturbance.
- Rehabilitation success will be assessed through vegetation monitoring and monitoring for habitat use indicators, in accordance with the completion criteria established within the Yandicoogina Closure Plan.
- Weed management measures will be implemented in accordance with Yandicoogina Weed Action Plan and equipment hygiene procedures to ensure weeds are controlled and recorded and equipment is cleaned to minimise the spread of weeds.
- Feral animal control will be undertaken by:
    - prohibiting feeding animals;
    - prohibiting keeping pets;
    - appropriate waste disposal for food scraps and other wastes as per the Waste Management Guidelines; and
    - regular feral animal reduction programs.
- Dust control measures (including road watering, water sprays and dust suppression systems) will be used to minimise dust from sites.
- Native fauna encountered on-site will be given the opportunity to move on if there is no threat to personnel safety in doing so.
- Injured fauna encountered on-site will be handled and transported in accordance with the Proponent's Wildlife interaction guidelines.
- Feeding of native fauna, hunting, keeping of firearms or pets on-site will be prohibited.
- Appropriate speed limits for mining equipment and light vehicles will be implemented, sign-posted and enforced, and communicated via education of site personnel.
- Vehicles will remain on designated roads and will not be permitted off designated roads unless in the case of emergency.
- Animal strikes by vehicles will be recorded and documented.
- Control fires caused by operations.

Implementation of snake handling and relocation procedures as required (this includes Pilbara Olive Python relocation protocol for any individuals encountered within the Yandi operational area). The Yandi SSMP addendum (**Appendix 4**) addresses management measures specifically to relevant EPBC Act listed species occurring, or potentially occurring, in the Revised Proposal Development Envelope. It outlines key management actions and accountability for issues relating to clearing and direct disturbance, indirect disturbance and other operational issues and outlines survey/monitoring requirements. These management actions are already been successfully implemented for the existing Yandi Operations.

15.8 Predicted outcome

A range of measures have been or will be implemented to reduce potential impacts to terrestrial fauna values (**Table 31**).

Table 31: **Mitigation hierarchy for terrestrial fauna values**

Mitigation measure	Description
Avoidance	Clearing will only occur within the approved Revised Proposal Development Envelope. Modify land clearing plans and evaluate alternative mine plans to avoid impacts on the conservation significant fauna species. Pets will be prohibited within the Proposal Area.
Minimisation	Clearing will be minimised to that required for safe construction and operation. Modify land clearing plans and evaluate alternative clearing options to minimise impacts on conservation significant fauna species. Clearing of vegetation will be staged allowing for the progressive movement of fauna into areas outside the proposed disturbance areas Infrastructure in creeklines designed to avoid disruption of low-flow line and flood flows. Low flows will be maintained in the low-flow line to support vegetation habitat. Vehicles will remain on designated roads and will not be permitted off designated roads unless in the case of an emergency. Any native animals encountered on-site will be given the opportunity to move on if there is no threat to human safety. Potential noise impacts to fauna will be minimised by selecting and locating equipment start-up alarms so that they reduce noise impacts. Lighting and dust controls will be implemented.
Rehabilitation	Disturbed areas will be progressively rehabilitated.

After mitigation and management measures have been applied, the Proposal is expected to result in the following residual outcomes in relation to terrestrial fauna:

- Clearing of up to 1,800[7] ha of terrestrial fauna habitat over the life of the Proposal.
- Habitat degradation due to the altered surface water and groundwater regime (including stress and some deaths of trees within the riparian zone), which may lead to local reductions in fauna populations in the Proposal Area. The habitat types present in the Proposal Area are considered to be well represented in the

[7] The total disturbance to fauna habitat is 1,327 ha, however the Proponent is seeking approval for overall disturbance of up to 1,800 to accommodate for detailed design of mining operations and infrastructure.

local and regional area. It is considered likely that individuals will continue to forage in the remaining habitats within and adjacent to the Proposal Area.

- Clearing will result in the direct removal of up to 1,800 ha of vegetation that contains potential SRE habitat within Proposal Area; this habitat is considered widespread locally and regionally.
- Risk of alteration to aquatic fauna habitat in Weeli Wolli Creek (surface water flows); additional habitat is available to north and south of the Proposal Area.
- Fragmentation of fauna habitat caused by the pit, waste dumps and association infrastructure; the mine footprint may also cause a barrier to dispersion for non-aerial species.
- Direct loss of some individual fauna through impact with machinery and vehicles, particularly during vegetation clearing.
- Rehabilitation, with consideration given to restoring fauna habitat values where practicable.

Clearing of up to 1,731 ha of native vegetation in Good to Excellent condition and 69 ha of riparian zone vegetation[8], including fauna habitat, within the Proposal Area will be offset as part of the Proposal (Section 18).

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[8] For the purposes of the offset calculation, riparian zone vegetation is classified as vegetation units within the riparian zone comprising C-coded and F2 coded vegetation located within the RCA.

16. Subterranean fauna

16.1 Key statutory requirements, environmental policy and guidance

16.1.1 EPA objective

The EPA has applied the following objective for the Proposal to its assessment of subterranean fauna:

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

16.1.2 Regulatory framework

The following legislation is relevant to the Proposal with respect to the protection of subterranean fauna values and the above EPA objective:

- *Wildlife Conservation Act 1950* (WA) *Environmental Protection Act 1986* (WA)
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

16.1.3 Relevant guidelines and policy

The following guidelines are relevant to the Proposal with respect to the protection of subterranean fauna and the above EPA objective:

- EAG 12: Environmental Assessment Guideline for Consideration of subterranean fauna in Environmental Impact Assessment in Western Australia (EPA 2013b)
- EPA Guidance Statement No. 54a: Sampling Methods and Survey Considerations for Subterranean Fauna in WA (EPA 2007)

16.2 Description of stygofauna

16.2.1 Stygofauna surveys

A total of 13 stygofauna surveys have been undertaken in and around the Revised Proposal Development Envelope since 2003, including the Proposal Area (Biota 2010a, 2011b, 2011c, 2013b; as cited in Biota 2015c). A total of 139 drillhole/boreholes have been sampled to date, encompassing JC, JSE, JSW, Oxbow and PBS deposits. Stygobitic fauna sampling has been undertaken using modified plankton haul nets lowered to the bottom of the drillholes and bore holes. Each site has been sampled in this way five times, unless the site recorded high water turbidity, in which case the drillhole/borehole was only sampled two or three times. A full description of the sampling methodology is outlined in the Biota (2015c) report (**Appendix 3**).

Of the 139 drillhole/boreholes sampled, 62 sites are located within the Proposal Area, including the 29 sites located within the proposed pit boundary. Sampling effort differed over the 13 stygofauna surveys, depending on the deposit-specific focus of the surveys and the access to and condition of drillhole/boreholes. Many sites were sampled over multiple phases; some sites were sampled in up to 11 surveys, while others were only sampled during a single survey. **Figure 66** shows the locations of the drillhole/boreholes used for the stygofauna surveys.

The methodology and approach used in all surveys were consistent with those outlined in EPA Guidance Statement No. 54a and EAG No. 12.

16.2.2 Stygofauna habitat

Stygofauna habitat is characterised by groundwater environments including porous, karstic and fractured rock aquifers, springs and the hyporheic zone of streams (Eberhard et al. 2005). Stygofauna inhabit voids, cavities and fractures in groundwater aquifers and a correlation exists between interconnectivity and transmissivity of the aquifer and suitability for stygofauna. Calcrete and alluvium are considered to be productive habitats for stygofauna, and pisolite and banded iron formations also considered to be suitable (Halse et al. 2014). The geological units found in the Proposal Area and their potential suitability for stygofauna as defined by Biota (2015c) are listed in **Table 32**.

Table 32: Geological units in the Proposal Area and their suitability for stygofauna

Geological time scale	Geological Formation Code	Description	Potential Habitat Suitability
Quaternary Period	Qw	Alluvium and colluvium – red-brown sandy and clayey soil; on low slopes and sheetwash areas.	High
	Qa	Alluvium – unconsolidated silt, sand, and gravel; in drainage channels and on adjacent floodplains. **Superficial aquifer**.	High
Cenozoic Era	Czk	Calcrete – sheet carbonate; found along major drainage lines.	High
	Czp	Pisolite (CID) – Pisolitic limonite deposits developed along ancient river channels (Palaeo-channel). **Deeper aquifer.**	Mod*
Proterozoic Eon	PLHj	Weeli Wolli Formation: banded iron formation (commonly jaspilitic), pelite, and numerous matadolerite sills.	Low

Adapted from Biota (2015c) * Typically classified as High, but classified as Moderate based on depth of CID habitat in the Proposal Area and Biota assessment (Biota 2015c).

The pre-mining habitat has been modified as a result of discharge from the Hope Downs 1 mining operations upstream of the Proposal; discharge from the existing Yandi Operations at the upstream discharge point DO6; and surplus water re-injection into the Billiard South deposit from the existing Yandi Operations since late 2006. This change, coupled with seasonal variability from cyclones and flooding, has resulted in a shallow water table in the Proposal Area and superficial formations remaining saturated for extended periods compared to past (pre-mining) conditions (Biota 2015c).

The hydrogeology in the Proposal Area is generally well suited for stygobitic fauna utilisation, with the majority of the shallow stratigraphy comprised of saturated alluvium (**Figure 67**). This shallow alluvial aquifer overlays a deeper aquifer formed by the CID. These systems are recharged both directly and indirectly by rainfall, groundwater and surface water flow. The CID is primarily recharged by seepage in areas where the present day creek overlays the CID (**Figure 25**). The shallow water table and seasonally variable influx of water from storm events are also likely to aid in fauna dispersal and general hydraulic connectivity of subterranean habitats within the area (Biota 2015c).

16.2.3 Stygofauna occurrence

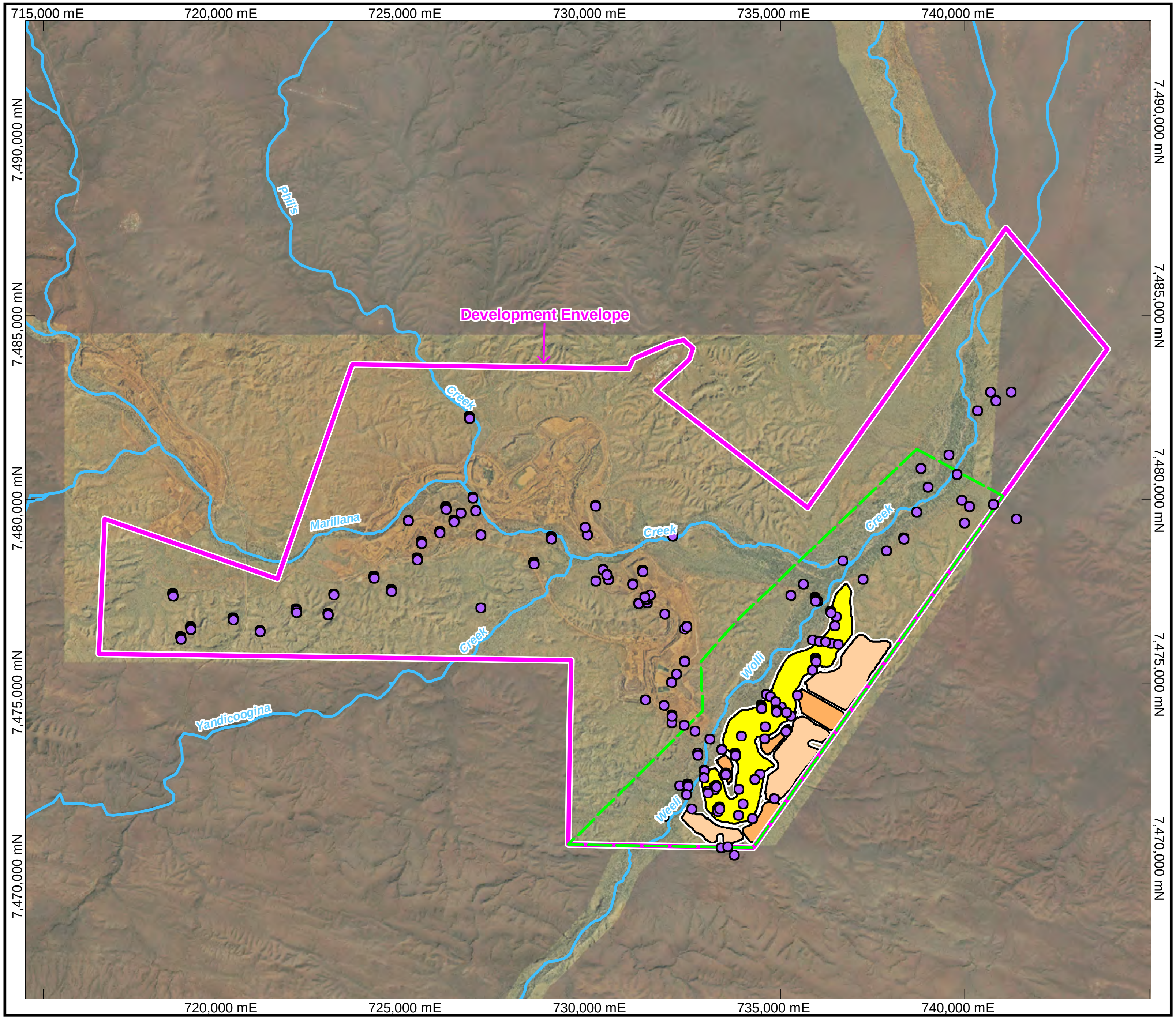
A total of 9,654 specimens of stygobitic fauna have been recorded from the Revised Proposal Development Envelope between 2003 and 2014 (Biota 2015c). These specimens were from eight phyla and at least nine classes. Specimens belonging to Gastropoda, Nematoda and Protozoa were unable to be classified beyond phylum, and turbellarian worms (phylum Platyhelminthes) could not be identified beyond class due to a lack of taxonomic framework for these groups in the Pilbara. Of the specimens that could be identified to lower taxonomic levels, Copepoda (copepods), Ostracoda (Seed Shrimp) and Amphipoda (Landhopper) were the most prolific, accounting for 77% of all specimens.

Approximately 64% of the total stygofauna species identified within the Revised Proposal Development Envelope have been recorded elsewhere in Australia or globally (Biota 2015c). The highest abundance of specimens was located in or adjacent to the Weeli Wolli and Marillana Creeks (Biota 2015c). Where the taxonomic framework is limited, identification of specimens beyond order can be difficult and results in limited conclusions for Environmental Impact Assessment at species level.

In the Proposal Area, 62 drillholes/boreholes have been sampled for stygofauna, with 42 sites yielding stygofauna specimens. In total there were 2,761 specimens from 62 taxa found in the Proposal Area since sampling commenced in 2003. The most abundant taxon was *Diacyclops humphreysi humphreysi* (918 specimens; 33% of records within the Proposal Area), followed by *Gordanitocrella trajani* (297 specimens; 11% of records within the Proposal Area) and *Notacandona boultoni* (270 specimens; 10% of records within the Proposal Area). Of the 29 sites within the proposed pit boundary, 21 of these sites contained stygofauna specimens (refer to **Figure 67**). From the sites that were sampled within the proposed pit boundary, Biota (2015c) identified 1,014 specimens from 39 individual taxa. Of these 39 taxa, three were only found within the proposed pit boundary and are not known from records outside this area:

- *Notobathynella* sp.;
- *Billibathynella* sp. B02; and
- *Brevisomabathynella* cf. *pilbaraensis.*

None of these species are currently Specially Protected, Schedule or Priority species or MNES. *Notobathynella* sp. and *Billibathynella* sp. B02 were only recorded as single specimens (singletons), while the two specimens of *Brevisomabathynella* cf. *pilbaraensis* were recorded from the same site. *Brevisomabathynella* cf. *pilbaraensis* is morphological similar to *Brevisomabathynella pilbaraensis* (type locality is 85 km away), however most Bathnellids have small distributions. *Brevisomabathynella* is known for its similarities between taxa, with two of the described species of this genus from the Pilbara (Ethel Creek and Millstream) also having only small morphological differences between them. **Table 33** provides a summary of the stygofauna survey results, including stygofauna recorded within the proposed pit boundary.



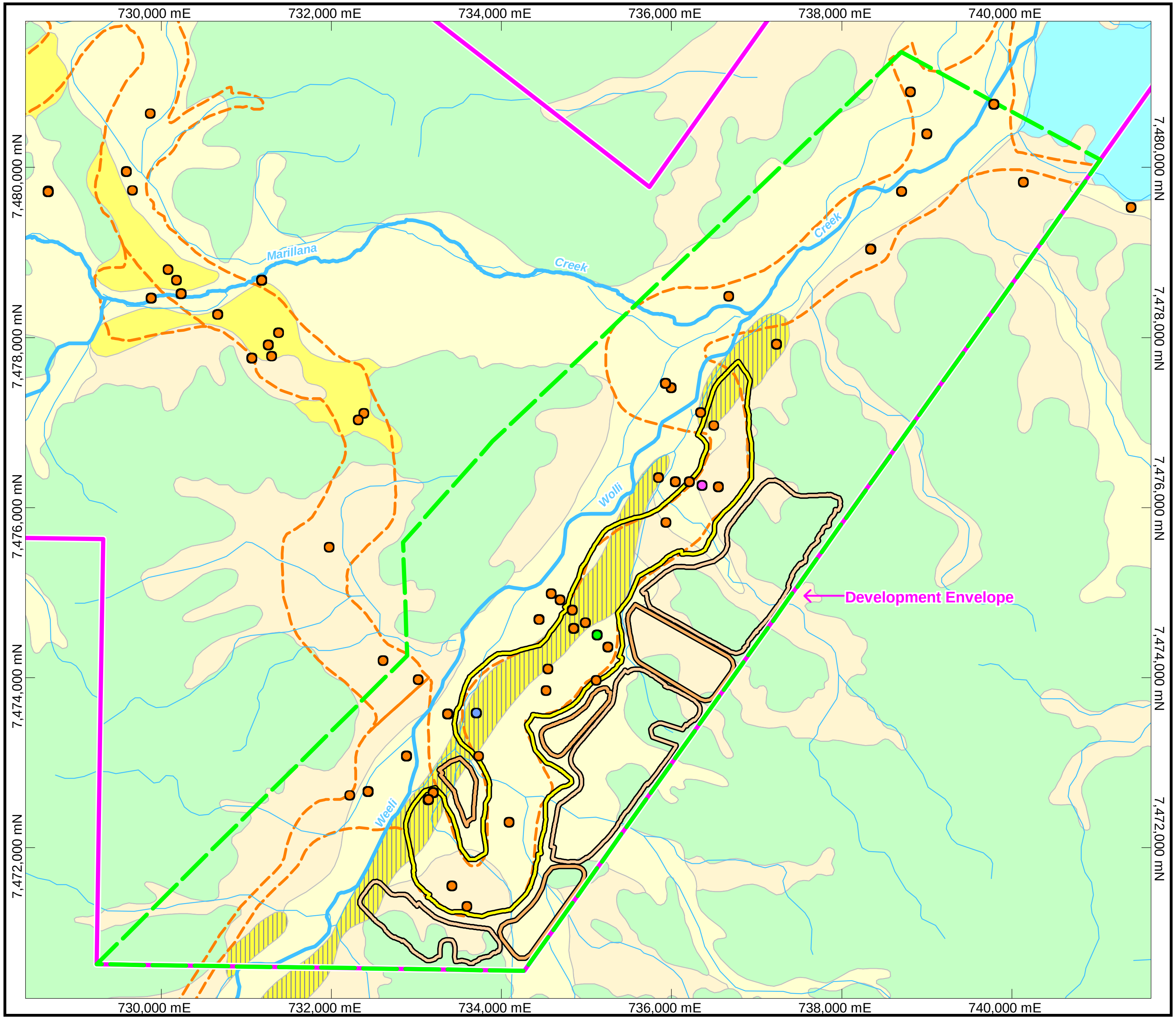
Rio Tinto

Iron Ore (WA)

Figure 66 Location of stygofauna sampling sites

Drawn: M.Swebbs
Date: Oct, 2015
Plan No: PDE0134734v3
Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

- Development Envelope
- Proposal Area
- Conceptual Mine Pit
- Conceptual Waste Dump
- Conceptual Topsoil / Subsoil Stockpile
- Major; Minor Watercourse
- Stygofauna Records
- *Brevisomabathynella cf. pilbaraensis*
- *Billibathynella sp. B02*
- *Notobathynella sp.*

Geology

- Colluvium
- Alluvium
- Pisolite and Limonite
- Calcrete
- HAMERSLEY GROUP
- Brockman Iron
- Weeli Wolli
- Extent of CID

N

SCALE

0 1 2 3km

1:65 000 @ A4

RioTinto

Iron Ore (WA)

Figure 67
Stygofauna records and surface geology of the Proposal Area

Drawn: M.Swebbs Plan No: PDE0134741v2
Date: October, 2015 Proj: MGA94 Zone50

Geospatial Information and Mapping

Table 33: Stygofauna specimens recorded from the Proposal Area between 2003 and 2014

CLASS	ORDER	FAMILY	GENUS	SPECIES	No. of specimens found in the proposed pit	Total no. of specimens recorded elsewhere in the Proposal Area	Total no. of specimens recorded in the Proposal Area	Taxon only known from the proposed pit?
Kingdom: Protozoa				sp.	0	6	6	N
Phylum: Nematoda				sp.	2	2	4	N
Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	sp. 02	0	13	13	N
Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	sp. 03	0	4	4	N
Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	sp. indet	0	3	3	N
Arachnida	Trombidiformes	Aturidae	*Axonopsella*	sp. B1	0	1	1	N
Arachnida	Trombidiformes	Mideopsidae	*Guineaxonopsis*	sp. S1 (PSS)	3	4	7	N
Arachnida	Trombidiformes	Unionicolidae	*Recifella*	sp. "Yandi"	1	2	3	N
Gastopoda	Hypsogastropoda	Hydrobiidae		sp.	0	1	1	N
Malacostraca	Amphipoda			sp. indet	2	1	3	N
Malacostraca	Amphipoda	Paramelitidae		sp. (lineage YB3)	2	5	7	N
Malacostraca	Amphipoda	Paramelitidae		sp. (lineage YB4)	0	2	2	N
Malacostraca	Amphipoda	Paramelitidae		sp. B02	84	82	166	N
Malacostraca	Amphipoda	Paramelitidae		sp. B03	3	0	3	N
Malacostraca	Amphipoda	Paramelitidae		sp. B16	1	0	1	N
Malacostraca	Amphipoda	Paramelitidae		sp. H8	0	16	16	N
Malacostraca	Amphipoda	Paramelitidae		sp. indet	1	10	11	N
Malacostraca	Amphipoda	Paramelitidae		sp. WW-2C	5	12	17	N
Malacostraca	Amphipoda	Paramelitidae	*Chydaekata*	sp.	64	125	189	N
Malacostraca	Amphipoda	Paramelitidae	*Chydaekata*	sp. B01	6	0	6	N
Malacostraca	Amphipoda	Paramelitidae	*Chydaekata*	sp. E	15	28	43	N
Malacostraca	Amphipoda	Paramelitidae	*Maarka*	sp. MA1	3	0	3	N
Malacostraca	Amphipoda	Paramelitidae	*Maarka*	*weeliwolli*	5	18	23	N
Malacostraca	Amphipoda	Paramelitidae	*Pilbarus*	*millsi*	0	2	2	N

CLASS	ORDER	FAMILY	GENUS	SPECIES	No. of specimens found in the proposed pit	Total no. of specimens recorded elsewhere in the Proposal Area	Total no. of specimens recorded in the Proposal Area	Taxon only known from the proposed pit?
Malacostraca	Bathynellacea	Parabathynellidae	*Atopobathynella*	sp. indet	0	1	1	N
Malacostraca	Bathynellacea	Parabathynellidae	*Billibathynella*	sp. B02	1	0	1	**Y**
Malacostraca	Bathynellacea	Parabathynellidae	*Billibathynella*	sp. B03	0	1	1	N
Malacostraca	Bathynellacea	Parabathynellidae	*Brevisomabathynella*	cf. *pilbaraensis*	2	0	2	**Y**
Malacostraca	Bathynellacea	Parabathynellidae	*Chilibathynella*	sp. B06	0	1	1	N
Malacostraca	Bathynellacea	Parabathynellidae	*Notobathynella*	sp.	1	0	1	**Y**
Malacostraca	Isopoda	Tainisopidae	*Pygolabis*	sp.	1	5	6	N
Malacostraca	Isopoda	Tainisopidae	*Pygolabis*	*weeliwolli*	38	62	100	N
Maxillopoda				sp.	2	0	2	N
Maxillopoda	Cyclopoida			sp.	0	1	1	N
Maxillopoda	Cyclopoida	Cyclopidae	*Diacyclops*	*cockingi*	33	65	98	N
Maxillopoda	Cyclopoida	Cyclopidae	*Diacyclops*	*humphreysi humphreysi*	367	551	918	N
Maxillopoda	Cyclopoida	Cyclopidae	*Diacyclops*	*humphreysi unispinosus*	60	2	62	N
Maxillopoda	Cyclopoida	Cyclopidae	*Diacyclops*	*sobeprolatus*	55	49	104	N
Maxillopoda	Cyclopoida	Cyclopidae	*Paracyclops*	*chiltoni*	0	3	3	N
Maxillopoda	Harpacticoida	Ameiridae	*Gordanitocrella*	*trajani*	48	249	297	N
Maxillopoda	Harpacticoida	Canthocamptidae		sp. B1	7	6	13	N
Oligochaeta	Tubificida	Enchytraeidae		Pilbara sp. 1 (PSS)	36	0	36	N
Oligochaeta	Tubificida	Enchytraeidae		sp. indet	0	1	1	N
Oligochaeta	Tubificida	Enchytraeidae	*Enchytraeus*	Pilbara sp. 2 (PSS)	8	26	34	N
Oligochaeta	Tubificida	Naididae		sp.	0	3	3	N
Oligochaeta	Tubificida	Naididae	*Dero*	*furcata*	0	2	2	N
Oligochaeta	Tubificida	Naididae	*Pristina*	*aequiseta*	0	1	1	N
Oligochaeta	Tubificida	Naididae	*Pristina*	*longiseta*	2	0	2	N
Oligochaeta	Tubificida	Phreodrilidae		sp.	0	3	3	N
Oligochaeta	Tubificida	Phreodrilidae		sp. indet	0	1	1	N

CLASS	ORDER	FAMILY	GENUS	SPECIES	No. of specimens found in the proposed pit	Total no. of specimens recorded elsewhere in the Proposal Area	Total no. of specimens recorded in the Proposal Area	Taxon only known from the proposed pit?
Oligochaeta	Tubificida	Tubificidae		morphospecies 1/1a (pss)	1	0	1	N
Oligochaeta	Tubificida	Tubificidae		stygo type 5	0	1	1	N
Ostracoda	Podocopida	Candonidae	*Areacandona*	*mulgae*	1	0	1	N
Ostracoda	Podocopida	Candonidae	*Meridiescandona*	*facies*	47	54	101	N
Ostracoda	Podocopida	Candonidae	*Meridiescandona*	*lucerna*	0	53	53	N
Ostracoda	Podocopida	Candonidae	*Meridiescandona*	*marillanae*	1	79	80	N
Ostracoda	Podocopida	Candonidae	*Meridiescandona*	sp. BOS399	0	6	6	N
Ostracoda	Podocopida	Candonidae	*Notacandona*	*boultoni*	95	175	270	N
Ostracoda	Podocopida	Limnocytheridae	*Gomphodella*	*alexanderi*	5	4	9	N
Ostracoda	Podocopida	Limnocytheridae	*Gomphodella*	*hirsuta*	2	3	5	N
Ostracoda	Podocopida	Limnocytheridae	*Gomphodella*	sp. BOS200	2	0	2	N
Turbellaria				sp.	2	2	4	N
				TOTAL	**1,014**	**1,747**	**2,761**	N/A

Adapted from Biota (2015c)

16.3 Description of troglofauna

16.3.1 Troglofauna surveys

Two phases of troglobitic fauna surveys were undertaken across the Proposal Area. Phase one was undertaken in 2009 and sampled 52 sites across the Revised Proposal Development Envelope, with 34 of these sites located within the Proposal Area. Phase two, completed in 2014, sampled 32 sites across the Revised Proposal Development Envelope, with 26 of these sites located within the ProposalArea (**Figure 68**). In addition to these two phases, troglofauna were opportunistically collected from four sites during past stygofauna sampling of the Revised Proposal Development Envelope, three of these sites are within the Proposal Area (Biota 2015d).

The methodology and approach used in all surveys were consistent with those outlined in EPA Guidance Statement No. 54a and EAG No. 12.

16.3.2 Troglofauna habitat

The suitability of a geological formation as troglofauna habitat is predominantly determined by above water table environments, with availability and interconnectivity of void/cavity space; the potential for nutrient infiltration from the surface; and the ability of the inhabited substrate to maintain a stable humidity (Biota 2015d). The surface geological formations occurring within the Proposal Area (where troglofauna have previously been recorded) and their suitability for troglofauna is provided in **Table 34.**

Table 34: Geological units in the Proposal Area and their suitability for troglofauna

Geological Time Scale	Geological Formation Code	Description	Suitability
Quaternary Period	Qw	Alluvium and colluvium – red-brown sandy and clayey soil; on low slopes and sheetwash areas.	Low
	Qa	Alluvium – unconsolidated silt, sand, and gravel; in drainage channels and on adjacent floodplains.	Medium
Cenozoic Era	Czk	Calcrete – sheet carbonate; found along major drainage lines.	High
	Czp	Robe Pisolite (CID): Pisolitic limonite deposits developed along river channels.	Low*
Proterozoic Eon	PLHj	Weeli Wolli Formation: banded iron formation (commonly jaspilitic), pelite, and numerous matadolerite sills.	Medium

Adapted from Biota (2015d) * Typically classified as High, but classified as Low based on 99% of CID habitat in the Proposal Area being below the water table and Biota assessment (Biota 2015c).

The majority of the troglofauna specimens recorded within the Revised Proposal Development Envelope have been collected from shallow alluvium, colluvium and calcrete drill holes with less than 10 m to water table. The surface geology units therefore generally characterise the habitats that the fauna were using at that time, given that other geological formations at depth were below water table.

All troglofauna specimens were recorded from three surface geological units, alluvium (Qa), colluvium (Czc) and calcrete (Czk; **Figure 69**) and these represent habitats that the fauna currently utilise within the Proposal Area.

The unconsolidated alluvium, colluvium and calcrete geological units located adjacent to Weeli Wolli Creek can be seasonally inundated during flooding, periodically rendering areas of habitat unsuitable for use by troglofauna. Adjoining higher elevation landforms, such as the Brockman Iron Formation and the Weeli Wolli Formation, potentially represent an alternative refuge from inundation, and potentially provides refuge habitat over longer timeframes (Biota 2015d). Troglofauna has been

Figure 68). In addition to these two phases, troglofauna were opportunistically collected from four sites during past stygofauna sampling of the Revised Proposal Development Envelope, three of these sites are within the Proposal Area (Biota 2015d).

The methodology and approach used in all surveys were consistent with those outlined in EPA Guidance Statement No. 54a and EAG No. 12.

16.3.2 Troglofauna habitat

The suitability of a geological formation as troglofauna habitat is predominantly determined by above water table environments, with availability and interconnectivity of void/cavity space; the potential for nutrient infiltration from the surface; and the ability of the inhabited substrate to maintain a stable humidity (Biota 2015d). The surface geological formations occurring within the Proposal Area (where troglofauna have previously been recorded) and their suitability for troglofauna is provided in **Table 34.**

Table 34: Geological units in the Proposal Area and their suitability for troglofauna

Geological Time Scale	Geological Formation Code	Description	Suitability
Quaternary Period	Qw	Alluvium and colluvium – red-brown sandy and clayey soil; on low slopes and sheetwash areas.	Low
	Qa	Alluvium – unconsolidated silt, sand, and gravel; in drainage channels and on adjacent floodplains.	Medium
Cenozoic Era	Czk	Calcrete – sheet carbonate; found along major drainage lines.	High
	Czp	Robe Pisolite (CID): Pisolitic limonite deposits developed along river channels.	Low*
Proterozoic Eon	PLHj	Weeli Wolli Formation: banded iron formation (commonly jaspilitic), pelite, and numerous matadolerite sills.	Medium

Adapted from Biota (2015d) * Typically classified as High, but classified as Low based on 99% of CID habitat in the Proposal Area being below the water table and Biota assessment (Biota 2015c).

The majority of the troglofauna specimens recorded within the Revised Proposal Development Envelope have been collected from shallow alluvium, colluvium and calcrete drill holes with less than 10 m to water table. The surface geology units therefore generally characterise the habitats that the fauna were using at that time, given that other geological formations at depth were below water table.

All troglofauna specimens were recorded from three surface geological units, alluvium (Qa), colluvium (Czc) and calcrete (Czk; **Figure 69**) and these represent habitats that the fauna currently utilise within the Proposal Area.

The unconsolidated alluvium, colluvium and calcrete geological units located adjacent to Weeli Wolli Creek can be seasonally inundated during flooding, periodically rendering areas of habitat unsuitable for use by troglofauna. Adjoining higher elevation landforms, such as the Brockman Iron Formation and the Weeli Wolli Formation, potentially represent an alternative refuge from inundation, and potentially provides refuge habitat over longer timeframes (Biota 2015d). Troglofauna has been recorded within the Brockman Iron Formation within hydrated zones (cavity-rich upper sections of the formation) at other locations such as Koodaideri within the bioregion (Biota 2015d).

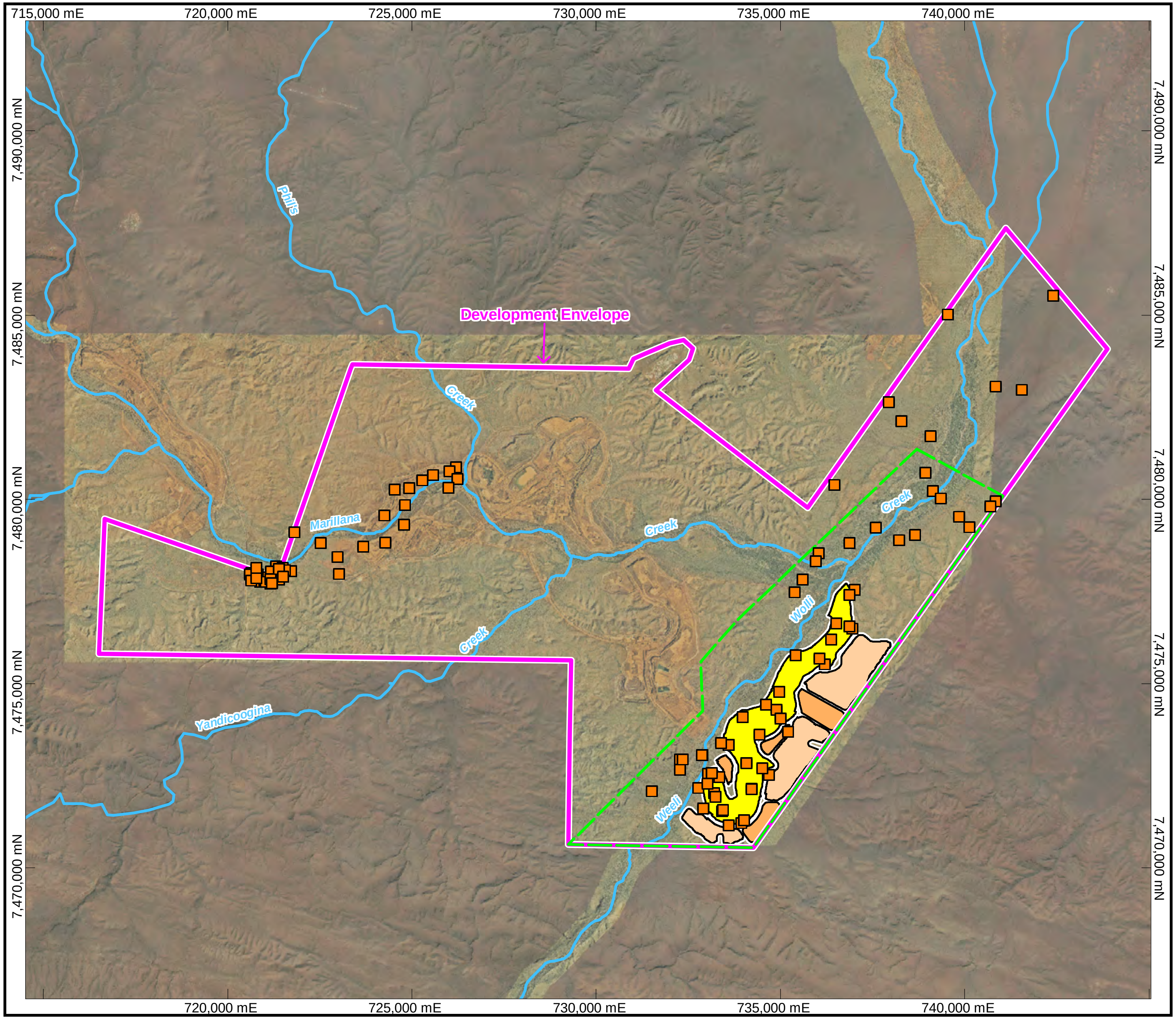
16.3.3 Troglofauna occurrence

Table 35 provides a summary of the troglofauna survey results, including troglofauna recorded within the proposed pit boundary. Six potential troglobitic fauna specimens have been recorded in the

Revised Proposal Development Envelope, three of which have been recorded within the Proposal Area (**Figure 69**):

- *Myrmopopaea* sp. nov;
- *Draculoides* sp. indet; and
- Pauropoda sp. indet.

Two of the specimens recorded within the Proposal Area are confirmed troglobites; *Myrmopopaea* sp. nov. and *Draculoides* sp. indet. The ecological status of the Pauropoda sp. indet is unconfirmed, as the distribution of this species is unknown (Biota 2015d). *Myrmopopaea* sp. nov. is the only taxon recorded from within the proposed pit boundary and it is not known from any other locations. *Draculoides* sp. indet and Pauropoda sp. indet were recorded from sites within 50 m from the proposed pit boundary



LEGEND

- Development Envelope
- Proposal Area
- Conceptual Mine Pit
- Conceptual Waste Dump
- Conceptual Topsoil / Subsoil Stockpile
- Troglofauna Sampling Site

N

SCALE

0 2 4 6km

1:150 000 @ A4

RioTinto

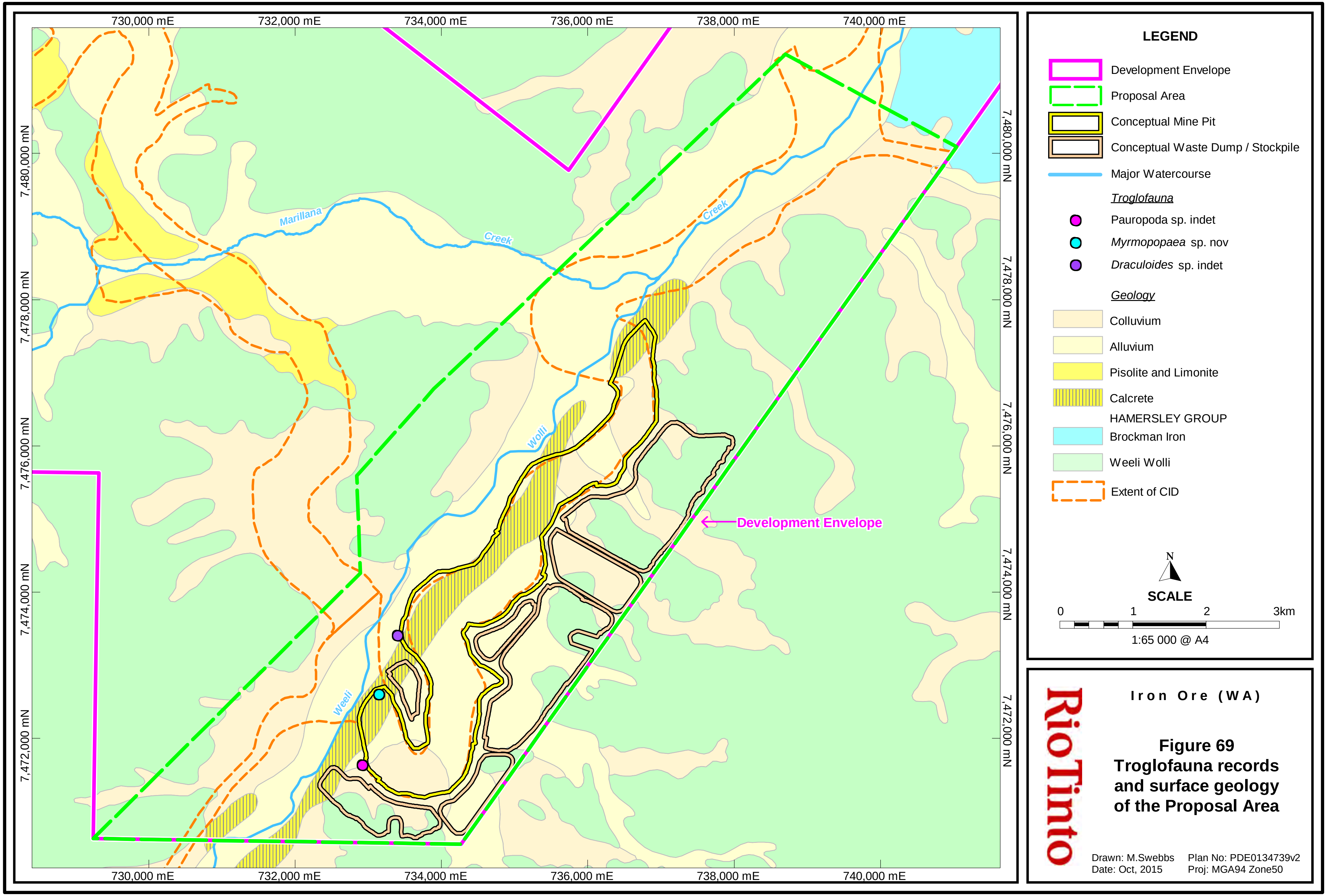
Iron Ore (WA)

Figure 68
Location of troglofauna sampling sites

Drawn: M.Swebbs
Date: Oct, 2015

Plan No: PDE0133894v3
Proj: MGA94 Zone50

Geospatial Information and Mapping



Rio Tinto

Iron Ore (WA)

Figure 69
Troglofauna records and surface geology of the Proposal Area

Drawn: M.Swebbs
Date: Oct, 2015
Plan No: PDE0134739v2
Proj: MGA94 Zone50

Geospatial Information and Mapping

Table 35: Troglofauna collected within the Proposal Area

Class	Order	Family	Genus	Species	No. of specimens found in the proposed pit	Total no. of specimens recorded elsewhere in the Proposal Area	Total no. of specimens recorded in the Proposal Area
Arachnida	Araneae	Oonopidae	*Myrmopopaea*	sp. nov	1	0	1
Arachnida	Shizomida	Hubbardiidae	*Draculoides*	sp. indet	0	1	1
Insecta	Pauropoda			sp. indet	0	1	1

16.4 Assessment of potential impact, mitigation and residual impact

The EPA has listed the following potential impacts for the Proposal in relation to subterranean fauna:

- direct mortality and loss of habitat through subsurface disturbance; and
- loss of habitat through abstraction of groundwater for dewatering.

16.4.1 Stygofauna

Potential impacts on stygofauna arise from excavation of habitat and abstraction of groundwater for dewatering. Extraction of ore will result in the direct removal of stygofauna individuals and habitat and also reduces the ability to move around the system (i.e. reduces habitat connectivity). In the surrounding areas where there is no excavation, nutrient infiltration may be affected by stockpiling of overburden at the proposed waste dump locations.

As the proposed pit is located on the floodplain (with approximately 99% of the CID occurring below the water table), the taxa that are present in the proposed pit footprint, and directly adjacent to it, are most at risk from the Proposal. Almost half of the stygofauna assemblage recorded from the Revised Proposal Development Envelope is known from the wider region and the frequency of wider ranging taxa indicate there is unlikely to be geographically restricted taxa (Biota 2015c). Of the 39 taxa recorded within the proposed pit boundary, three species were only found within the proposed pit boundary and are not known from any other records outside this area: *Notobathynella* sp., *Billibathynella* sp. B02 and *Brevisomabathynella* cf. *pilbaraensis*. These species are not currently conservation listed. It is considered likely that the three taxa recorded only from the proposed pit would occur throughout the broader alluvial and CID aquifer and therefore would not be significantly impacted by the Proposal. The paucity of records may be an artefact of sampling, rather than an indication of an extremely restricted distribution (Biota 2015c).

The alluvial and CID aquifer in which the stygofauna occur is associated with the Weeli Wolli Creek system and extends north and south of the Proposal Area including northwards beyond the Marillana Creek confluence, which is further associated with alluvial units draining towards Fortescue Marsh (**Figure 67**). This extensive and hydrologically connected system of aquifers results in habitat that extends continuously beyond the predicted area of impact from pit excavation and groundwater drawdown. Seasonal flooding caused by cyclonic events may also assist in dispersing stygofauna taxa. This continuous aquifer linkage suggests that it is less likely that stygofauna species recorded in the proposed pit boundary and Proposal Area are restricted to this area (Biota 2015c). Potential stygofauna habitat and refuge areas within the local catchment are presented in **Figure 76**.

Figure 71 and **Figure 75** show the sequential modelled groundwater drawdown pattern during the life of the Proposal from 2017 to 2032. The peak dewatering period is predicted to occur within the first 6 years of dewatering in which the modelling shows the drawdown cone of depression would extend up to 85m bgl, encompassing the proposed pit area and extending to the mapped southern limit of the CID in the Proposal Area. This drawdown extent is modelled to continue from 2027 to 2031. Stygofauna that have been recorded within this drawdown area are likely to be affected.

While there will be a reduction in suitable habitat for stygofauna within the drawdown cone of depression, there is substantial habitat available within the adjacent alluvium (shallow aquifer) beneath Weeli Wolli Creek and also upstream and downstream both within the CID aquifer and shallow aquifer alluvium. The stygofauna habitat identification (Biota 2015d) was mapped and jointly considered with pre-mining depth to water table (Biota 2015e). This adopted a conservative approach of combining the most prospective geological units (**Table 32**), with areas where depth to water table was less than 40 m bgl. This is shown in **Figure 70**, along with the distribution of all stygofauna records from the Revised Proposal Development Envelope, which demonstrate the habitat mapping aligns with the known occurrence of this fauna.

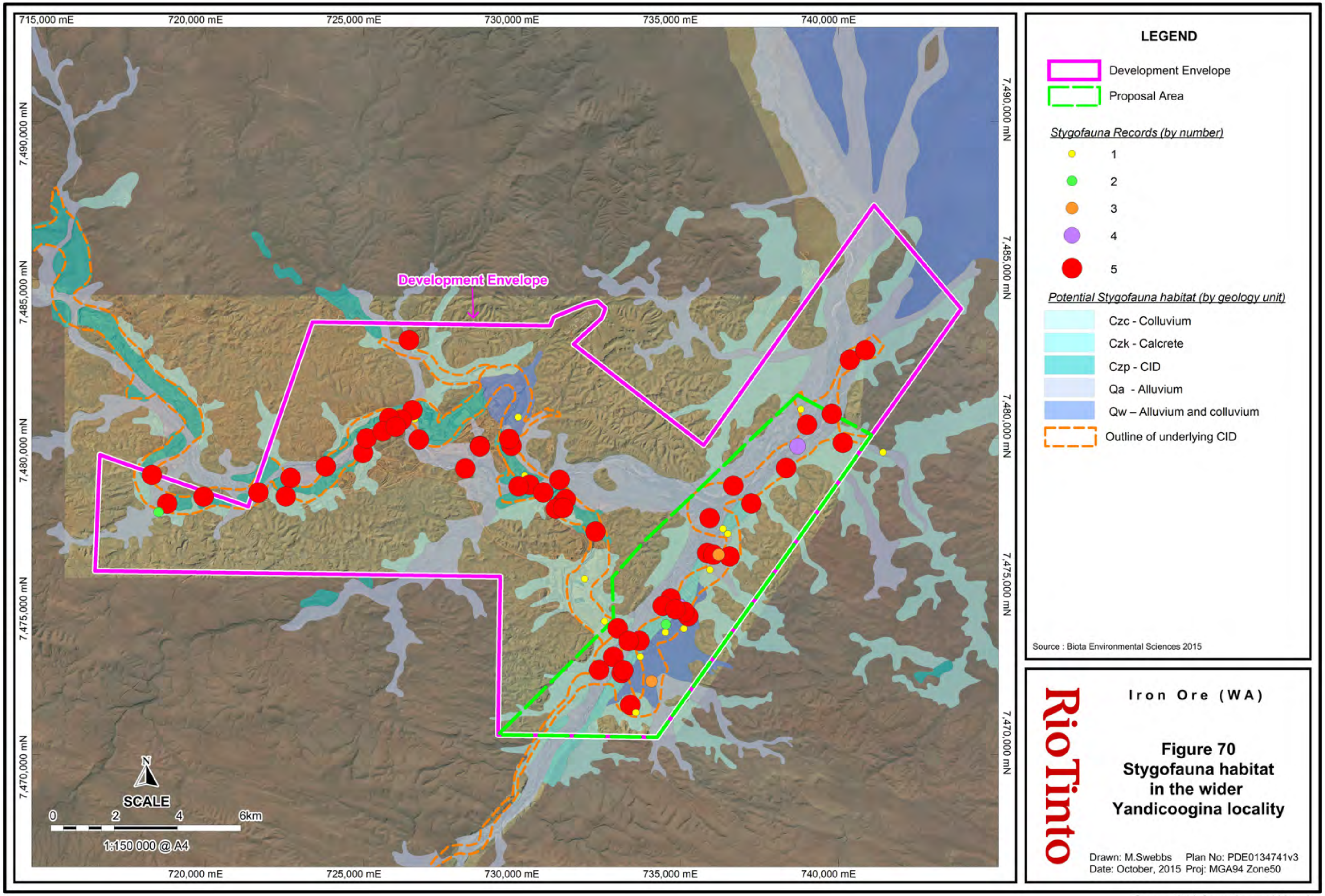
Figure 70 also overlays the extent of predicted dewatering drawdown for the Proposal on the mapped stygofauna habitat. This illustrates that while sections of habitat in the Proposal Area may be effectively desaturated, equivalent and connected stygofauna habitat both upstream and downstream of the Proposal Area will remain suitable, allowing stygofauna to persist locally in the system over the life of the proposal. Reviews of stygofauna habitat indicate that there are no significant geological or hydrogeological barriers to dispersal within the broader Weeli Wolli – Marillana Creek system (Biota 2015d). This is consistent with both the habitat mapping shown in **Figure 70**, and reviews of the distributions of individual stygofauna species (Biota 2015d). Genetic and morphological determinations of stygofauna species, with representatives from most stygal orders, show that the same species occur within Weeli Wolli Creek and Marillana Creek, from higher in the catchment (e.g. Weeli Wolli Springs) to past the confluence of the two creeks (Biota 2015d, Finston and Johnson 2004). Sections of both Marillana Creek and Weeli Wolli Creek will remain unaffected by both the dewatering of the current Proposal, and that arising from other existing operations such as Hope Downs 1 and BHP's Yandi Operations, effectively representing habitat refugia for the stygal community that occurs within the local catchments (**Figure 76**).

Discharge of surface water from other operations may also serve to offset any impacts from dewatering. While the peak dewatering periods may reduce the ability for stygofauna to move through the Proposal Area, restricting the ability for some dispersal through the groundwater system towards Fortescue Marsh, the continuation of upstream discharge from Hope Downs 1 maintaining flow within the low-flow channel combined with natural seasonal flooding events, is expected to largely reduce this impact. Discharge from DO9 will likely increase the extent of downstream saturation within the alluvial aquifer within the downstream extents of Marillana and Weeli Wolli Creeks and potentially extend the available habitat and dispersal range. During the majority of mining and following cessation of mining activities, it is likely that there will be continual habitat connection upstream and downstream of the Proposal, allowing the ongoing dispersal of the stygofauna. It is considered unlikely that there will be a substantial regional impact to stygofauna (Biota 2015c).

Overland surface water flows into the pit from the east will be diverted through the construction of roads, pit, dumps and via a surface water diversion drain. This construction will potentially reduce localised replenishment and nutrient flows into subterranean fauna habitat, however major flood flows in Weeli Wolli Creek will continue to deliver nutrients to the system.

Water quality monitoring to date at the existing Yandi Operations indicates some minor variation in water quality parameters, however this is considered to be within natural fluctuations and no significant effects on baseline water quality has occurred as a result of abstraction and discharge activities. Given the abstraction and discharge of water from the Proposal is from the same water source as the existing Yandi Operations, it is expected that there will not be any significant effects on stygofauna due to water quality changes as a result of the Proposal operation.

The post-closure landform will include the development of permanent pit lakes, which will influence the way surface and groundwater inputs are redistributed within and released from the Proposal Area. This could potentially influence aquifer water quality and riparian environments within the Proposal Area and to some extent, downstream. The post-closure landform has been designed to enable periodic flushing of the pit voids, thereby reducing the potential for long term aquifer salinisation and minimising potential ongoing impacts to stygofauna. The post-closure landform is discussed further in Section 17.2.



Geospatial Information and Mapping

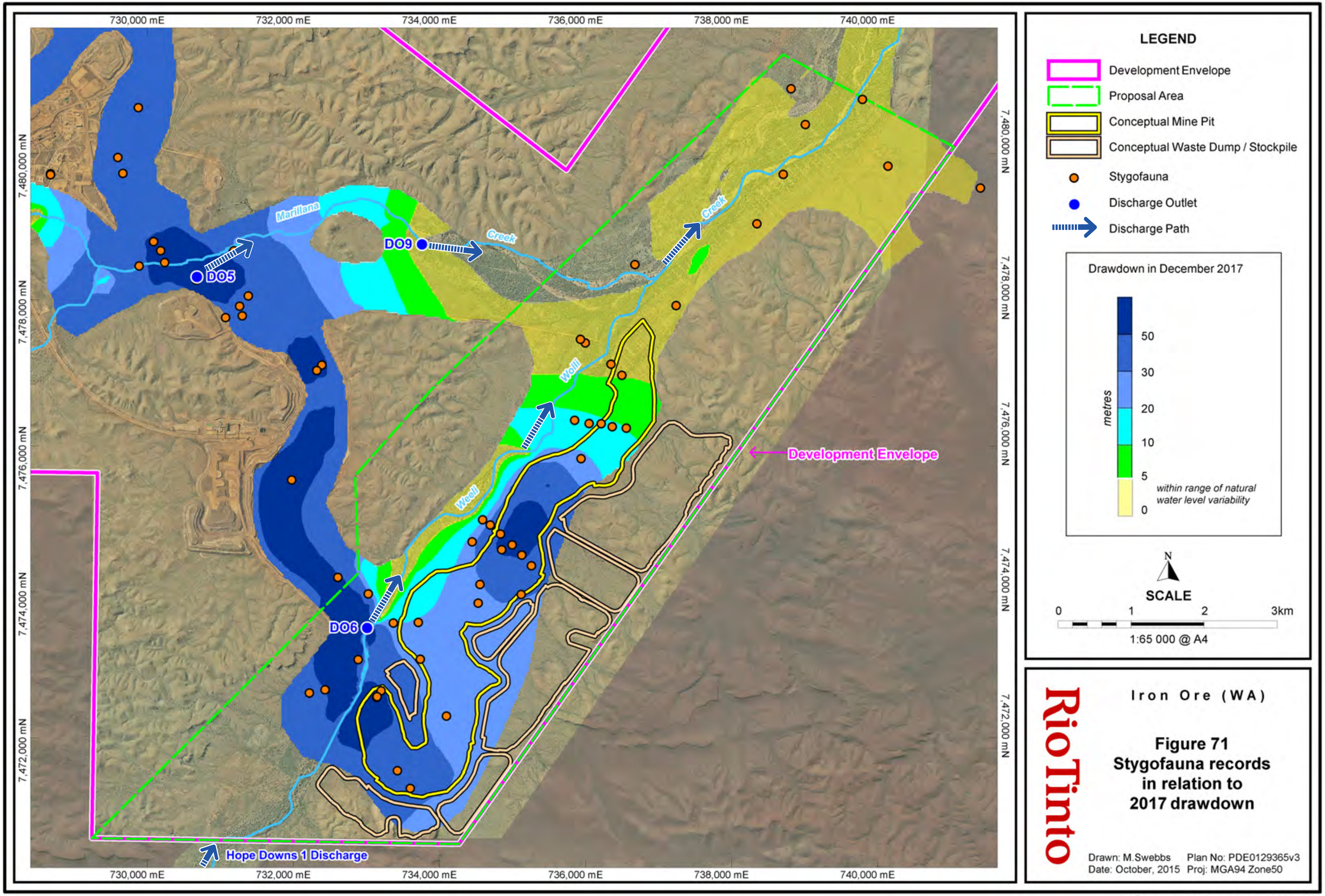
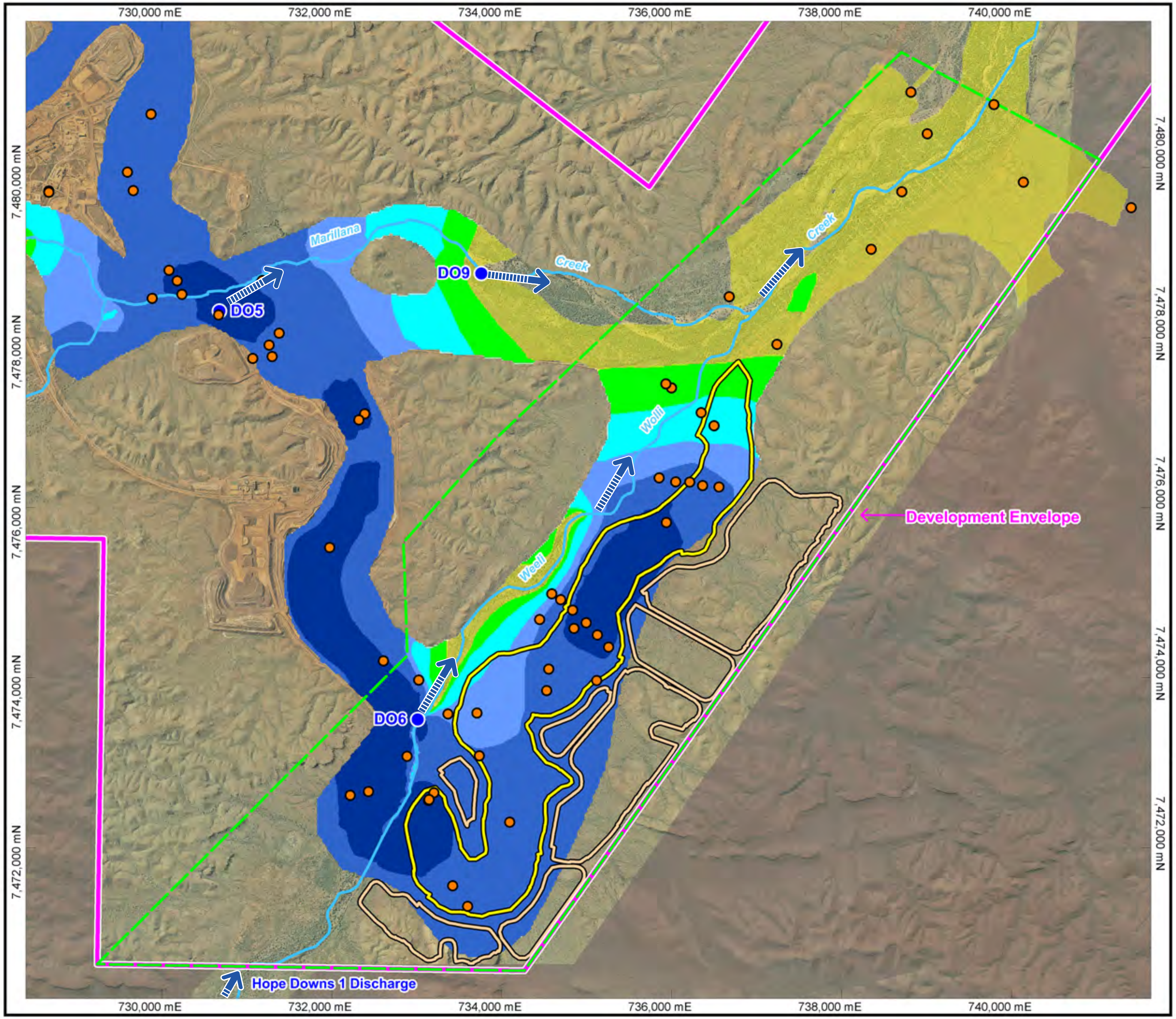


Figure 71
Stygofauna records in relation to 2017 drawdown

Geospatial Information and Mapping



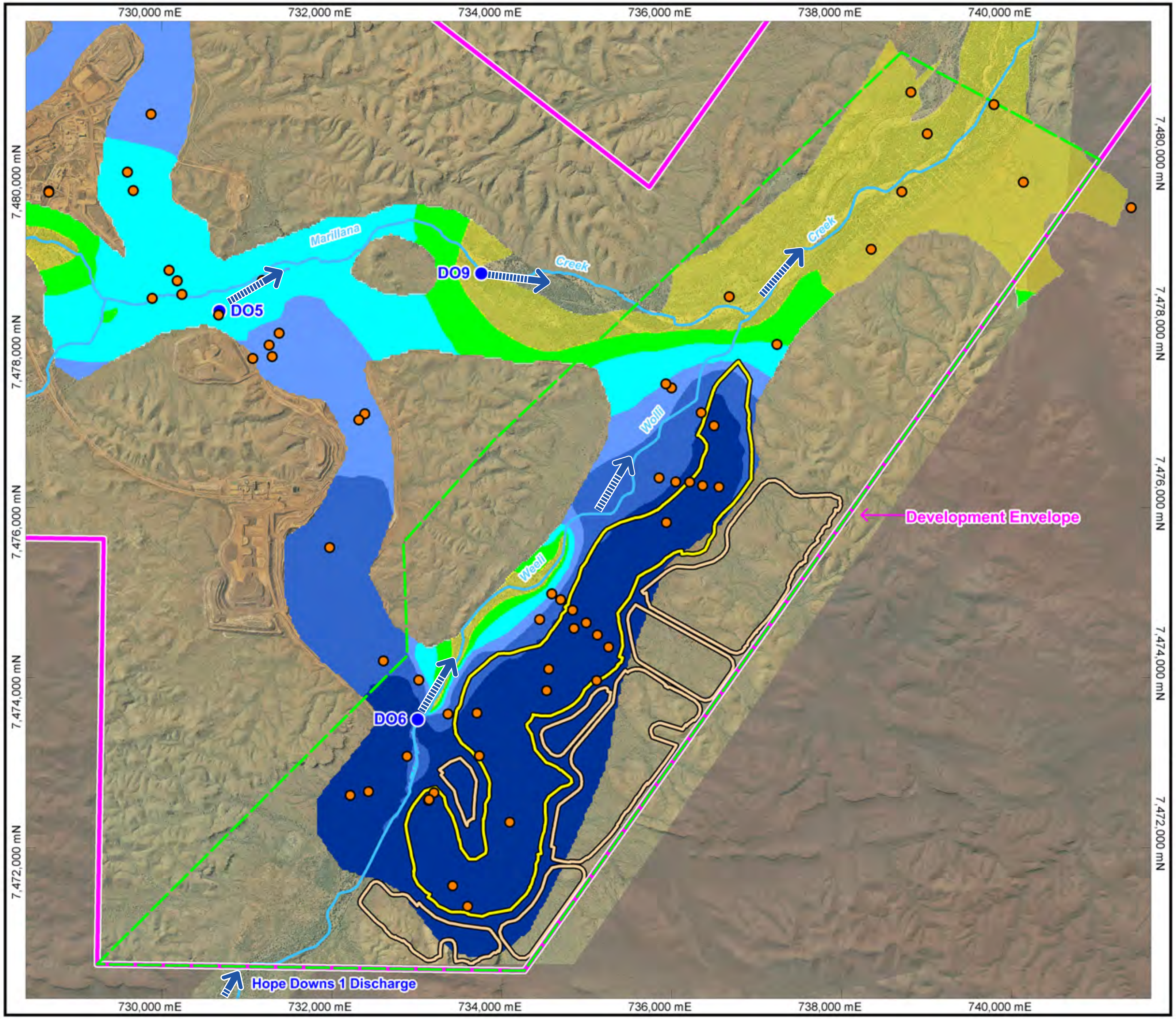
Rio Tinto

Iron Ore (WA)

Figure 72
Stygofauna records in relation to 2019 drawdown

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0129365v3
Proj: MGA94 Zone50

Geospatial Information and Mapping



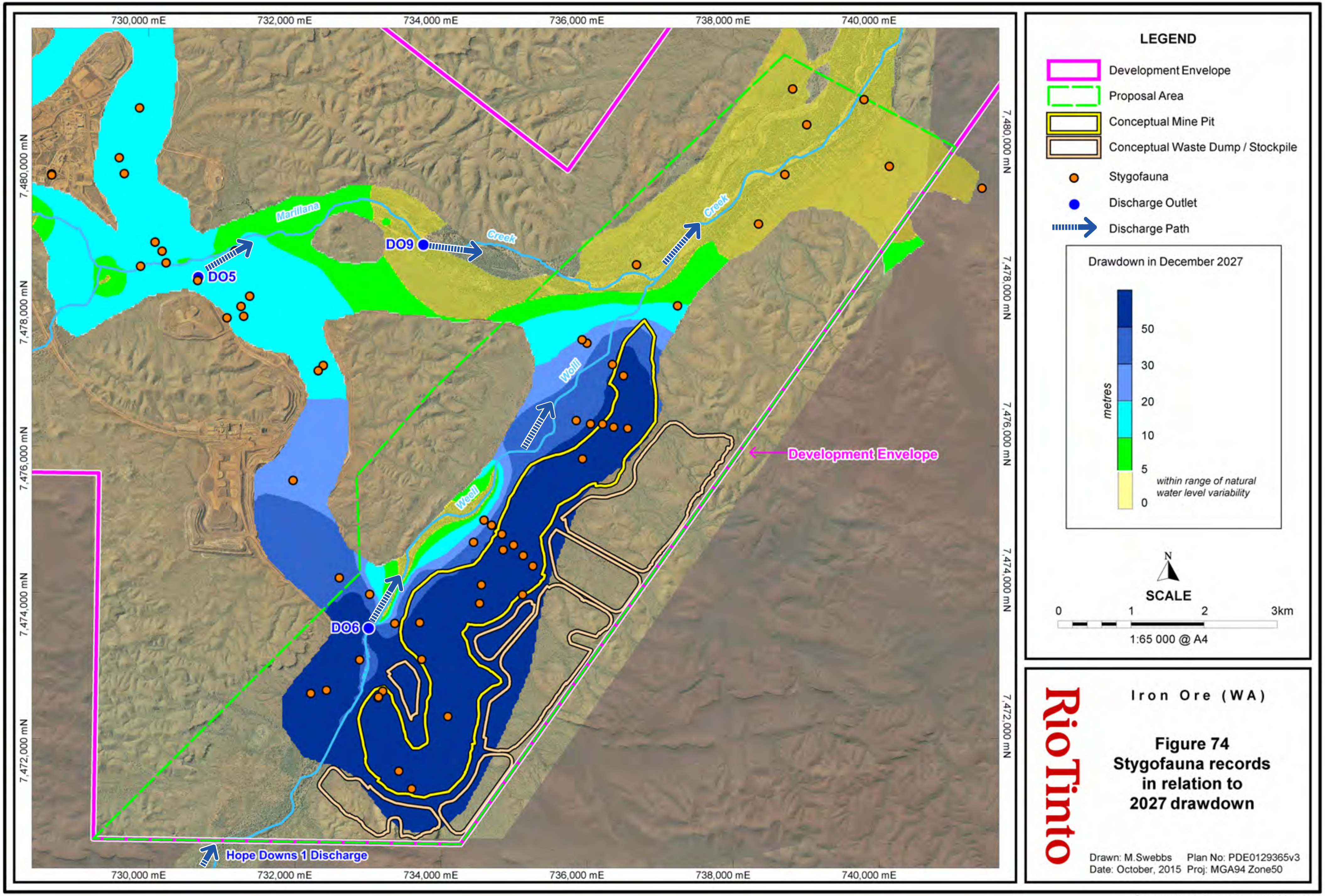
Rio Tinto

Iron Ore (WA)

**Figure 73
Stygofauna records
in relation to
2023 drawdown**

Drawn: M.Swebbs Plan No: PDE0129365v3
Date: October, 2015 Proj: MGA94 Zone50

Geospatial Information and Mapping



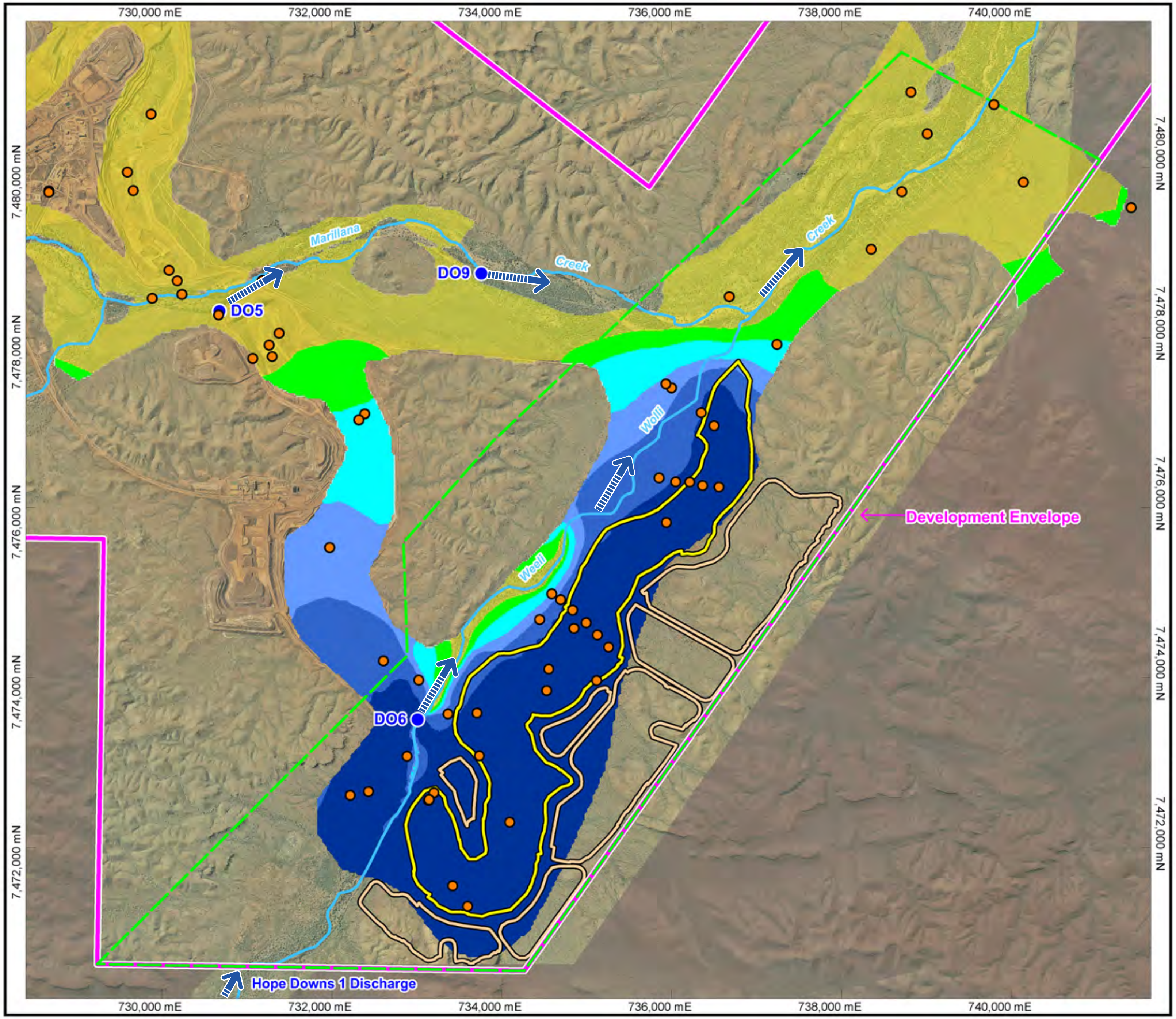
Rio Tinto

Iron Ore (WA)

Figure 74
Stygofauna records in relation to 2027 drawdown

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0129365v3
Proj: MGA94 Zone50

Geospatial Information and Mapping



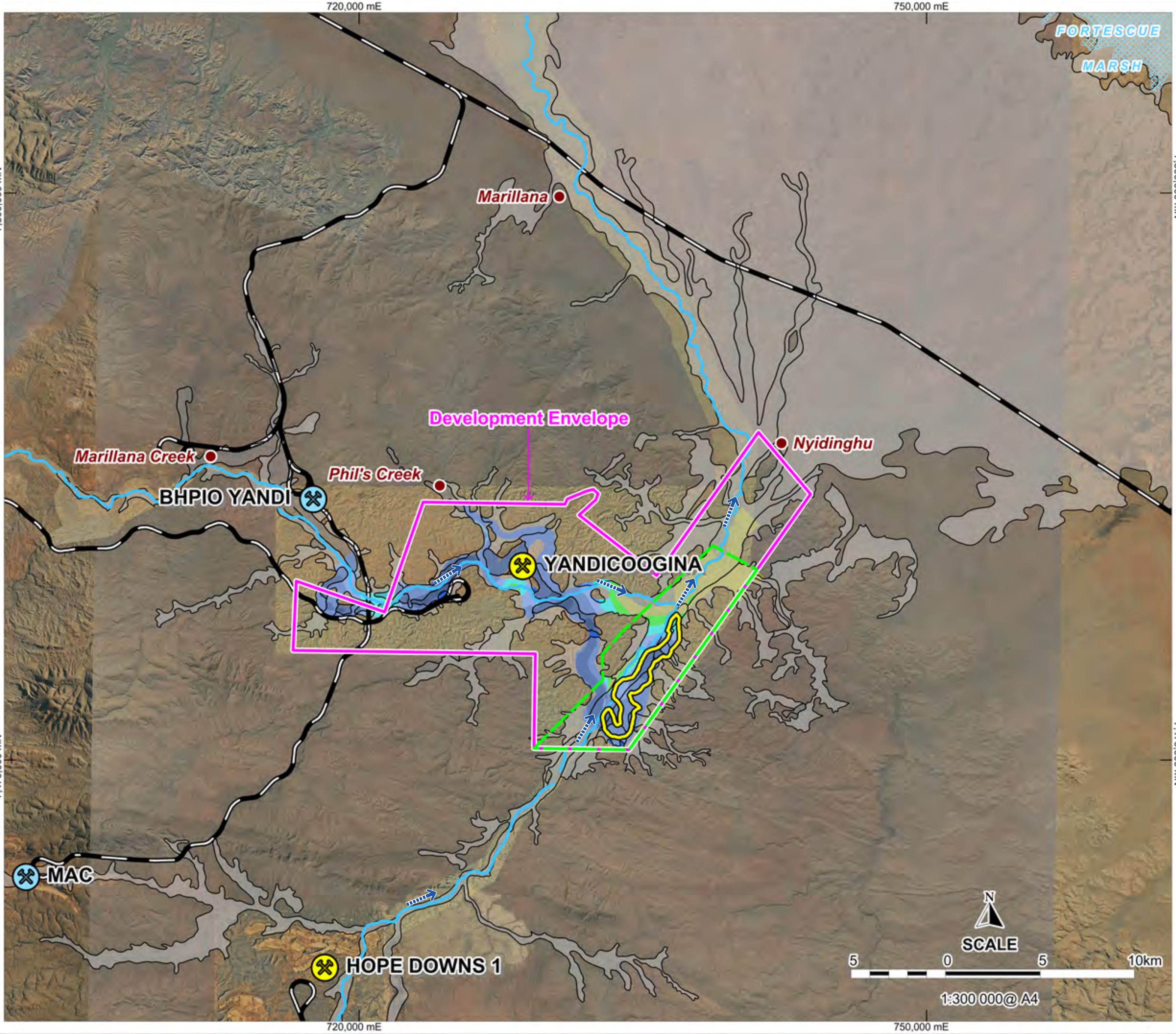
Rio Tinto

Iron Ore (WA)

Figure 75
Stygofauna records in relation to 2031 drawdown

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0129365v3
Proj: MGA94 Zone50

Geospatial Information and Mapping



LEGEND

Development Envelope
Proposal Area
Conceptual Mine Pit
Existing Railway
Major Watercourse
Other mining operations within catchment with potential to impact local habitat
Discharge (potential additional refuge)

Potential Stygofauna habitat and refuge (by geology unit)

Alluvium
Colluvium
Calcrete
Czp - CID

Drawdown in December 2019

metres
50
30
20
10
5
0
within range of natural water level variability

Iron Ore (WA)

RioTinto

Figure 76
Stygofauna habitat and local catchment habitat

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0136314v1
Proj: MGA94 Zone50

16.4.2 Troglofauna

The excavation of ore and removal of overburden material will result in the direct removal of the habitat for troglobitic fauna. In addition, discharge of additional surplus water from DO9 is likely to broaden the lateral extent and height of perennial flow in the low-flow channel which may increase inundation of some areas of downstream habitats beyond natural seasonal durations.

The only confirmed troglobite specimen recorded from within the proposed pit area was *Myrmopopaea* sp. nov., which was recorded within interconnected calcrete and alluvium formations. These largely interconnected geological formations are located adjacent to, and extend parallel to Weeli Wolli Creek and contain sufficient interstitial spaces and cavities to allow movement of troglobitic fauna. This habitat continuity suggests that the single record of *Myrmopopaea* sp. nov. is likely to occur more widely than the current record and its distribution likely extends beyond the area of impact for the Proposal (Biota 2015d), see **Figure 69**.

The singleton records of *Draculoides* sp. indet (confirmed troglobite) and Pauropoda sp. indet. (unconfirmed troglobite) were recorded in calcrete from sites less than 50 m outside the proposed pit area. However, it is considered that these species will not be directly affected, they are likely to occur more widely than the current records, and their distribution is expected to extend beyond the area of impact for the Proposal (Biota 2015d).

Although the primary habitat for troglofauna in the area is currently poorly defined, the CID deposit proposed for excavation in the Proposal Area is located 99% below the water table, and is therefore not suitable for troglofauna habitat. The continuous nature of the alluvium, colluvium and calcrete units indicates that geology is not a limiting factor in the distribution of the taxa currently known from the area of impact for the Proposal (Biota 2015c). The long term persistence of the fauna in the riverine habitat setting of the Proposal Area suggests these habitats are well connected with other older geological units that provide refugia habitat over longer timeframes (Biota 2015d).

16.5 Key management actions

Potential impacts to subterranean fauna values will be mitigated through the implementation of measures described in the Yandicoogina MMP, the Yandicoogina GWOS; the E11 Standard: Water Quality Protection and Water Management; the E15 Standard: Hazardous Materials and Non-Mineral Waste Control and Minimisation; and the Yandicoogina Closure Plan. Key mitigation and management measures are:

- Maintaining viable habitat by maintaining groundwater levels within predicted ranges, including maintaining upstream surface water discharge (perennial flows) during drawdown to partially negate drawdown impacts;
- Maintaining surface water discharge quality by managing erosion and sedimentation; and
- Maintaining groundwater and surface water quality by managing contamination (eg. hydrocarbon spills).

16.6 Predicted outcome

Stygofauna and troglofauna habitat will be affected by implementation of the Proposal. A range of measures have been or will be implemented to reduce potential impacts to subterranean fauna values (**Table 36** and **Table 37**).

Table 36: Mitigation hierarchy for stygofauna values

Mitigation measure	Description
Avoidance	Direct physical disturbance (excavation) to Weeli Wolli Creek floodplain and shallow alluvial aquifer (core habitat) will largely be avoided Weeli Wolli Creek flood flows will be maintained.
Minimisation	Maintain discharge flows/water availability in the Weeli Wolli low-flow channel adjacent to the proposed pit for the duration of mining to partially negate drawdown impacts in the alluvial aquifer. Areas of saturated habitat for stygofauna will be preserved across the Revised Proposal Development Envelope from staged sequence of mining. Water quality, including pollution and salinisation (surplus discharge water quality and groundwater quality) will be maintained and managed in accordance with the Yandi MMP; GWOS; E11 Standard: Water Quality and Protection Standard; E15 Standard: Hazardous Materials and Non-Mineral Waste Control and Minimisation; and the Yandicoogina Closure Plan.
Rehabilitation	Disturbed areas will be rehabilitated consistent with the Yandicoogina Closure Plan. Key functional creek elements retained (e.g. flood pathways, vegetation seed bank) to support natural rehabilitation upon closure.

Table 37: Mitigation hierarchy for troglofauna values

Mitigation measure	Description
Avoidance	Direct disturbance to Weeli Wolli Creek will largely be avoided and low-flow lines will be maintained.
Minimisation	Clearing will be minimised to that required for safe construction and operation. Limited direct impact on creekline alluvial habitat.
Rehabilitation	Disturbed areas will be rehabilitated consistent with the Yandicoogina Closure Plan. Key functional creek elements retained (e.g. flood pathways, vegetation seed bank) to support natural rehabilitation upon closure.

After management and mitigation measures have been applied, it is expected that the Proposal will result in the following outcomes for subterranean fauna:

- Direct mortality and reduction in available subterranean habitats as a result of pit excavation and groundwater drawdown.
- Potential impacts will be localised to the proposed pit area and the groundwater drawdown zone during mining operations. However, it is not expected to significantly impact subterranean assemblages and species persistence.
- The risk of pollutants being transported into the subterranean habitats is likely to be low and restricted to localised areas. There is some risk of aquifer salinisation from the pit lakes after mine closure. This is further addressed in Section 17.2.4.
- The continuous nature of the alluvium, colluvium and calcrete units in which the subterranean fauna were predominately recorded indicates that geology is not a limiting factor in the distribution of the taxa currently known from the proposed pit area and the groundwater drawdown zone within the Proposal Area.

The Proponent considers that there are no significant residual impacts to subterranean fauna that require an offset.

17. Rehabilitation and closure

17.1 Key statutory requirements, environmental policy and guidance

17.1.1 EPA objective

The EPA has applied the following objective for the Proposal to its assessment of rehabilitation and closure:

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

17.1.2 Regulatory framework

Key legislation relevant to the Proposal with respect to rehabilitation and closure includes:

- *Environmental Protection Act 1986* (WA).
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).
- *Contaminated Sites Act 2003* (WA).
- *Iron Ore (Yandicoogina) Agreement Act 1996* (WA).
- *Mining Act 1978 (WA).*

A more comprehensive list of legislation and closure obligations for the Proposal are set out in the Yandicoogina Closure Plan (**Appendix 4**).

17.1.3 Relevant guidelines and policy

The DMP and EPA have issued the *Guidelines for Preparing Mine Closure Plans – May 2015* (referred to herein as Closure Guidelines) which establish standards for closure plans being submitted to Government (DMP and EPA 2015). The *Mining Act 1978* (WA) has been amended to specifically require closure plans that comply with the Closure Guidelines to be submitted with mining proposals, and reviewed on a three-yearly basis. For projects subject to State Agreements rather than the Mining Act, such as the Proposal, the EPA will expect compliant closure plans to be submitted as part of the assessment under Part IV of the EP Act.

The following regulatory position and Guidance Statements set the framework for the management of rehabilitation and mine closure for the Proposal:

- Guidelines for Preparing Mine Closure Plans – May 2015 (DMP and EPA 2015).
- EPA Guidance Statement No. 6: Rehabilitation of Terrestrial Ecosystems (EPA 2006).
- Strategic Framework for Mine Closure (ANZMEC and MCA 2000).
- Mine Closure and Completion (DITR 2006a).
- Mine Rehabilitation (DITR 2006b).

17.2 Description of rehabilitation and closure

17.2.1 Mine Closure Plan

A Closure Plan for the existing Yandi Operation was approved by OEPA on 23 January 2015, in accordance with the existing decommissioning and rehabilitation condition (Condition 9) within MS 914. This Closure Plan has been updated, consistent with the

Guidelines for Preparing Mine Closure Plans (DMP and EPA 2015), to detail the closure requirements for the Proposal Area.

The updated Yandicoogina Closure Plan (**Appendix 4**) provides an integrated closure vision for the entire Yandicoogina mine lease, consistent with the agreed closure objectives:

(1) rehabilitated landforms are stable and designed to manage floodwater appropriately;

(2) the environmental and cultural heritage values associated with creek flows and function are maintained post-closure;

(3) environmental values of Fortescue Marsh are not compromised;

(4) water quality within pit lakes support natural ecosystems and are compatible with post-mining land use;

(5) alluvial groundwater systems support remnant phreatophytic vegetation;

(6) final landforms are rehabilitated to be compatible with post-mining land use; and

(7) public safety hazards have been addressed.

Closure completion criteria to support the closure objectives have been recommended within the Yandicoogina Closure Plan. The completion criteria include processes, evidence and metrics to assess:

- erosion of the constructed landforms;
- preservation of surface water hydrological regimes, considering flow volumes, levels and quality;
- pit lake salinity;
- groundwater salinity;
- phreatophytic vegetation health; and
- prevalence of invasive species in rehabilitated areas.

These completion criteria will be refined based on information developed during implementation of the Proposal, from baseline studies and rehabilitation trials. The completion criteria will also evolve and grow as the expectations of the stakeholders and probable environmental outcomes are clarified.

Post-closure, environmental and other site management activities will continue until it is determined that the closure objectives have been met or it is otherwise agreed with Government to allow relinquishment of the site.

The volume of overburden and waste material generated by implementing the Proposal is relatively low compared to the volume of ore extracted. As a consequence, there is insufficient overburden and waste material available to backfill into the pit to cover the groundwater table on closure. Proximity to Weeli Wolli Creek is also an important consideration in development of the closure. Removal of the flood protection levee of closure will reduce the stressors on the riparian floodplain vegetation, but will also enable flood water to interact with the final mine void.

The proposed closure strategy, described within the Yandicoogina Closure Plan, has been developed in consideration of the closure objectives and proposed mine activity, to create a safe, stable, non-polluting landform that supports a native ecosystem. A conceptual design of the post-closure landform for the Proposal Area is presented in **Figure 77**.

The closure strategy includes the development of a native, self-sustaining wetland ecosystem within the final mine void. The wetland ecosystem will comprise two groundwater dependent pit lakes located in the Weeli Wolli Creek floodplain, away from the low-flow channel of Weeli Wolli Creek proper. On closure, the available overburden and waste materials will be utilised to stabilise the pit walls adjacent to the floodplain and to create a spillway that will facilitate flood water ingress into the final mine void during the peak of large flood events. The spillway will be engineered to minimise erosion as floodwater flows into the lake system.

Once the groundwater table recovers, the pit lakes will have an average water depth of 35 m to 45 m, storing approximately 80 GL of water. During significant flood events, when the spillway activates, the lakes will combine and can hold an additional 70 GL of flood water, increasing water depth by 60 m to 70 m. The maximum total storage capacity of the mine void is approximately 150 GL, beyond that capacity the water will overtop the northern tip of the mine void and will be returned to the Weeli Wolli Creek floodplain.

17.2.2 Mineral waste geochemical characterisation

Static geochemical tests have been conducted on all waste types, with more comprehensive sequential leach and kinetic tests undertaken to confirm that materials had indeed low geochemical risk. All tests were conducted in accordance with the *Global Acid Rock Drainage (GARD) Guide.*

No sulphides, the primary source of acid drainage issues, have been identified in the host geology or mineral waste at Yandicoogina. The total sulphur concentration of the 99th percentile of all sampled processed ore and waste at Yandicoogina is less than 0.02%, suggesting the overall acid rock drainage risk is low to nil.

In the Proposal Area, mineral waste will be returned to the mine voids, where it will form part of the groundwater aquifer. Post-closure, groundwater will flow from the existing aquifer systems, through the mineral waste aquifer, into pit lakes and, where not lost to evaporative processes, will flow back into the groundwater aquifer beneath the Weeli Wolli Creek floodplain. Tailored sequential extraction and submerged column test work are being conducted to understand how water quality may change as a consequence of these interactions.

Standard leach tests conducted on waste rock and waste fines presented circum-neutral pH values between 6.5 to 8.5 and EC values of around 650 µS/cm for waste rock and 70 µS/cm for waste fines, regardless of test conditions. Sequential extraction test work demonstrated that trace elements like arsenic, selenium and antimony are incorporated in the crystalline structure of iron oxides and silicates resulting in a reduced potential for these elements to be released. The potential for contaminant release under slightly alkaline and saline conditions are currently being investigated.

Saline drainage conditions are anticipated to evolve at Yandicoogina post-closure. Based on preliminary lab test results, alkaline conditions may occur for very limited periods of time, e.g. during prolonged drought periods, but are not expected to be sustained over the long term. Ion exchange reactions and the release of contaminants under saline conditions are expected to be limited due to the combined effects of the sorption capacity of iron and aluminium oxides and low mineral solubility expected to occur under neutral pH conditions.

Readily detectable elements within the waste rock included the major elements Ca, Mg, Na, K, Cl, Si and SO4 and the trace elements Al, B, Ba, F, Fe, Sr and Zn. The highest concentrations of elements were recorded in the low contact ratio leach tests. The majority of the elements were source term limited, such that low masses were present in the samples and would be completely dissolve during the test. The test work also indicated that elements Al, Ba, F and Si may be solubility controlled.

The characteristics of the waste fines materials are similar to the waste rock, with the exception that low contact ratio leach tests contained low but detectable concentrations of Cd, Cr, Cu, Pb, Mn and Ni. These elements were not detected in the 2:1 L:S leach.

17.2.3 Mineral waste physical characterisation and waste landforms

Mineral waste generated at the site consists largely of overburden material and CID fines. Characteristics of the material are summarised as presented in **Table 38** and **Table 39**.

Table 38: General properties of the alluvial overburden material at Yandicoogina

pH	$EC_{1:5}$	$EC_{1:2}$	ESP	Potentially Dispersive	Exchangeable Cations (m.eq./100g)					ECEC
(-)	(dS/m)	(dS/m)	(%)		K	Ca	Mg	Na	Al	
6.5	0.02	0.04	3.1	No	0.42	1.85	0.82	0.1	0	3.2

Table 39: Particle size distribution of the alluvial overburden material at Yandicoogina

Rock >45mm (%)	Pebbles 22-45mm (%)	Gravel 2-22mm (%)	Fine Fraction <2mm (%)	Coarse Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)
1	0	18	81	40	44	4	12

The majority of the mineral waste is expected to be of high erodibility, and will require conservative landform design parameters (e.g. batter angles of 20 degrees, in 5 m lifts with 10 m berm widths) to be used in order to create stable slopes.

All mineral waste in the Proposal Area will be returned to the mine void on closure, where it will be used, primarily, to buttress (strengthen) the pit wall that intersects Weeli Wolli Creek floodplain. This same strategy will be implemented in the event of unexpected closure.

The design of the buttress will evolve over the life of the mine, in consideration of the shape of the final mine void, associated geotechnical stability and location of progressive backfill. The conceptual design for the buttress, is presented in **Figure 77**, includes:

- An in pit waste slope that extends from the pit floor to the pit crest at an angle of 20 degrees, in 5 m lifts with 10 m berm widths widths (commensurate with the mineral waste material properties); and
- A spillway and central island used, in combination, to control floodwater from Weeli Wolli Creek floodplain as it flows into the lake areas. The design will

minimise erosion inside the mine void and within Weeli Wolli Creek floodplain, to maintain the integrity of the Weeli Wolli Creek hydrological regime.

As discussed in Section 4.2.5, the existing in pit waste fines cells at JSE will be used for the disposal of waste generated by wet processing. Mineral waste will be used to cover the waste fines cell and raise the surface to above the long term projected groundwater elevation.

Monitoring and, if required, corrective actions will be undertaken to ensure erosion does not threaten the long term stability of the landform. Erosion monitoring will include visual and measured assessments of rill and gull formation over time. Flow over the spillway will also be monitored, to validate the spillway function.

17.2.4 Post-closure water quality

Groundwater recovery in the Proposal Area is predicted to occur within a few decades. As the groundwater table recovers, permanent lakes will be established in the Proposal Area mine voids.

Once the groundwater table is recovered, and the system reaches steady state conditions, these pit lakes are expected to have an average depth of 35 - 45 m, 20 m below the pit crest, with a surface area of 2 - 4 km^2 (depending on the final buttress design), storing approximately 80 GL of water. The lake geometry suggests the lake water column will be fully mixed, however, density driven flow may occur during long dry periods.

Although the pit lakes will be groundwater dependent, the lakes are expected to receive flood water when the Weeli Wolli Creek floodplain activates. These flood events will deliver nutrients and aquatic fauna/flora to the lakes, but will also result in rapid increases in the lake water levels. Three times in every 200 years, Weeli Wolli Creek is predicted to flood with such magnitude that the mine void, which has a maximum storage capacity of approximately 150 GL, will be completely filled with flood water. The mine void will overtop via the northern point of the pit, contributing flow back into Weeli Wolli Creek floodplain. During these events, salts and nutrients will be flushed from the pit lakes. The volume of overtopping water will be very small relative to the volume of the water flowing down Weeli Wolli Creek during these flood events; and as a consequence, the salts and nutrients are not expected to have a measurable impact on Weeli Wolli Creek water quality or, by extension, the downstream Fortescue Marsh.

A preliminary stochastic water balance model has been developed, based on the conceptual buttress landform and using estimated aquifer parameters, to predict how water levels (**Figure 78**) and salinity may change over time. The stochastic modelling showed that the pit lake water quality will be strongly influenced by the future climate conditions. The modelling suggests that, over a 1,000 year period, salinity is likely to follow an increasing trend. During periods of simulated prolonged drought, when water levels dropped to their lowest levels, up to 11,000 mg/L salt was modelled. However, during simulated wet periods, salinity could also be reduced to as low as 200 mg/L salt. The stochastic model suggests there is a 50 percent probability that after 75 years pit lake water salinity would still be fresh (<1000 mg/L), and that after 1,000 years there was a 50 percent probability that the average annual salinity would be 3,000 mg/L or less.

The stochastic water balance also shows that during periods of drought, resulting in high salinity, the pit lake water levels drop below downstream groundwater levels. When this occurs, the lake system will stop functioning as a through-flow system, and revert to groundwater ‘sink’. Lake water levels and water quality are not expected to be restored to average until the next large magnitude flood event, when the salts will be flushed out of the lake during the overtopping and water quality salinity will be reduced.

The stochastic water balance suggests that the average downstream groundwater flow contribution from the pit lakes could be around 0.1 GL per year to the aquifer under Weeli Wolli Creek. This represents less than 10 percent of the upstream groundwater inflow into the pit lakes and significantly less than 10 percent of the total aquifer flow. The quality as it enters the groundwater aquifer is expected to be similar to that of the pit lakes, which will be saltier than the groundwater aquifer. This saltier water is expected to be denser than the downstream groundwater aquifer, and is unlikely to move towards the surface or interact with the environment.

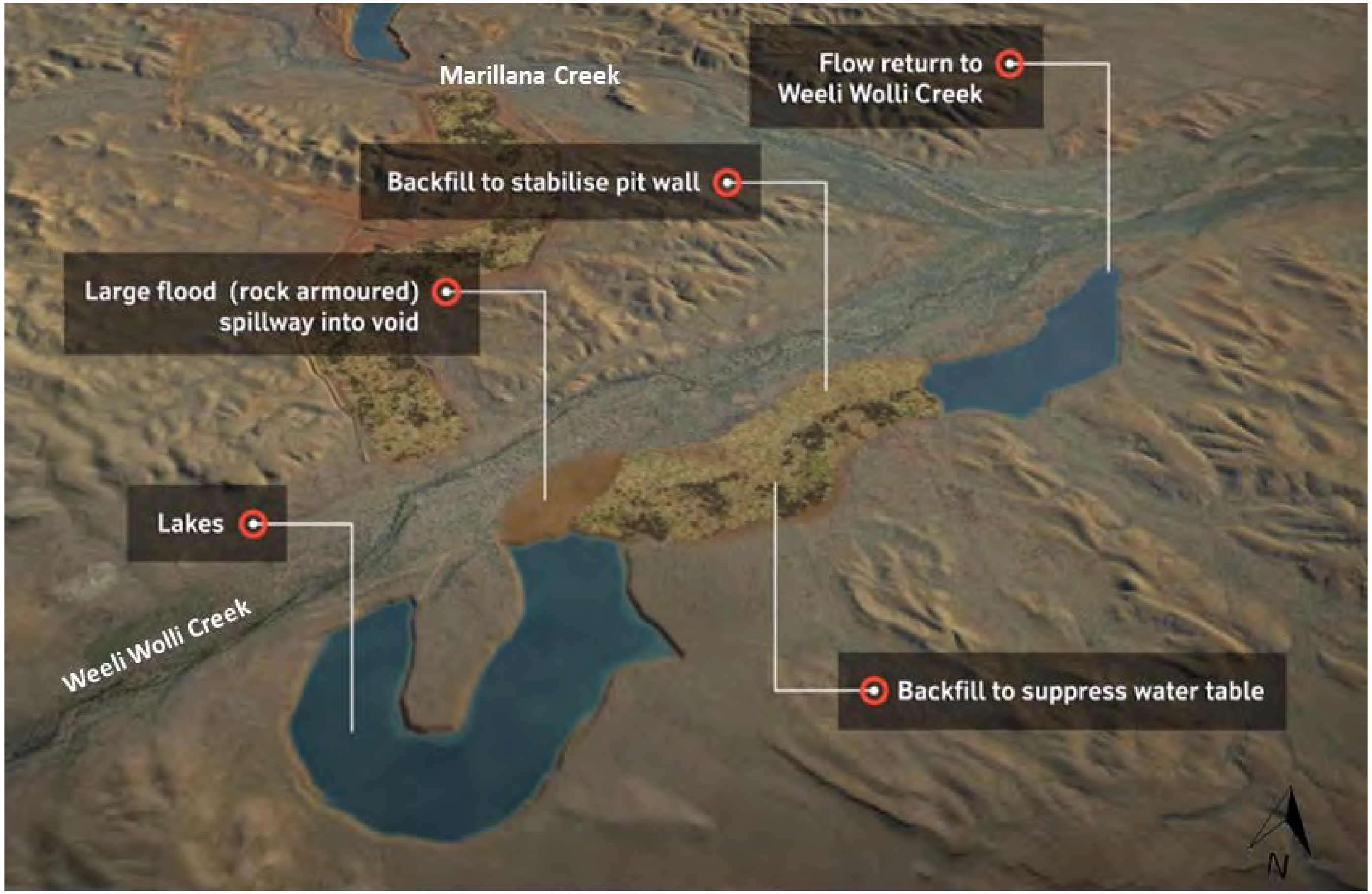


Figure 77: Post-closure landform of the Proposal

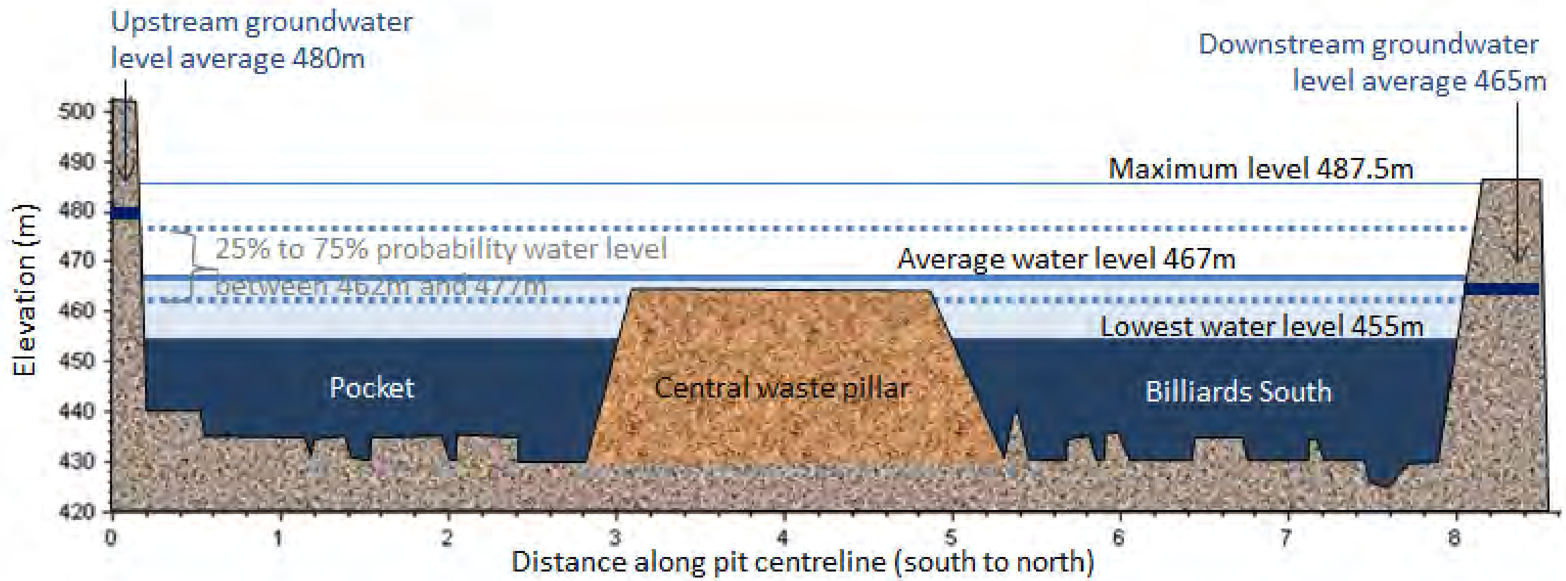


Figure 78: Proposal proposed pit lake cross-section

Rehabilitation strategies

17.2.4.1 Desktop Assessment of Rehabilitation

Rio Tinto has developed practice standards for rehabilitation, as described in the following standards:

- Iron Ore (WA) Rehabilitation Management Plan.
- Iron Ore (WA) Landform Design Guidelines.

The rehabilitation performance of Pilbara geologies and ecosystems that are similar to the Proposal Area were assessed via a desktop assessment to determine if Rio Tinto's standard practice would enable the Proposal's closure objectives to be met (**Table 40**; **Appendix 4**). The assessment was undertaken by comparing key indicators of rehabilitation success against benchmarks established in adjacent reference/control sites for different disturbance types, including:

- created landforms, e.g. the mineral waste buttress proposed to be developed within the mine void;
- long term disturbance areas, e.g. laydown areas, permanent facilities;
- short term disturbance areas, e.g. borrow pits and access tracks; and
- linear and fragmentation disturbances, e.g. road and powerlines.

Table 40: Examples of rehabilitation success across Rio Tinto's Pilbara operations

Rehabilitation Type	Key Similarities to the Proposal	Examples Reviewed	Applicability to Proposal
Created landforms (e.g. waste rock dump)	Channel Iron Style Deposit Detrital Ion Style Deposit	Mesa J Waste Dump S, Waste Dump T Brockman 2 Pit 2 Waste Dump	Rehabilitated mineral waste slopes within the pit area that are well above the water table
Short term disturbances (e.g. borrow pits and access tracks)	Minor earthworks in top few metres of the profile (topography), disturbed and rehabilitated in short time frames, minor earthworks in top few metres of the profile (topography),	Yandi Borrow Pits 363,374 & 417 Hope downs 4 Haul roads, Borrow Pits, Power Line & Railway construction rehabilitation	Borrow pits, access tracks
Long- term disturbances (e.g. construction camp, permanent accommodation villages)	Minor earthworks in top few metres of the profile (topography), generally flat areas, disturbed and rehabilitated in longer time frame	Yandi Landfill (disturbed for 3 and a half years prior to rehabilitation) Mesa A Fixed Plant	Laydown yards

Linear and/or fragmentation disturbances (e.g. roads, powerlines, bore fields)	Considered as similar to the short term disturbances – Minor earthworks in top few metres of the profile (topography), minor earthworks in top few metres of the profile (topography),	As per the short term disturbances examples	Roads, power lines

Created landforms are considered to be the most challenging areas to rehabilitate. Created landforms that will be developed as part of the Proposal's post-closure landform include rehabilitated slopes, associated with decommissioned infrastructure, and the development of the in pit buttress landform. There have been limited opportunities to undertake rehabilitation of created landforms at the existing Yandi Operations, as these features are used or modified as part of daily activities, e.g. in pit waste dumps are still under construction. However, mineral wastes with similar material type properties have been rehabilitated using the Proponent's standard practice at other Rio Tinto managed operations and provide a means of assessing expected rehabilitation performance for the Proposal Area (details are provided in **Appendix 4**).

In accordance with Rio Tinto's standard practice, created landforms and long term disturbances are rehabilitated by:

- considering the local climate conditions and physical properties of the soil and mineral waste properties when designing slopes;
- shaping the built or disturbed landform to blend with the surrounding topography;
- applying topsoil and salvaged vegetation, when available; and
- ripping along the contour then seeding.

Rehabilitation of the Dump S overburden waste dump at Robe River's Pannawonica Operation (a CID style deposit) was completed in 2001. Rehabilitation monitoring shows good perennial species diversity with 13 species present, which exceeds the slope benchmark of seven species. The lower storey vegetation, although present, was slow to develop and currently represents a very small proportion of the total cover. The cover composition differs across the rehabilitation area, and thus is slightly different to the reference sites. However, total plant cover percentages and density values are within or above the range exhibited within the reference sites, and rehabilitation is considered to be on track to provide a stable, native and self-sustaining ecosystem with habitat for native fauna present.

Overall, the Proponent's standard rehabilitation practices are considered sufficient to meet the Proposal's closure objectives for general created landforms, long term disturbance areas, short term disturbance areas and linear/fragmented disturbance area.

However, no rehabilitation activities have been completed adjacent to open water bodies on Rio Tinto managed operations, such as those proposed to be developed within the mine void post-closure (**Table 41**). These landforms, which form part of the dynamic wetland environment, will incorporate soil and water interactions that do not occur naturally in the neighbouring environment; although similar landforms are expected to be constructed throughout the Weeli Wolli Creek catchment as part of the existing Yandi Operations, and other mining company closure strategies.

Table 41: Rehabilitation types and gaps in knowledge

Rehabilitating Type	Applicability to Yandi	Knowledge Gaps
Created Landforms - backfilled alluvial waste that forms the pit lake fringes	Pit lake built edges (excludes pit walls)	• Landform design that will ensure alluvial materials will form stable slopes with undulating water levels. • Surface treatments required (if any) to enable vegetation growth and slope stability (eg. mulch, ripping, armouring, topsoil alone or rehab into alluvial materials with no treatment). • Species selection (what species will establish and grow with increased soil moisture, wet roots and survive with undulating water levels). • Species selection that are applicable to changing quality of water levels (increasing salinity and then flushes of fresh water).
Created Landforms - tailings storage facilities	In pit Tailings Storage Facility	• Landform design – particularly if capping is required and how much. • Species selection (what species will establish and grow with the growth medium which could be tailings and no capping, differing amounts of capping and topsoil).
Created Landform - backfilled pit large flat plains built of alluvial material	The backfilled pit areas that exist between the pit lakes	• Landform design to support stability and vegetation growth (e.g. gentle undulating peaks and troughs or very slight angle for drainage or completely flat). • Species selection (what species are best suited to flat alluvial areas that may be infrequently inundated).

The Proponent recognises the importance and challenges associated with creating these unusual habitats. In response, the Proponent has initiated research programs and rehabilitation trials, as described in the Yandicoogina Closure Plan, to investigate:

- how local creek species germinate, establish and grow in response to groundwater changes when grown in mineral waste (growth media);
- whether these species thrive post-germination with variable access to the groundwater table;
- which plant species combination(s) ensure wetland and floodplain vegetation communities are self-sustaining;
- what landform shapes support lake littoral zone development and other niche habitats; and
- what management is required to ensure water quality in the recovering lakes remain non-toxic and promotes ecosystem development.

The wetland rehabilitation trial at the existing Yandi Operations, which commenced in 2014, is an example of the ongoing research. This trial will establish how common Pilbara plant species of local provenance grow on sheltered lake fringes. The trial is being conducted on slopes created from mineral waste located on top of the exposed groundwater table, similar to the post-closure pit lake environment. Monitoring equipment has been installed to monitor moisture and temperature down the soil profile as the plants grow. The performance of mineral waste slope batter angles of 20 degrees and 10 degrees will also be reviewed as part of the study.

17.2.4.2 Rehabilitation Activities Undertaken to Date

Yandi Operations have completed 86 ha of rehabilitation since 1998. Rehabilitation opportunities have been limited as the majority of the disturbed areas are actively utilised as part of daily mining activities. Completed rehabilitation comprises of a small waste dump, numerous borrow pits and construction related rehabilitation, exploration related rehabilitation and completed landfill sites.

Borrow pits associated with the railway at the existing Yandi Operations were rehabilitated in the second half of 1998. In accordance with Rio Tinto's standard practice (applicable for short term disturbance and linear infrastructure) the borrow pits were rehabilitated by:

- re-shaping the disturbed area, where required, to ensure it is free draining and blends with surrounding topography;
- replacing stockpiled topsoil and salvaged vegetation; and
- ripping along the contour (no seed applied).

Monitoring completed in 2013 show that vegetation communities have similar number of species, plants per quadrant and percentage of perennial cover when compared to reference sites (**Table 42**), and are on target to achieve the closure objectives. Differences between the rehabilitated areas and reference sites are believe to result from changes to the vegetation communities after a bushfire. There is no evidence of erosion in any of the borrow pits.

Table 42: Selected monitoring results of the Borrow Pit rehabilitation areas and reference site values (shown in brackets).

Borrow Pit	Age of Rehabilitation (years)	Number of Species (Rehab)	Plants per Quadrant	% Perennial Cover	Summary
BP363	14	7 (8)	4.3 (4.2)	45 (64)	Site continues to compare favourably with the reference site
BP374	14	7 (13)	5.6 (20.3)	55 (53)	The 2007 burn in the reference site significantly changed a number of key parameters, making comparison of the two sites difficult. Overall, site is developing well.
BP417	14	7 (7)	3.3 (13.3)	49 (31)	Vegetation communities exhibiting similar trends to reference sites prior to a fire in 2010. Different trends apparent after fire. Overall, site is developing well.

17.2.4.3 Planned Progressive Rehabilitation at Yandicoogina

In 2017, the first substantive area of disturbance not required for future operational use is expected to be available for rehabilitation (subject to confirmation). Detailed rehabilitation designs for this area are expected to be included in the next update to the Yandicoogina Closure Plan.

17.2.5 Post-mining land use

Rehabilitation undertaken outside of the mine void is expected to be compatible with the pre-mining and adjacent (current) cattle grazing pastoral activities. However, the volume of overburden and waste material generated by implementing the Proposal is relatively low compared to the volume of ore extracted. As a consequence, there is insufficient overburden and waste material available to backfill into the pit to cover the groundwater table on closure or reinstate the natural surface, resulting in the creation of permanent pit lakes post-closure.

The mine void and resulting post-closure wetland, the pit lakes and the associated lake fringe proposed to be developed in the mine void of the Proposal Area, may not be compatible with cattle grazing pastoral activities. Alternatives to cattle grazing, for the created wetland, are under investigation in consultation with relevant stakeholders (including Pastoral Stations and Aboriginal Traditional Owners). Until an alternate land use is agreed for the pit lake areas, the Closure Plan has been prepared to ensure the area remains compatible with general Pilbara land uses, by:

- designing landforms that are stable for access by humans and native fauna;
- ensuring the water systems support existing riparian vegetation and are compatible with the natural system dynamics; and
- planning for a wetland ecosystem created from native vegetation that is compatible with the surrounding environment.

17.3 Assessment of potential impact, mitigation and residual impact

The impacts created by implementing the Proposal (beyond those generated by the existing Yandi Operations) include the loss of vegetation and habitat, soil disturbance, changes to the natural landforms and drainage features, and a lower groundwater table.

17.3.1 Post-mining land use

The values and constraints of the surrounding physical and biological environment need to be considered when selecting appropriate land use options for the Proposal Area post-mining. Heritage requirements and agreements with native title claimants, and other socio-economic aspects of the Proposal must also be taken into account.

Rehabilitation undertaken outside of the mine void is expected to be compatible with the pre-mining and adjacent (current) cattle grazing pastoral activities. However, the mine void resulting from implementation of the Proposal is not compatible with the pre-mining land use of cattle grazing pastoral activities. Other potential impacts could include unstable landforms, altered hydrology, changes to water chemistry, contamination and/or limited return of the native ecosystems.

17.3.2 Hydrological processes and inland environmental water quality

Groundwater modelling studies indicate that aquifer recharge and through-flow are important processes for maintaining water quality (principally low salinity), particularly for the Proposal.

The post-closure landform including the development of permanent pit lakes may influence the way surface and groundwater inputs are redistributed within, and released from, the Proposal Area. This in turn could influence aquifer water quality and riparian environments within the Proposal Area and to some extent, downstream. There is a risk that inappropriate landform design could result in increased salinity within the adjacent aquifers, increased sediment load within the adjacent drainage network and subsequent ecosystem degradation.

Water quality will vary over time, depending on the different interactions between the groundwater source, surface water systems, the water levels, climatic conditions and whether groundwater or surface water can exit the pit lakes.

17.3.3 Vegetation

Disturbed areas, excluding the pit walls and pit lake water body, will be revegetated using locally occurring native species. The design of the final landform will influence its suitability for establishing particular vegetation communities and its long term persistence. Key factors include:

- Providing stable landforms with infiltration and runoff characteristics that support vegetation growth, reproduction and vegetation succession.
- Soil profiles with adequate water holding capacity and physiochemical characteristics, to enable plant root system development and access to water and nutrients.
- Minimising exposure to water quality conditions which may not support local vegetation, for example extremes of soil pH, salinity and exposure to toxic metal ions.
- Developing vegetation communities suited to the changed (wetland) environments.

Inappropriate landform construction may affect the rehabilitated area’s ability to support native vegetation and meet revegetation completion criteria. Poorly designed and/or poorly implemented rehabilitation could also result in suboptimal vegetation re-establishment and increased numbers of weed species. Topsoil handling and storage practices are important for maintaining seed viability and enhancing rehabilitation success.

17.3.4 Fauna

17.3.4.1 Terrestrial Fauna

The final landform will be gradually recolonised by native fauna. The ability of fauna to use the area will be influenced by landform components and configurations, with some species being favoured and others disadvantaged. Inappropriately constructed habitat could lead to poor habitat use or favour undesirable species, such as feral animals.

17.3.4.2 Subterranean Fauna

Mining activities will result in the removal of subterranean habitat. The design of the post-mining landform will influence the amount of habitat retained in the Proposal Area, for the persistence of stygofauna assemblages post-mining. Factors that could detract from reinstating suitable habitat include:

- reduction of void space within the alluvials due to silt and sediment runoff from surrounding habitat;
- the development of saline pit lakes and saline groundwater aquifers;

- nutrient enrichment derived from the surface infiltration, e.g. due to a lack of buffering vegetation; and
- hydrology changes.

Aquatic fauna in Weeli Wolli Creek may also be impacted a result of changes to the hydrology of Weeli Wolli Creek system, development of a permanent pit lake and water quality (including salinity and nutrient enrichment).

17.3.5 Aboriginal Heritage

The post-mining landform could affect the accessibility of heritage sites and the ability of the Traditional Owners to use the Proposal Area for cultural and amenity purposes. These uses require safe and stable landforms that are suitably integrated with the wider landscape and environment.

17.4 Key management actions

Closure management, monitoring and mitigation measures required to achieve and demonstrate successful rehabilitation and closure of the Proposal Area are discussed within the Yandicoogina Closure Plan (**Appendix 4**).

Closure management includes regular review and update of the Yandicoogina Closure Plan, to account for changes resulting from:

- amendments to the mine plan;
- improvements of the site closure knowledge base (e.g. through daily activities, technical studies and research actions, progressive rehabilitation);
- new or amended regulation;
- changes to surrounding land uses; and
- evolving stakeholder expectations.

The review processes bring experts and stakeholders together to discuss current performance, proposed mine changes and opportunities to improve closure outcomes. A key aspect of the review process is the risk identification and management process. This process:

- Identifies hazards, aspects and opportunities, within the current closure strategy and associated with the current level of knowledge, that could influence the successful closure of Yandicoogina.
- Evaluates the hazards and opportunities with respect to the impact to people, property and / or the environment.
- Defines the actions required to improve knowledge, management guidance and / or the closure strategy.

Understanding of the local ecosystem will be advanced through implementation of the Proposal management programs and actions identified through the Closure Plan review process. As a result, the detail within the Yandicoogina Closure Plan will increase over the life of the Proposal.

The closure landform will be rehabilitated to include a wide variety of habitats, including:

- exposed bare rock areas, associated with the pit walls and rock armoured slopes;
- *Acacia* dominated plains-style habitat, similar to the pre-disturbance habitat;
- creek and floodplain habitat, similar to the pre-disturbance habitat; and
- created wetland habitats surrounding the pit lakes.

The mine void and post-closure landforms within the mine void, such as the fringe of the pit lakes, may not be compatible with cattle grazing activities that dominated the area prior to mining. Land capability assessments will be completed during the life of Proposal, based on post-closure ecosystem functionality, to guide discussions with key stakeholders on post-mining land use. Post-closure land uses will be resolved with key stakeholders prior to closure.

When the site approaches scheduled closure, location specific management plans will be finalised for each closure domain. These plans will detail the physical closure, dismantling and subsequent rehabilitation implementation, in accordance with the closure objectives and legal obligations. Stakeholder engagement and endorsement of the final completion criteria will be facilitated at this time, and the post-closure monitoring program will be finalised in alignment with the agreed completion criteria. These monitoring programs are expected to address:

- vegetation, erosion and ecological function;
- invasive species, including weeds and feral animals;
- terrestrial fauna and stygofauna;
- surface water and groundwater levels, quality and contaminants; and
- heritage.

Monitoring programs will define triggers and provide details of management actions and strategies to be implemented should the trigger levels be exceeded.

In the event of temporary closure, measures will be undertaken to transfer the site from operations into a care and maintenance regime and relevant authorities notified. A Care and Maintenance Plan will be developed prior to the care and maintenance period, which demonstrates how ongoing environmental obligations associated with the site will continue to be met during the period of care and maintenance. Social obligations and responsibilities will also be addressed in this plan.

17.5 Predicted outcome

Implementation of the Yandicoogina Closure Plan is expected to produce the following long term outcomes for the Proposal Area:

- Pit walls of the final mine void that are adjacent to Weeli Wolli Creek are stabilised in a way that prevents the creek from collapsing into the mine voids post-closure, ensuring continued function of Weeli Wolli Creek.
- All areas disturbed for mining (with the exception of pit walls) and infrastructure that are not required by the State (under conditions of applicable State

Agreements) are rehabilitated to a condition compatible with the post-mining land use following decommissioning.

- Creation of a dynamic wetland environment within the mine void, including two pit lakes and associated lake fringe, with water levels that will rise and fall in accordance with flooding of the creek systems.

- Regional hydrogeological impacts are minimised and adequately managed.

- Outside of the mining disturbance areas and more than 2 km from the Proposal mine voids, water levels are largely predicted to return to pre-disturbance levels.

- No impacts to the hydrological regime of the Fortescue Marsh as a result of closure of the site.

These outcomes suggest the Proposal is not likely to result in significant environmental impact. During the life of the Proposal, investigations and an adaptive management approach will be used to ensure that risks to closure are identified and addressed so as to meet the EPA's objective for rehabilitation and closure.

18. Offsets

18.1 Key statutory requirements, environmental policy and guidance

18.1.1 EPA objective

The EPA has applied the following objective for the Proposal to its assessment of residual risk management:

"To counterbalance any significant residual environmental impacts and/or uncertainty through the application of offsets."

18.1.2 Relevant guidelines and policy

Environmental offsets are "*actions that provide environmental benefits which counterbalance the significant residual environmental impacts or risks of a proposal. Unlike mitigation actions which occur on-site as part of the proposal and reduce the direct impact of that project, offsets are undertaken outside of the Proposal Area and counterbalance significant residual impacts*" (EPA 2014a).

The following guidelines and polices are relevant to the Proposal with respect to offsets and the above EPA objective:

- EPA Environmental Protection Bulletin No. 1 – Environmental Offsets – Biodiversity (EPA 2014a);
- WA Environmental Offsets Policy (Government of Western Australia 2011); and
- WA Environmental Offsets Guidelines (Government of Western Australia 2014).

18.2 Description of potential residual impacts

"*In general, significant residual impacts include those that affect:*

- *rare and endangered plants and animals (such as Declared Rare Flora and threatened species that are protected by statute);*
- *areas within the formal conservation reserve system;*
- *important environmental systems and species that are protected under international agreements (such as Ramsar listed wetlands); and*
- *areas that are already defined as being critically impacted in a cumulative context.*

Impacts may also be significant if, for example, they could cause plants or animals to become rare or endangered, or they affect vegetation which provides important ecological functions" (Government of Western Australia 2014).

The following elements are considered in quantifying the significant residual impact (Government of Western Australia 2014):

- extent of impact (hectares or numbers);
- quality of the environmental value;
- conservation significance of the environmental value;
- land tenure; and
- time scale.

Potential impacts associated with the Proposal in relation to offsets were identified by the EPA in the ESD as:

- Potential impacts on vegetation, flora, habitat and fauna species of State and National Significance.

Potential impacts for vegetation, flora, habitat and fauna species of State and National Significance are addressed in the following sections:

- Section 14 - Flora and vegetation; and
- Section 15 - Terrestrial fauna and habitat.

18.3 Residual impact evaluation for vegetation, flora, habitat and fauna species of State significance

Taking into account measures to avoid, minimise and rehabilitate impacts (**Table 43**), the following significant residual impact arising from the Proposal has been identified:

- Clearing of up to 1,731 ha of native vegetation in Good to Excellent condition within the Proposal Area, including fauna habitat (excluding riparian zone vegetation[9]).
- Clearing of up to 69 ha of native riparian zone vegetation[9] within the Proposal Area, including fauna habitat.

While 1,327 ha of vegetation is currently proposed to be cleared within the Proposal Area as part of the current mine layout (1,277 ha in Good to Excellent condition, which includes 2.9 ha of riparian zone vegetation), approval for clearing of up for 1,800 ha of the Proposal Area is being requested as part of the Proposal, to allow for flexibility with mine planning and development. As the location of up to 457 ha (excludes 16 ha of riparian zone vegetation) of this vegetation clearing is unconfirmed (and thus the condition of this vegetation is also unknown), it has been assumed this vegetation is in Good to Excellent condition; thus 1,731 ha of vegetation in Good to Excellent condition is proposed to be offset. A total of 69 ha of riparian zone vegetation is also proposed to be offset as good to excellent condition due to its local significance, irrespective of its actual condition.

The EPA has raised concerns regarding cumulative impacts on terrestrial biodiversity values in the Pilbara IBRA region (Government of Western Australia 2014). A number of recommendations have been made to improve management and monitoring of issues in the area, including the establishment of a strategic conservation initiative to coordinate delivery of offsets in the Pilbara.

Consistent with the WA Environmental Offsets Guidelines (Government of Western Australia 2014), it is considered that the residual impact of disturbance of vegetation in Good to Excellent condition is significant and will therefore require compensation via an offset. A standard offset approach has been developed by the EPA in regard to this residual impact and it has been applied consistently to projects in the Pilbara. As such, the Proponent is proposing to contribute funding of $1,500 (excluding GST) per hectare of native vegetation, and funding of $3,000 (excluding GST) per hectare of riparian

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[9] For the purposes of the offset calculation, riparian zone vegetation is classified as vegetation units within the riparian zone comprising C-coded and F2 coded vegetation located within the RCA.

vegetation cleared to a government-established conservation offset fund or an alternative offset arrangement providing an equivalent outcome as determined by the Minister.

Table 43: Quantification of significant residual impacts and proposed offsets

Existing environment /Impact	Mitigation			Significant Residual Impact	Offset Calculation Methodology				
	Avoid and minimise	Rehabilitation Type	Likely rehabilitation success		Type	Risk	Likely offset success	Time Lag	Offset Quantification
EPA objective: *To counterbalance any significant residual environmental impacts and/or uncertainty through the application of offsets.*									
Up to 1,800 ha of clearing of native vegetation, including fauna habitat, considered to be in Good to Excellent condition, including 69 ha of riparian zone vegetation	The Proposal has been designed to minimise the required amount of clearing; being an extension of an existing mine site enables utilisation of many existing facilities and reduces the footprint that would otherwise have been required.	Areas will be progressively rehabilitated with local native vegetation. The Yandicoogina Closure Plan will be implemented to ensure that the Proposal can be closed in an ecologically sustainable manner, consistent with agreed outcomes and land uses.	<u>Can the environmental values be rehabilitated/ Evidence?</u> <u>Operator experience in undertaking rehabilitation?</u> Yes – Rio Tinto has completed several areas of successful rehabilitation including examples within the Yandicoogina operation. <u>What is the type of vegetation being rehabilitated?</u> Assorted vegetation assemblages associated with plains, hills, flow lines and terminal basin habitat types. <u>Time lag?</u> Progressive rehabilitation where practicable; with mining of Proposal pit currently expected to be complete in 2032 (this timing may change). <u>Credibility of the rehabilitation proposed (evidence of</u>	<u>Extent</u>: 1,800 ha (1,731 ha Good to Excellent vegetation and 69 ha riparian zone vegetation) <u>Quality:</u> Vegetation is in Good to Excellent condition; provides fauna habitat. Riparian zone vegetation is in Very Poor to Excellent condition; provides fauna habitat. <u>Conservation Significance:</u> Local conservation significance for riparian vegetation <u>Land Tenure:</u> N/A <u>Time Scale:</u> N/A	Provision of funds to a government-established conservation offset fund or an alternative offset arrangement providing an equivalent outcome as determined by the Minister.	N/A	N/A	N/A	$1,500 (excl. GST)/ha of native vegetation clearing of Good to Excellent condition vegetation; $3,000 (excl. GST)/ha of riparian zone vegetation.

			demonstrated success) See previous rehabilitation from Rio Tinto.						
DRF - *Lepidium catapycnon*	Reconfigured waste dumps to avoid all recorded *L. catapycnon* populations (as well as applying a 50 m buffer) within the Proposal Area; all populations identified as 'areas of special protection from ground disturbance'.	Rehabilitation of areas surrounding DRF locations will occur in accordance with the Yandicoogina Closure Plan.	Rio Tinto has completed several areas of successful rehabilitation including examples within the Yandicoogina operation.	No.	N/A	N/A	N/A	N/A	N/A
Priority flora – Four populations (37 individuals) of *Goodenia nuda* (P4) will be impacted	Impact on individuals within Proposal Area represents less than 1% of Rio Tinto records for the species within the Pilbara.	Rehabilitation of Proposal Area will occur in accordance with the Yandicoogina Closure Plan.	Rio Tinto has completed several areas of successful rehabilitation including examples within the Yandicoogina operation.	No.	N/A	N/A	N/A	N/A	N/A

Recorded Threatened fauna species: - Pilbara Olive Python (*Liasis olivaceus barroni*); Schedule 1, Vulnerable Recorded Migratory fauna species: - Eastern Great Egret (*Ardea modesta*); Schedule 3, Migratory - Fork-tailed Swift (*Apus pacificus*); Schedule 3, Migratory - Rainbow Bee-eater (*Merops ornatus*); Schedule 3, Migratory Recorded Priority fauna species: - Western Pebble-mound Mouse (*Pseudomys chapmani*); Priority 4	Approximately 90% of the core habitat identified for the Pilbara Olive Python within the Proposal Area will be retained; with the species recorded in the broader Yandicoogina area and throughout the Pilbara bioregion. Implementation of the Yandicoogina EMP will further reduce any impacts to the species from car collisions or feral animals. The recorded Migratory fauna species are considered transient, highly mobile, common and/or widespread in the Pilbara bioregion and are unlikely to be reliant on habitats within the Proposal Area. Eleven known mounds of the Western Pebble-mound Mouse will be removed as a result of the Proposal, however, the species is considered to be broadly distributed throughout the Pilbara bioregion.	Rehabilitation of Proposal Area will occur in accordance with the Yandicoogina Closure Plan.	Rio Tinto has completed several areas of successful rehabilitation including examples within the Yandicoogina operation.	No.	N/A	N/A	N/A	N/A	N/A

19. Other environmental factors

19.1 Aboriginal heritage

19.1.1 Assessment of potential impacts

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. Aboriginal heritage sites could potentially be disturbed by proposed activities such as clearing, dewatering, excavation and surface water discharge, although it is Rio Tinto's policy to avoid heritage sites, wherever practicable. Aboriginal archaeological and ethnographic surveys have been completed for the majority of the Revised Proposal Development Envelope. Numerous Aboriginal archaeological sites have been recorded in the locality ranging from low to high in archaeological and cultural significance (Rio Tinto 2014b). A number of ethnographic sites have been identified in the Yandicoogina region in connection to the Marillana Creek and Weeli Wolli Creek. The creeks are recognised to have important links with camping activities, ceremonial activities and other cultural activities (Rio Tinto 2014b).

Section 18 approvals under the *Aboriginal Heritage Act 1972* will be required where disturbance to heritage sites cannot be avoided. All potential indirect impacts to heritage sites and cultural values are also considered prior to any works approvals being granted (e.g. relating to dust, blasting, dewatering, discharge and subsidence). These are often site and works specific, and as such mitigation measures may vary.

A heritage zone is currently delineated around Weeli Wolli Creek, due to the association of this site with camping activities, ceremonial activities and other cultural activities. However, it is noted that part of the proposed mining activities occur within this exclusion zone. Proposed mining activities include the clearing of up to 69 ha of riparian zone vegetation within the proposed Restricted Clearing Area, locating some infrastructure within the heritage zone, and alteration to the creek system by groundwater drawdown from the mine and surplus water discharge. Any long term alteration to the regional water regime is also considered to likely be of high cultural significance (Rio Tinto 2014b). Rio Tinto is required to consult with Traditional Owners prior to any disturbance within this exclusion zone and engage them in the approvals process. Consultations to date have been on both a broader level and a detailed level with the main concerns raised by Traditional Owners being in relation to cultural landscape changes as a whole. While there will be some disturbance to Weeli Wolli Creek, it has been identified that the pit lakes proposed to be present at closure do have the potential to provide for alternate land use (Rio Tinto 2014b).

19.1.2 Proposed mitigation and management measures

Management strategies to address the potential impacts identified are briefly summarised below. These strategies are in place to ensure identified significant areas are protected as much as possible, in accordance with the following Rio Tinto practices and procedures for protecting Aboriginal heritage sites:

- Rio Tinto Cultural Heritage Management Procedure.
- Rio Tinto Heritage Policy.

Rio Tinto also adheres to environmental legislation with relevance for managing potential impacts on heritage values (such as dust control), together with Rio Tinto's internal environmental and health compliance policies and procedures.

Specific strategies for mitigating impacts to heritage values include:

- Complying with the *Aboriginal Heritage Act 1972.*

- Seeking statutory heritage approvals.
- Continuing consultation with the Traditional Owners likely to be affected by the Proposal. Previous comments received from Traditional Owners during consultation are summarised in Section 3.
- Implementing the Aboriginal Heritage Management Guidelines, in conjunction with the Cultural Heritage Management Plan.
- Avoiding Aboriginal heritage sites whenever reasonably practicable in accordance with internal Rio Tinto guidelines and policies.
- Creation and implementation of a heritage drill and blast management plan, where applicable.
- Appropriately fencing/signposting or barricading key heritage sites outside the footprint area (where approval to disturb is not being sought under the *Aboriginal Heritage Act 1972)* to prevent inadvertent impacts to these sites, or alternative suitable approaches agreed with Traditional Owners.
- Stopping work immediately if human remains or archaeological material are accidentally uncovered during any ground-disturbing activity, and contacting the DAA and Rio Tinto's Heritage team.
- Requiring all personnel working in the Proposal Area to attend inductions for the area covering Health, Safety and Environmental requirements, of which Cultural Heritage Awareness is one component.
- Cultural heritage values associated with the Proposal Area to be maintained post-closure as per Yandicoogina Closure Plan.

19.1.3 Predicted environmental outcome

After mitigation and management measures have been applied, the Proposal is expected to have some effect on the ethnographic cultural values of Weeli Wolli Creek. Any disturbance within the Weeli Wolli Creek heritage zone or of other archaeological/ethnographic sites will be in accordance with the provisions of the *Aboriginal Heritage Act 1972* and will have the consent of the relevant Traditional Owners. Rio Tinto will maintain ongoing consultation with Aboriginal stakeholders over the life of the Proposal, in accordance with processes established for the existing Yandi Operations.

19.2 Air quality

19.2.1 Assessment of potential impacts

Air quality has the potential to be negatively impacted by dust created by the Proposal. Dust will be generated by construction and mining activities such as vegetation clearing, earthworks and mining (including blasting), vehicle movements and dry ore processing, stockpiling, reclaiming and transport. The potential impact of dust on native vegetation is discussed in Section 14.3.5.

As the majority of the Iron Ore at the Proposal is below watertable ore, the moisture content of the ore will reduce the likelihood of dust-related impacts from materials handling. Additionally, the Proposal is remote from sensitive air quality receptors, with other mining operations being the nearest premise. There have never been any complaints received in regard to dust emissions from the existing Yandi Operations, with existing mitigation measures to be implemented for the Proposal. Dust emissions are also an occupational health and safety risk for employees at the mine site, and as such are managed appropriately.

19.2.2 Proposed mitigation and management measures

Dust management procedures successfully employed at existing Rio Tinto mines will be used to control dust emissions. Potential dust emissions from processing facilities that are currently operational at the Yandi Operations, and will be utilised for processing of ore from the Proposal, may also be subject to controls imposed through an environmental licence required for such prescribed premises, in accordance with Part V of the EP Act. The strategies for minimising impacts from dust include:

- Clearing work areas only as they are required.
- Minimising exposed surfaces by progressively rehabilitating disturbed and available areas no longer in use.
- Applying water, or appropriate suppressants to haul roads, working surfaces and stockpiles as required.
- Implementing speed limits to minimise dust generation from roads.

19.2.3 Predicted environmental outcome

There is not expected to be a significant air quality impact as a result of the Proposal. Existing Rio Tinto procedures and practices used at the existing Yandi Operations to effectively prevent significant dust emissions will be applied to the Proposal and the ore is predominantly below the water table so presents a lower dust risk.

19.3 Amenity

19.3.1 Assessment of potential impacts

The Proposal is located within the south east corner of the Revised Proposal Development Envelope. The Revised Proposal Development Envelope is not located near any major population centres, with the closest town of Newman being located approximately 90 km to the south east. Tourism in the vicinity is very limited, with the only significant feature being the Weeli Wolli Spring, located approximately 7 km south of the Proposal Area.

The topography of the area around the Proposal range from hilly terrain to the northwest and southeast of the deposit, which descends into the Weeli Wolli Creek floodplain, where the Proposal pit lie. Through the life of the Proposal there will be changes in the immediate vicinity of the mine. Excavation of the mine pit will result in the creation of temporary waste dumps that will be approximately 80 m high, which may be higher in areas than the surrounding landscape which ranges from 50 – 80 m in height above the broader floodplain. These waste dumps will be utilised to backfill part of the mine pit during closure, so the predominantly flat floodplain landscape will be reinstated. There will be a range of other infrastructure and facilities constructed for the Proposal, however, these are not considered to be particularly prominent in the landscape given the proximity to the existing Yandi Operations. The Weeli Wolli Creek crossing will be a culvert bridge arrangement, and hence not an imposing feature on the landscape.

Drawdown of the groundwater associated with dewatering of the mine pit will reduce water available to riparian vegetation along Weeli Wolli Creek, resulting in the death of some native vegetation. Discharge of surplus water to Marillana Creek will also increase the current water available to riparian vegetation in this location, which is likely to cause waterlogging and death of some native vegetation. It is expected that the riparian vegetation will be returned to baseline conditions (i.e. pre-impact from dewatering or surplus water discharge) whereby the system is returned to an ephemeral system.

During mine closure, the maintenance of aesthetic values for cultural and amenity purposes are an important consideration. Creating suitable final landforms and maintaining ecological processes (such as water requirements for vegetation) are significant factors. It is expected that there will be two pit lakes established at the time of closure. These will be located adjacent to Weeli Wolli Creek and form part of the creek system in the long term.

19.3.2 Proposed mitigation and management measures

Proposal implementation will result in a change to visual amenity of the Yandicoogina area, particularly in regard to reduced riparian vegetation and the creation of pit lakes, and it should be considered during the life of the Proposal when possible.

The post-mining landform will affect the accessibility of heritage sites and the ability of the Traditional Owners to use the area for cultural and amenity purposes. These uses require safe and stable landforms that are suitably integrated with the wider landscape and environment. For example, when constructing waste dumps, in pit disposal of waste is preferable. The planned closure will use the waste dumps for infill to the pit. However, there will not be sufficient material to completely backfill the pit void, resulting in two pit lakes being formed in the northern and southern ends of the pit. This will allow for new ecosystems to develop. The measures implemented to maintain amenity upon mine closure are addressed in the Yandicoogina Closure Plan.

19.3.3 Predicted environmental outcome

There will be some temporary and permanent changes to the landforms and general landscape of the Proposal Area. There will be the temporary visual effects in the immediate region around the mine pit with the use of waste dumps and infrastructure/facilities. The extent and condition of riparian vegetation is also expected to be reduced in the long term as the creeks are ultimately returned to an ephemeral system. Through mine closure the visual amenity will be returned as much as possible to the original pre-disturbance landscape. However, two pit lakes will be created within the Proposal Area, which have the potential to create new ecosystems. Amenity will be considered where possible during the life of the Proposal, and the management measures outlined in the Yandicoogina Closure Plan should ensure the key amenity values are maintained after mine closure.

Part 6 – Summary of cumulative impacts

This part provides a summary of the cumulative impacts associated with hydrological processes; flora and vegetation; and terrestrial fauna.

The following factors were considered in regard to cumulative impacts as a key issue for the Proposal:

- Hydrological processes and Inland waters environmental quality:
  - Marillana and Weeli Wolli Creeks.
- Flora and vegetation:
  - Riparian vegetation.
- Terrestrial fauna:
  - Pilbara Olive Python.
  - Chocolate Wattled Bat.
  - Four mygalomorph SRE spiders.

20. Hydrological processes cumulative impacts

The key hydrological receptors near the Proposal are Marillana Creek, Weeli Wolli Creek and Fortescue Marsh. Of these, an assessment of potential cumulative impacts was conducted for Marillana and Weeli Wolli Creeks. Fortescue Marsh will not be affected by the Proposal and therefore was excluded from the CIA.

A preliminary assessment of cumulative impacts to surface water hydrology in the Marillana-Weeli Wolli Creek system was conducted based on a review of the potential impacts of the Proposal, the existing Yandi Operations and six other projects identified as being potentially relevant based on their location in the Weeli Wolli Creek or Marillana Creek sub-catchments of the Upper Fortescue River Catchment.

The average of existing discharge to the Marillana - Weeli Wolli Creek system is approximately 46 GL/y, with a peak of approximately 70 GL/y. Average discharge is expected to increase to approximately 111 GL/y and may reach a peak of approximately 144 GL/y. The existing Yandi Operations, including the Proposal (this assessment), is predicted to account for an average of 55 GL/y (approximately 50% of the total average discharge), with a peak of approximately 83 GL/y (approximately 57% of the total peak discharge).

21. Flora and vegetation cumulative impacts

A preliminary assessment of cumulative impacts to potentially groundwater dependent riparian vegetation (herein defined as vegetation supporting *Eucalyptus camaldulensis* and/or *E. victrix* and/or *Melaleuca argentea*) was conducted based on a review of the potential impacts of the Proposal (Rio Tinto), the existing Yandi Operations and 19 other projects identified as being potentially relevant based on their location in the Upper Fortescue River Catchment (three Rio Tinto and 17 third party projects).

Of the approximately 14,946 ha of potentially groundwater dependent riparian vegetation mapped for the projects considered (including the Proposal), up to 1,800 ha will be disturbed (including areas cleared and areas subject to potentially significant impacts due to groundwater drawdown), which represents approximately 14% of the mapped extent.

22. Terrestrial fauna cumulative impacts

A preliminary assessment of cumulative impacts to the Chocolate Wattled Bat, Pilbara Olive Python and four potential SRE invertebrate taxa was conducted based on a review of the potential impacts of the Proposal, the existing Yandi Operations and other projects identified as being potentially relevant.

Of the approximately 859 ha of potential habitat for the Chocolate Wattled Bat occurring in the Proposal Area, up to 85.9 ha will be cleared for the Proposal. This represents approximately 10% of the extent of this habitat in the Proposal Area. Taken together with the remaining projects for which habitat has been quantified, the cumulative impact is a loss of up to 1,463 ha of potential Chocolate Wattled Bat habitat, which represents approximately 5.6% of the 2,902 ha of habitat mapped across the four projects.

Of the approximately 873 ha of potential habitat for the Pilbara Olive Python occurring in the Proposal Area, up to 87 ha will be cleared for the Proposal. This represents approximately 10% of the extent of this habitat in the Proposal Area. Taken together with the remaining projects for which habitat has been quantified, the cumulative impact is a loss of up to 5,447 ha of potential Pilbara Olive Python habitat, which represents approximately 15% of the 37,376 ha of habitat mapped across the seven projects.

For the four potential SRE invertebrate taxa:

- Approximately 1,439 ha (13%) of the currently known distribution of Nemesiidae sp. N42 (11,300 ha) is located in the Revised Proposal Development Envelope, including less than 1 ha (<1%) in the Proposal Area.
- Approximately 1,638 ha (63%) of the currently known distribution of Nemesiidae sp. N44 (2,600 ha) is located in the Revised Proposal Development Envelope, all of which (63%) is in the Proposal Area.
- Approximately 18,606 ha (7%) of the currently known distribution of Idiopidae sp. I1 (255,900 ha) is located in the Revised Proposal Development Envelope, including approximately 4,231 ha (2%) in the Proposal Area.
- Approximately 157 ha (2%) of the currently known distribution of Idiopidae sp. I9 (6,500 ha) is located in the Revised Proposal Development Envelope, including approximately 50 ha (<1) in the Proposal Area.

Part 7 – Proposed environmental management program and environmental commitments

This part describes the environmental management framework for the Proposal, including management measures identified in Part 5, to prevent and mitigate potential impacts. This part also provides measures to offset significant residual impacts and proposes draft conditions to further ensure the environmental acceptability of the Proposal.

23. Environmental management framework

23.1 Overview

The Proponent is a member of the Rio Tinto Group, which has extensive experience in managing the development, operation and environmental compliance of iron ore mining projects similar to the Proposal. This experience, along with stakeholder consultation, has been used to define the potential environmental impacts from the Proposal, and the proposed mitigation and management measures. The Proponent aims to conduct its business in an efficient and environmentally responsible manner that is compatible with the expectations of stakeholders. A systematic process of environmental management has been adopted, which improves the likelihood that significant environmental impacts have been identified, investigated and mitigated, as far as practicable. As a result, there is greater certainty in achieving desirable environmental outcomes.

At a high level, the Proponent will manage environmental impacts through:

- Complying with environmental approval conditions.
- Maintaining an EMS and supporting business systems.
- Preparing and implementing the management plans for the Proposal as outlined in Section 12, and regularly reviewing the performance of the management plans that address specific environmental factors.
- Measuring energy use and calculating greenhouse gas emissions, and continually seeking opportunities to reduce emissions.
- Improving the efficiency of using natural resources.
- Regularly updating plans for ground disturbance and closure, progressively rehabilitating disturbed land and measuring success.
- Training staff and contractors in environmental requirements and considerations of their work.
- Seeking stakeholder views and ensuring they are respected and considered.
- Reporting regularly to stakeholders on performance.
- Aligning with the Proponent's Health, Safety, Environment, Community and Quality Policy (HSECQ Policy).

23.2 Environmental policies and codes

The Proponent operates under a HSECQ Policy, as all members of the Rio Tinto Group are required to do. The HSECQ Policy is the guiding document for environmental management and provides context and specific direction for continuous improvement.

Rio Tinto has also developed a set of environment standards which establishes Group wide expectations for environmental performance. These standards act to consolidate Group wide principles and guidelines, formalise external voluntary agreements and strengthen Rio Tinto's assurance processes. Operational sites are audited against the standards on a bi-annual basis by Rio Tinto.

Existing environment standards cover:

- Air quality control.
- Hazardous materials and contamination control.
- Mineral waste management (including acid rock drainage).
- Land use and rehabilitation.
- Water use and quality control.

23.3 Environmental Management System

Rio Tinto requires its operations to implement and maintain an EMS that provides a model for continuous improvement, the key elements of which include assessing environmental risk and legal requirements, developing objectives and targets for improvement, training, operational control, communication, emergency response, corrective actions, audits and reviews.

23.4 Sustainability

The Proponent will consider the Rio Tinto Sustainable Development Principles. These principles are applied to all proposals to ensure the sustainable development outcomes align with the sustainability principles stated in the WA State Sustainability Strategy and in the Rio Tinto 'The Way We Work' statement of business practice.

Policies detailed in 'The Way We Work' state that Rio Tinto businesses, projects, operations and products should contribute constructively to the global transition to sustainable development. This will be achieved by helping satisfy global and community needs and aspirations, whether economic, social or environmental. Sustainable development considerations have been made an integral part of business planning, decision making processes and operations.

The Rio Tinto Sustainable Development Principles cover the interrelated streams of environmental stewardship, social wellbeing, economic prosperity, governance and integrity systems. The ten principles are:

- Deliver economic value from our assets and resources.
- Ensure our communities benefit from the value generated by our operations.
- Contribute to the creation of resilient communities.
- Protect the health, safety and wellbeing of our employees, contractors, customers and host communities.
- Attract, develop and retain diverse people with diverse backgrounds and skills.
- Respect the cultures, customs, beliefs and values of our employees, contractors, customers and host communities.
- Demonstrate responsible biodiversity stewardship in the regions in which as operate.

- Improve energy efficiency and contribute to a reduction in greenhouse gas intensity over our product life cycle.
- Responsibly manage our water resources.
- Minimise all forms of environmental harm.

23.5 Summary of likely environmental control instruments

The Proponent has identified the regulatory controls that will ensure that environmental values are protected during implementation of the Proposal. The key controls include, but are not limited to:

- Environmental conditions in any Statement issued by the WA Minister for the Environment allowing the Proposal to be implemented.
- Environmental conditions in any approval conditions issued by the Australian Government Minister for the Environment allowing the Proposal to be implemented.
- Conditions of DER Native Vegetation Clearing Permits, if applicable.
- Conditions of DER Works Approval(s) (under Part V of the EP Act) for construction of works on prescribed premises.
- Conditions of DER Licence(s) (under Part V of the EP Act) for the operation of activities on prescribed premises.
- Conditions of the Licences and Permits for activities relating to the abstraction of groundwater and disturbance to river bed and banks (under the RIWI Act 1914).
- Conditions of any DMP Program of Works or Mining Proposal approvals, if applicable.
- As part of the Proposal, management controls will be implemented to ensure key environmental factors are managed. Other relevant measures and/or actions are also contained in the management plans outlined in Section 11.
-

Table 44: Principles of environmental protection

Principles of Environmental Protection	Relevant (yes/no)	If yes, consideration	Relevant sections of PER
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	The Proponent uses a risk assessment process in the development of new projects to identify potential issues and management actions early in the study phase. Part of this process includes undertaking site investigations of the biological and physical environments to identify existing conditions and significance as part of a detailed environmental assessment of the Proposal. The risk assessment process used throughout the scoping process identified the environmental factors at risk from the Proposal. These factors and the potential environmental impact on these factors are addressed in this PER document. Scoping of relevant environmental factors was undertaken through the ESD process for the Proposal. The EPA prepared and issued the ESD in consultation with relevant decision making authorities and the Proponent. The EPA, in its development of the ESD, consulted with the Proponent on the details of the Proposal, its environmental setting and the environmental surveys and investigations required and expected outcomes.	Section 9
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	The Proposal has been developed to align with the Proponent's sustainable development principles which seek to ensure that a balance is achieved between economic, environmental and social aspects of the Proposal activities. These principles are consistent with the intent of the WA State Sustainability Strategy and Rio Tinto's 'The Way We Work' statement of business practice. The Proposal incorporates progressive rehabilitation of disturbed areas through the Yandicoogina Closure Plan. The aim of closure and rehabilitation is to ensure that post-mining land uses are enabled to ensure that relevant areas of the Proposal Area retain enduring value for future generations.	Section 17
The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration	Yes	Environmental studies have been conducted in the Proposal Area to identify environmental values and the risks of impact associated with proposed operations. The requirement and scope of the environmental studies was defined through preliminary risk assessment, stakeholder consultation and scoping of the Proposal as part of the ESD process. Results from these studies have been used in the Environmental Impact Assessment presented in this PER document. A number of biodiversity management measures have been developed. These will be put in place in accordance with the EMS, MMP, SSMP, Yandi SSMP addendum and Yandicoogina Closure Plan to prevent and mitigate potential impacts to local and regional biological diversity and ecological integrity.	Sections 11, 13, 14, 15 and 1
***Principles relating to improved valuation, pricing and incentive mechanisms*:** (a) Environmental factors should be included in the valuation of assets and services (b) The polluter pays principle – those who generate pollution and waste should bear the cost of	Yes	The Proponent conducted a pre-feasibility study of the Proposal, accounting for environmental, economic and social considerations. The full life cycle costs of the Proposal, including costs associated with decommissioning and closure will be re-estimated for internal purposes at various stages of the Proposal life. The importance of improved valuation, pricing and incentive mechanisms is recognised. The Proponent has committed significant human and financial resources to ensure that an environmental management program for the Proposal is well developed and implemented.	Appendix 4 (Yandi MMP)

Principles of Environmental Protection	Relevant (yes/no)	If yes, consideration	Relevant sections of PER
containment, avoidance and abatement (c) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste (d) Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems		The Proponent recognises the polluter pays principle, and has designed the Proposal to ensure that pollution impacts are avoided. The potential pollution impacts of the Proposal have been identified and management measures to minimise these impacts developed. Pollution will largely be addressed through a combination of minimisation and on-site treatment, resulting in minimal export of pollutants off-site. Environmental goals will be pursued in the most cost-effective manner, using a combination of internal resources and external expertise where appropriate. A comprehensive approach for mine rehabilitation and closure has been developed in the Yandicoogina Closure Plan.	
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	Waste production will be minimised through the implementation of waste management approaches that apply the hierarchy of avoid, reduce, reuse, recycle and recover waste. The Proposal includes measures to minimise the generation of waste and reuse and recycle waste materials, wherever possible.	Appendix 4 (Yandi MMP)

Table 45: Statutory and environmental management controls for the Proposal

Factor	Proposed Statement Conditions	Yandi Operations management plans	Works Approval & licence (Part V, EP Act)	Other legislation and regulations
Key Environmental Factors				
Flora and Vegetation	x	x		x
Terrestrial Fauna	x	x		x
Subterranean Fauna	x	x		x
Hydrological Processes and Inland Waters Environmental Quality	x	x	x	x
Integrating Factors				
Rehabilitation and Closure	x	x		x
Residual Risk Management (Offsets)	x	x		x
Other Environmental Factors				
Aboriginal heritage		x		x
Air Quality		x	x	
Amenity		x		

24. Revised Proposal and proposed environmental conditions

The Revised Proposal will be implemented such that the resultant environmental effects will be as anticipated and assessed in this PER document, or as approved for the existing Yandi Operations based on MS 914.

The environmental footprint and other key characteristics of the Revised Proposal have been developed based on the description of the Proposal (Section 4) and MS 914 for the existing Yandi Operations (**Table 46**). A summary of the existing Yandi Operations and Proposal key characteristics, which together comprise the Yandicoogina Iron Ore Project – Revised Proposal, is outlined in **Table 1**, Section 1.4.1.

As the Proponent will be bound to implementing the Revised Proposal in accordance with technical specifications detailed in this PER document and as prescribed in any approval conditions (i.e. Schedule 1 of WA Ministerial Statement), only those elements of the Proposal that are significant from the point of view of environmental protection have been proposed as key characteristics.

The Proponent has also proposed environmental conditions for consideration by the State Minister (**Table 47**). These conditions are based on those outlined in MS 914, which would be superseded by a new Ministerial Statement pursuant to approval of the Revised Proposal. The changes made to MS 914 and the proposed new environmental conditions are also listed in **Appendix 6**.

The proposed Key Proposal Characteristics (**Table 46**) and Environmental Conditions (**Table 47**) have been developed to avoid duplication with other regulatory controls that can be applied under other existing legislation (Section 23.5). A condition relating to the management of a specific environmental factor has not been proposed if environmental impact can be, or is, adequately addressed by other environmental controls.

Table 46: Key Proposal Characteristics

Summary of the Proposal		
Proposal title	Yandicoogina Iron Ore Project – Revised Proposal	
Proponent name	Hamersley Iron – Yandi Pty Limited	
Short description	The proposal is to develop Iron Ore deposits Junction Central, Junction South East, Junction South West, Oxbow and Pocket and Billiard South, located in the central Pilbara region of Western Australia, on mining lease 274SA. Key aspects of the proposal include: • Ore transport and storage infrastructure (including rail link) –overland conveyors, stockyards, ore stackers and ore reclaimers, and storage infrastructure, rail loops. • Rail corridor allowing for rail lines and associated infrastructure. • Construction and operations support infrastructure. • 220kv power network including switchyard, back-up diesel power and transmission lines. • Dry and wet processing plants (including in pit waste fines storage facilities). • Flood protection structures and creek crossings. • Accommodation camps. • Access roads.	
Physical elements	**Location**	**Proposed Extent**
2. Mine and associated infrastructure	Figure 4 and Figure 79	Vegetation clearing up to 7,400 ha within Revised Proposal Development Envelope. Vegetation clearing up to 129 ha within the

		proposed Restricted Clearing Area.
Operational elements	**Location**	**Proposed Extent**
3. Dewatering	Figure 34	No more than 83 GL/year for entire Revised Proposal.
4. Surface water discharge	Figure 34	Up to 78 GL/year for entire Revised Proposal. No water flow or pooling further than 17 km downstream from the Marillana Creek and Weeli Wolli Creek system confluence.

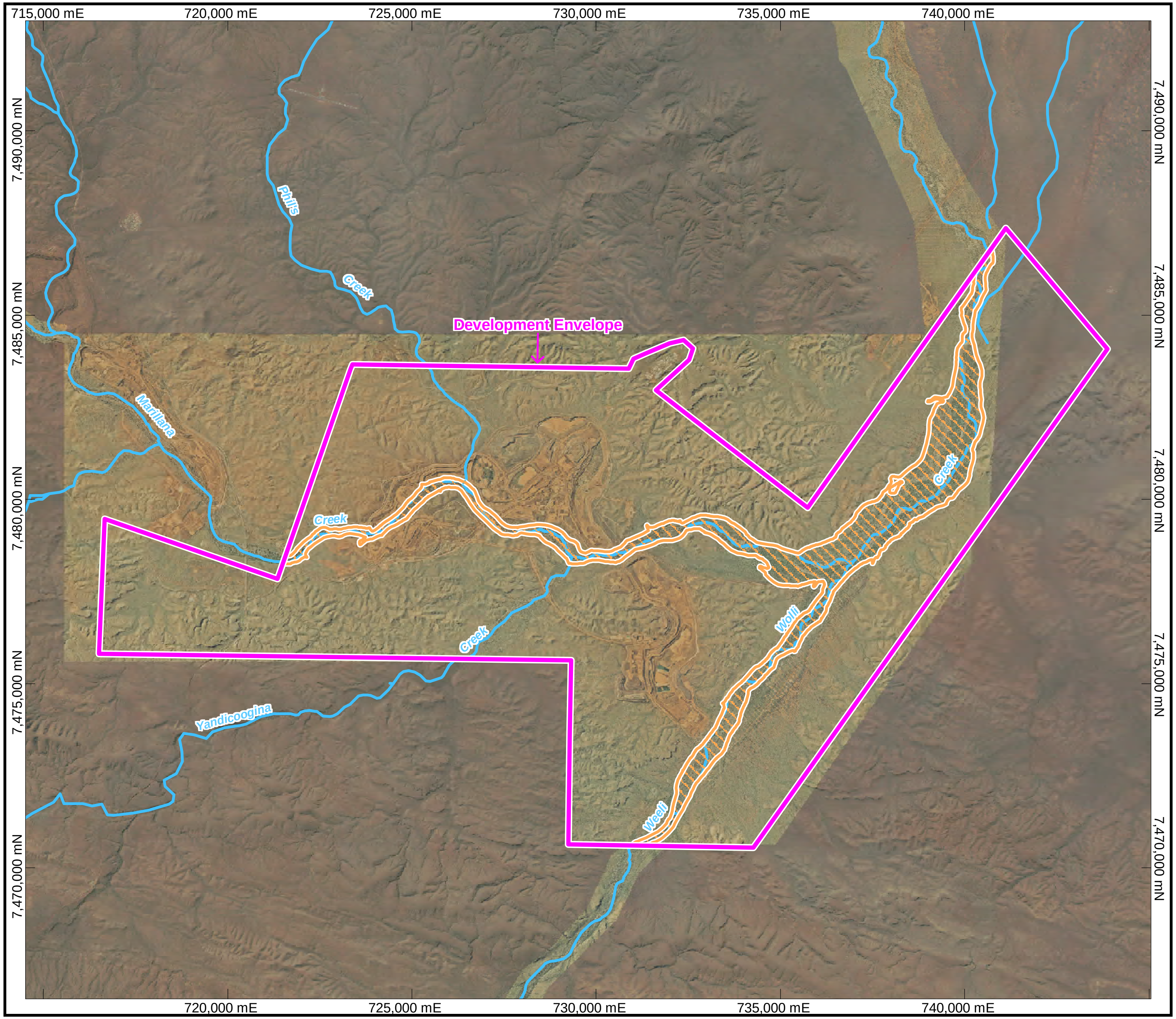
Table 47: Proposed environmental conditions for the Yandicoogina Iron Ore Project – Revised Proposal

Condition No.	Proposed condition
Proposal implementation	
1-1	When implementing the proposal, the proponent shall not exceed the authorised extent of the proposal as defined in Schedule 1, unless amendments to the proposal and the authorised extent of the Proposal have been approved under the EP Act.
Contact details	
2-1	The proponent shall notify the CEO of any change of its name, physical address or postal address for the serving of notices or other correspondence within 28 days of such change. Where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State.
Compliance reporting	
3-1	The proponent shall prepare and maintain a compliance assessment plan to the satisfaction of the CEO at least six (6) months prior to the first compliance assessment report required by condition 3-6.
3-2	The compliance assessment plan shall indicate: (1) the frequency of compliance reporting; (2) the approach and timing of compliance assessments; (3) the retention of compliance assessments; (4) the method of reporting of potential non-compliances and corrective actions taken; (5) the table of contents of compliance assessment reports; and (6) public availability of compliance assessment reports.
3-3	After receiving notice in writing from the CEO that the compliance assessment plan satisfies the requirements of condition 3-2 the proponent shall assess compliance with conditions in accordance with the compliance assessment plan required by condition 3-1.
3-4	The proponent shall retain reports of all compliance assessments described in the compliance assessment plan required by condition 3-1 and shall make those reports available when requested by the CEO.
3-5	The proponent shall advise the CEO of any potential non-compliance within seven days of that non-compliance being known.
3-6	The proponent shall submit to the CEO a compliance assessment report by the end of April each year addressing compliance in the previous calendar year. The compliance assessment report must address compliance for the period from the date of issue of this statement, notwithstanding that the first report may cover a period less or more than 12 months. The compliance assessment report shall: (1) be endorsed by the proponent's Managing Director / General Manager / Chief Executive Officer or a person delegated to sign on the Managing Director's / General Manager's / Chief Executive Officer's behalf; (2) include a statement as to whether the proponent has complied with the conditions; (3) identify all potential non-compliances and describe corrective and preventative actions taken; (4) be made publicly available in accordance with the approved compliance assessment plan; and (5) indicate any proposed changes to the compliance assessment plan required by condition 3-1.
Public availability of data	
4-1	Subject to condition 4-2, within six months of the issue of this statement and for the remainder of the life of the proposal the proponent shall make publically available, in a manner approved by the CEO, all validated environmental data (including sampling

Condition No.	Proposed condition
	design, sampling methodologies, empirical data and derived information products [e.g. maps]) relevant to the assessment of this proposal and implementation of this statement.
4-2	If any data referred to in condition 4-1 contains particulars of: (1) a secret formula or process; or (2) confidential commercially sensitive information The proponent may submit a request for approval from the CEO to not make this data publically available. In making such a request the Proponent shall provide the CEO with an explanation and reasons why the data should not be made publically available.
Surface water discharge (protection of Weeli Wolli Creek)	
5-1	The proponent shall ensure that the discharge of excess water from the Yandicoogina Iron Ore Project – Revised Proposal as a result of mining does not cause long term impacts to environmental values of the Weeli Wolli Creek system.
5-2	To verify that condition 5-1 is being met, the proponent shall maintain an Environmental Values Statement for the Weeli Wolli Creek system that defines the environmental values of the Weeli Wolli Creek system to the satisfaction of the CEO in consultation with Parks and Wildlife.
5-3	The proponent shall ensure that dewatering discharge from the Yandicoogina Iron Ore Project – Revised Proposal does not cause water flow or pooling downstream from the Marillana Creek and Weeli Wolli Creek system Confluence further than the extent identified in Schedule 1 (under natural no flow conditions).
5-4	The proponent shall submit a revised Water Discharge Monitoring and Management Plan in consultation with the DoW, to the satisfaction of the CEO, to ensure that identified environmental values associated with the Weeli Wolli Creek system and any downstream ecosystems, including the Fortescue Marsh, are maintained. This plan shall: (1) describe the water discharge and monitoring program; (2) when implemented, demonstrate by monitoring, whether conditions 5-1 and 5-3 are being met; (3) when implemented, require the proponent to manage the implementation of the proposal to meet the requirements of conditions 5-1 and 5-3; and (4) detail management actions and strategies to be implemented should the monitoring required by condition 5-4 (2) indicate that condition 5-1 or 5-3 may not be met.
5-5	The proponent shall implement the approved Water Discharge Monitoring and Management Plan required by condition 5-4, and any subsequent approved revisions.
Riparian vegetation	
6-1	The proponent shall ensure that surplus water discharge does not cause long term impacts on the health or cover of riparian vegetation or groundwater dependent ecosystems outside the management zones as shown in Figure 80.
6-2	The proponent shall ensure that dewatering discharge does not cause long term impacts on the health or cover of riparian vegetation or groundwater dependent ecosystems outside the management zones as shown in Figure 80.
6-3	The proponent shall manage the proposal in a manner that ensures there is no irreversible impact to riparian vegetation or groundwater dependent ecosystems across the catchment as measured within the management zones shown in Figure 80.
6-4	The proponent shall submit a revised Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan to the satisfaction of the CEO.
6-5	The Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan required pursuant to condition 6-4 shall: (1) when implemented, require the proponent to manage the implementation of the proposal to meet the requirements of conditions 6-1, 6-2, and 6-3; (2) when implemented, require the proponent to monitor to substantiate whether conditions 6-1, 6-2 and 6-3 are being met; (3) identify monitoring and control sites; (4) require the proponent to design a survey to acquire baseline biotic data, including health and abundance parameters and environmental data; (5) define health and cover parameters; (6) define monitoring frequency and timing; (7) identify criteria to measure any decline in health; (8) define critical correlative environmental parameters, including groundwater

Condition No.	Proposed condition
	drawdown; (9) define trigger and threshold levels for 'no irreversible impact'; (10) provide details of management actions and strategies to be implemented should trigger and threshold levels defined pursuant to condition 6-5(9) be exceeded within the management zones.
6-6	The proponent shall implement the approved Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan.
6-7	The proponent shall review and revise the approved Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan at intervals not exceeding five years, to the approval of the CEO.
6-8	Commencing on the date of this statement and until it commences implementation of the revised Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan in accordance with condition 6-6, the proponent shall continue to implement the existing approved Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan.
6-9	In the event that monitoring, undertaken pursuant to condition 6-6, identifies that trigger and threshold levels for no irreversible impact, defined pursuant to condition 6-5(9), have been or are being exceeded within the management zones, the proponent shall implement management actions and strategies defined in condition 6-5(10) to the satisfaction of the CEO.
Weeds	
7-1	The proponent shall ensure: (1) no increase in the species of weeds (including both declared weeds and environmental weeds) in the Proposal Area as a result of the implementation of the proposal; (2) the cover of weeds (including both declared weeds and environmental weeds) within the Proposal Area does not increase as a result of implementation of the proposal; and (3) identification and establishment of reference sites on nearby land outside the impact area shall be undertaken in consultation with the OEPA, on advice from Parks and Wildlife, to the satisfaction of the CEO. The reference sites are to be monitored biennially to determine whether changes in weed cover and type are as a result of proposal implementation or broader regional changes.
Decommissioning and rehabilitation	
8-1	The proponent shall ensure that the proposal is decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed outcomes and land uses, and without unacceptable liability to the State of Western Australia, through the implementation of the Mine Closure Plan required by condition 8-2.
8-2	The proponent shall prepare the Yandicoogina Mine Closure Plan in accordance with the *Guidelines for Preparing Mine Closure Plans*, *June 2015* and any updates, to the requirements of the CEO on advice of the Department of Mines and Petroleum.
8-3	The proponent shall review and revise the Yandicoogina Mine Closure Plan required by condition 8-2 at intervals not exceeding three years, or as otherwise specified by the CEO.
8-4	The proponent shall implement the latest revision of the Yandicoogina Mine Closure Plan, which the CEO has confirmed by notice in writing, satisfies the requirements of condition 8-2.
Residual impact and risk management measures	
9-1	The 5,600 ha of clearing of native vegetation previously approved under Ministerial Statement 914 is exempt from the requirement to offset under condition 9-3.
9-2	In view of the significant residual impacts and risks as a result of implementation of the additional clearing for the Yandi PBS Proposal, the proponent shall contribute funds to offset the clearing of 'Good to Excellent' condition native vegetation, and calculated pursuant to condition 9-3. This funding shall be provided to a government-established conservation offset fund or an alternative offset arrangement providing an equivalent outcome as determined by the Minister.

Condition No.	Proposed condition
9-3	The proponent's contribution to the initiative identified in condition 9-3 shall be paid biennially, the first payment due two years after commencement of the additional ground disturbance defined in Schedule 1. The amount of funding will be $1,500 AUD (excluding GST) per hectare of 'Good to Excellent' condition native vegetation and $3,000 AUD (excluding GST) per hectare of riparian zone vegetation cleared within the Development Envelope (delineated in Figure 1 and defined by the geographic coordinates in Schedule 2), within the Hamersley IBRA subregion.



LEGEND

- Development Envelope
- Proposed Restricted Clearing Area
- Major Watercourse

N

SCALE

0 2 4 6km

1:150 000 @ A4

RioTinto

Iron Ore (WA)

Figure 79
Yandicoogina Iron Ore Project - Revised Proposal Development Envelope and restricted clearing area

Drawn: M.Swebbs
Date: October, 2015
Plan No: PDE0133900v4
Proj: MGA94 (Zone 50)

Geospatial Information and Mapping

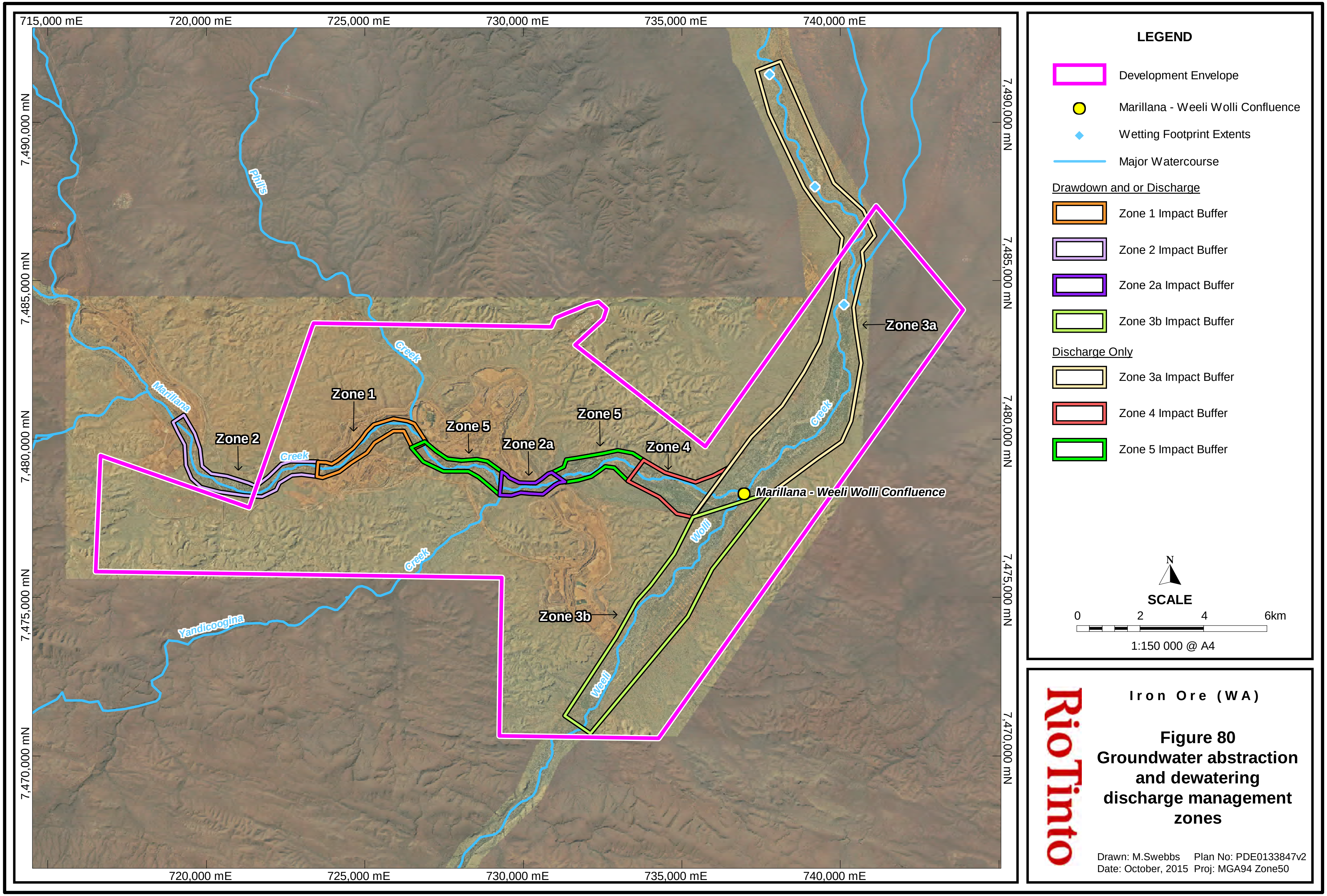


Figure 80
Groundwater abstraction and dewatering discharge management zones

Geospatial Information and Mapping

25. Conclusions

This PER provides:

- A description of the key components of the Revised Proposal.
- A summary of the important physical, biological and social factors of the existing environment.
- A discussion of the extent of stakeholder consultation.
- An evaluation of potential impacts of the Proposal to environmental factors, including cumulative impacts.
- Strategies and measures to ensure environmental factors and values are protected and managed to an appropriate level.

The PER has been prepared in accordance with the ESD developed by the EPA (**Appendix 2** and **Appendix 2**).

This PER document and all supporting biological survey reports have been prepared in line with the guidelines presented in the EPA checklist for documents submitted for Environmental Impact Assessment on marine and terrestrial biodiversity (**Appendix 5**).

25.1 Environmental impacts and mitigation

The key environmental factors identified by the EPA in the ESD for the Proposal were:

- Flora and vegetation.
- Terrestrial fauna.
- Subterranean fauna.
- Hydrological processes and Inland waters environmental quality.
- Rehabilitation and closure.
- Residual risk management (offsets).

Other environmental factors identified by the EPA in the ESD to be relevant to the Proposal were:

- Aboriginal heritage.
- Air quality.
- Amenity.

After mitigation and management measures have been applied, it is expected that the Proposal will result in the following residual outcomes in relation to the environmental factors identified by the EPA:

Hydrological processes and Inland waters environmental quality

- Natural surface water systems and flows – potential impacts likely to be minor and can be managed through typical stormwater management measures such as levees around the pit, diversion drains around waste dumps, and culverts under roads.

- Surface water resources including Weeli Wolli Creek due to surface discharge of surplus mine dewater – wetting front will be within existing approved limits, and therefore there will be negligible additional impacts on the downstream hydrological system of Weeli Wolli Creek.
- Altered flow regime to the Fortescue Marsh – surface water wetting front associated with the additional discharge from the Proposal is predicted to remain within existing approved limits of MS 914.
- Potential contamination of surface water and groundwater – acid rock drainage risk at the Revised Proposal has been assessed as low due to the geology of the area. Site drainage will be designed to minimise or eliminate surface runoff into areas where activities with a potential risk of hydrocarbon contamination occur. Management of waste dumps will ensure that risks of contamination of surface and groundwater are minimised.

Flora and vegetation

- Clearing of up to 1,800 ha flora and vegetation (including 69 ha riparian zone vegetation).
- Loss of some riparian vegetation associated with dewatering activities, with the vegetation expected to return to a more 'natural' state (i.e. pre-mining).
- Loss of some riparian vegetation associated with surplus water discharge, particularly waterlogging affects, though overall impacts will be limited to the currently approved limits of MS 914 (17 km downstream from confluence of Marillana and Weeli Wolli Creeks).
- No loss of known and recorded individuals of *Lepidium catapycnon* (Hamersley Lepidium); redesign of the waste dumps has avoided recorded individuals and they have been designated 'areas of special protection from ground disturbance' and therefore excluded from the ground disturbance footprint.
- Removal of some individuals of Priority 4 flora species (*Goodenia nuda*), though it is recorded throughout the Pilbara and it is considered that this will not alter the species' conservation status.
- Rehabilitation of areas disturbed by the Proposal, consistent with the Yandicoogina Closure Plan.

Terrestrial fauna

- Clearing of up to 1,800 ha of terrestrial fauna habitat over the life of the Proposal and habitat degradation due to the altered groundwater regime (some tree deaths within the riparian zone), which may lead to local reductions in fauna populations in the Proposal Area. The habitat types present in the Proposal Area are considered to be well represented in the local and regional area. It is considered likely that individuals will continue to forage in the remaining habitats within and adjacent to the Proposal Area.
- Clearing will result in the direct removal of up to 1,800 ha of potential SRE habitat within Proposal Area; this habitat is considered widespread locally and regionally.
- Risk of alteration to aquatic fauna habitat in Weeli Wolli Creek (surface water flows); additional habitat is available to north and south of the Proposal Area.

- Fragmentation of fauna habitat caused by the pit, waste dumps and association infrastructure; the mine footprint may also cause a barrier to dispersion for non-aerial species.
- Direct loss of some individual fauna through impact with machinery and vehicles, particularly during vegetation clearing.
- Progressive rehabilitation, with consideration given to restoring fauna habitat values where practicable.

Subterranean fauna

- Direct mortality and reduction in available subterranean habitats as a result of pit excavation and groundwater drawdown.
- Potential impacts will be localised to the proposed pit area and the groundwater drawdown zone during mining operations. However, it is not expected to significantly impact subterranean fauna assemblages and species persistence.
- The risk of pollutants being transported into the subterranean habitats is likely to be low and restricted to localised areas.
- The continuous nature of the alluvium, colluvium and calcrete units in which the subterranean fauna were predominately recorded indicates that geology is not a limiting factor in the distribution of the taxa currently known from the proposed pit area and the groundwater drawdown zone within the Proposal Area.

Rehabilitation and closure

- Pit walls of the final mine void that are adjacent to Weeli Wolli Creek are stabilised in a way that prevents the creek from collapsing into the mine voids post-closure, ensuring continued function of Weeli Wolli Creek.
- All areas disturbed for mining (with the exception of pit walls) and infrastructure that are not required by the State (under conditions of applicable State Agreements) are rehabilitated to a condition compatible with the post-mining land use following decommissioning.
- Creation of a dynamic wetland environment within the mine void, including two pit lakes and associated lake fringe, with water levels that will rise and fall in accordance with flooding of the creek systems.
- Regional hydrogeological impacts are minimised and adequately managed.
- Outside of the mining disturbance areas and more than 2 km from the Proposal mine voids, water levels are largely predicted to return to pre-disturbance levels.
- No impacts to the hydrological regime of the Fortescue Marsh as a result of closure of the site.

Offsets

Taking into account measures to avoid, minimise and rehabilitate impacts, the following significant residual impact arising from the Proposal has been identified:

- Clearing of up to 1,731 ha of native vegetation in Good to Excellent condition within the Proposal Area, including fauna habitat (excluding riparian zone vegetation[10]).
- Clearing of up to 69 ha of native riparian zone vegetation[10] within the Proposal Area, including fauna habitat.

The EPA has raised concerns regarding cumulative impacts on terrestrial biodiversity values in the Pilbara IBRA region. Consistent with the WA Environmental Offsets Guidelines, it is considered that the residual impact of disturbance of vegetation in Good to Excellent condition or riparian zone vegetation is significant and will therefore require compensation via an offset. As such, the Proponent is proposing to contribute funding of $1,500 (excluding GST) per hectare of native vegetation, and funding of $3,000 (excluding GST) per hectare of riparian zone vegetation cleared to a government-established conservation offset fund or an alternative offset arrangement providing an equivalent outcome as determined by the Minister.

Aboriginal heritage

- Any disturbance within the Weeli Wolli Creek heritage zone or of other archaeological/ethnographic sites will be in accordance with the provisions of the *Aboriginal Heritage Act 1972* (WA) and will have the consent of the relevant Traditional Owners.

Air quality

- Existing Proponent procedures and practices used at Yandi Operations to effectively prevent significant dust emissions will be applied to the Proposal.

Amenity

- Through mine closure the visual amenity will be returned as much as possible to the original pre-disturbance landscape. However, two pit lakes will be created within the Proposal Area, which have the potential to create new ecosystems. Amenity will be considered where possible during the life of the Proposal, and the management measures outlined in the Yandicoogina Closure Plan should ensure the key amenity values are maintained after mine closure.

25.2 Environmental management framework

The Proposal will be subject to the Proponent's HSECQ Policy and operated under the company EMS.

Management controls to be implemented as part of the Proposal to ensure key environmental factors are managed as described in the PER include measures and/or actions contained within the following key documents:

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[10] For the purposes of the offset calculation, riparian vegetation is classified as vegetation units within the riparian zone comprising C-coded and F2 coded vegetation located within the RCA.

- Yandicoogina MMP, which includes:
  - Yandicoogina Vegetation and Groundwater Dependant Ecosystems Monitoring and Management Plan.
  - Yandicoogina Surface Water Discharge Monitoring and Management Plan.
- Yandicoogina Weed Action Plan:
- SSMP, including Yandi Operations site specific addendum.
- Yandicoogina Closure Plan.

25.3 Environmental offsets

The Proponent recognises that an environmental offset will be required for significant residual impacts that remain after mitigation measures have been exhausted. An offset is proposed in regard to significant residual impacts on 'Good to Excellent' condition vegetation (Sections 18 and 24).

25.4 Environmental acceptability of the Proposal

The approach taken in this PER has been based on a risk assessment approach to characterise the environmental factors, determine potential impacts and develop mitigation measures.

The Proponent has extensive experience in managing the development, operation and environmental compliance of similar projects, particularly including the existing Yandi Operations. The knowledge and experience gained from the Yandi Operations to date is considered to have provided rigour to additional studies undertaken for the Proposal and is anticipated to lead to a greater certainty in achieving stated environmental outcomes.

The Proponent has consulted with key stakeholders to scope the potential impacts of the Proposal and to determine the significance of environmental issues and the acceptability of mitigation. This process substantially improves the likelihood that all significant environmental issues have been identified, investigated and mitigated as far as practicable.

On the basis of the findings of this PER, the Proposal is considered to be environmentally acceptable if implemented in accordance with the proposed management and mitigation measures, including proposed Ministerial Statement implementation conditions (which are based on the existing conditions in MS 914 for the Yandi Operations).

Part 8 – Abbreviations and references

26. Abbreviations

Abbreviation	Definition
%	Percent
°C	Degrees celsius
AEP	Annual Exceedance Probability
ALA	Atlas of Living Australia
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Annual Recurrence Interval
AUD$	Dollars (Australian)
bgl	Below ground level
BHP	BHP Billiton Iron Ore
BIF	Banded Iron Formation
BWT	Below water table
CAA	Clearing Avoidance Area
CAMBA	China-Australia Migratory Bird Agreements
CID	Channel iron deposit
cm	Centimetre/s
CIA	Cumulative impact assessment
DAA	Department of Aboriginal Affairs
DCP	Digital canopy photography
DER	Department of Environment Regulation
DMAs	Decision making authorities
DMP	Department of Mines and Petroleum
DO	Discharge Outlet
DoE	Department of the Environment (Commonwealth)

Abbreviation	Definition
DoW	Department of Water
DSD	Department of State Development
EAG	Environmental Assessment Guideline
EIA	Environmental impact assessment
EMS	Environmental Management System
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESD	Environmental Scoping Document
EVS	Environmental Values Statement
FIFO	Fly In-Fly Out
GIS	Geographic information system
GL	Gigalitre/s
GL/y	Gigalitre/s per year
ha	Hectare/s
Hamersley Iron	Hamersley Iron – Yandi Pty Limited
HSECQ	Health, Safety, Environment, Community and Quality Policy
IBRA	Interim Biogeographic Regionalisation for Australia
JAMBA	Japan-Australia Migratory Bird Agreements
JC	Junction Central
JSE	Junction South East
JSW	Junction South West (-A & C pits)
km	Kilometre/s
km^2	Square kilometre/s
kV	Kilovolt/s
m	Metre/s

Abbreviation	Definition
m^3	Cubic metre/s
Matters of NES	Matters of National Environmental Significance
mg/L	Milligrams per litre
mm	Millimetre/s
MMP	Monitoring and Management Plan
MS 914	Ministerial Statement No. 914
Mt	Million tonnes
Mtpa	Million tonnes per annum
MW	Megawatt/s
OEPA	Office of the Environmental Protection Authority
Parks and Wildlife	Department of Parks and Wildlife
PER	Public Environmental Review
Pilbara Iron	Pilbara Iron Company (Services) Pty Limited
RCA	Restricted Clearing Area
Revised Proposal	Yandicoogina Iron Ore Project – Revised Proposal; comprised of the existing Yandi Operations and Yandi PBS Proposal
RIWI Act	*Rights in Water and Irrigation Act 1914*
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreements
SRE	Short Range Endemic
SSMP	Significant Species Management Plan
TDS	Total Dissolved Solids
TEC	Threatened Ecological Community
Existing Yandi Operations	Existing Yandicoogina Operations
Proposal	Yandicoogina Pocket and Billiard South Iron Ore Development
YLUA	Yandicoogina Land Use Agreement
WA	Western Australia
WAM	Western Australian Museum

Abbreviation	Definition
WC Act	*Wildlife Conservation Act 1950*
WFSFs	Waste fines storage facilities

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Appendix 1: Yandicoogina Iron Ore Project – Revised Proposal Environmental Scoping Document

(Yandicoogina Iron Ore Project – Revised Proposal Environmental Scoping Document is contained on CD inside the back cover of the PER)

Appendix 2: Compliance checklist

Compliance checklist of work requirements for preliminary key environmental factors (and other environmental factors) stated in the ESD. For the EPA objective, relevant aspects and potential impacts, please see Appendix 1 (ESD).

Environmental factor	Work required	PER reference
Flora and Vegetation	1. Provide information on the current status and outcomes of the riparian vegetation management actions required by Ministerial Statement 914 Condition 7 - Riparian Vegetation, and Condition 8 - Weeds.	Section 14.5.1
	2. Provide a detailed description of the cumulative impacts associated with the proposal, including direct impacts from clearing, and indirect impacts such as groundwater drawdown, surface discharge of excess groundwater, altered drainage, changes in water quality, dust emissions and fragmentation of vegetation.	Section 14.4
	3. Provide figures showing the extent of clearing and indirect impact to vegetation and conservation significant flora species, including but not limited to threatened and/or Priority ecological communities, Declared Rare Flora, Priority flora and new flora species.	Figures 44 to 56
	4. Consolidate vegetation and flora reports incorporating information from all relevant previous and new studies, particularly for the Declared Rare Flora species *Lepidium catapycnon*.	Section 14.2.1; Appendix 3; Biota (2015a)
	5. Describe the environmental values and rational of the Clearing Avoidance Area identified in Ministerial Statement 914. Quantify the disturbance to this area as a result of implementing the proposal and describe how the environmental values of the Clearing Avoidance Area and Weeli Wolli Creek will be maintained.	Section 6.2.1.2 and 14.3.1
	6. Carry out Level 2 flora and vegetation surveys in areas that are likely to be directly or indirectly disturbed. Surveys are to be undertaken in accordance with Guidance Statement 51. Details of the scope, timing (survey season/s) and methodology for surveys used must be provided. Follow up targeted surveys may be required based on the results of the baseline survey for conservation significant flora and vegetation.	Section 14.2.1; Appendix 3; Biota (2015a)
	7. Analyse the extent of clearing and indirect impacts to assist in the determination of the significance of impacts, including impacts on: • vegetation units; • threatened and Priority ecological communities; • threatened and Priority flora; • species identified as significant consistent with Guidance Statement 51;	Section 14.3

Environmental factor	Work required	PER reference
	• vegetation units identified as significant consistent with Guidance Statement 51; and • groundwater dependent vegetation.	
	8. Undertake baseline mapping of weed affected areas in any area likely to be directly or indirectly impacted by the proposal.	Section 14.2.1; Appendix 3; Biota (2015a)
	9. Discuss potential direct/indirect (including downstream) and cumulative impacts to flora and vegetation as a result of the proposal, and provide quantitative data on impacts of the proposal to species of conservation significance.	Section 14.3
	10. Discuss proposed management, monitoring and mitigation methods to be implemented. Also, discuss engineering solutions that could be implemented to redesign the waste rock dump locations to avoid impacts to *Lepidium catapycnon*.	Sections 14.3 and 14.5
	11. Demonstrate that all practicable measures have been taken to reduce both the area of the proposed disturbance footprint and the Development Envelope based on progress in the proposal design and understanding of the environmental impacts.	Sections 14.3 and 14.5
	12. Demonstrate that the mitigation hierarchy of avoid, minimise, rehabilitate and offset has been applied effectively during the mine planning and design stages of the project.	Sections 14.3 to 14.6, Section 17 and Section18
Terrestrial Fauna	1. Conduct desktop study of information available to provide a comprehensive listing of vertebrate fauna and SRE invertebrate fauna known or likely to occur in the habitats present, and identification of conservation significant fauna species likely to occur in the area. Consideration of species listed under both the WA *Wildlife Conservation Act 1950* and the *Environment Protection & Biodiversity Conservation Act 1999 (*EPBC Act), and species listed by the Department of Parks and Wildlife as Priority Fauna to include, but not necessarily be limited to, the following species of conservation significance have been recorded in the Yandicoogina PBS surveys: • Brush-tailed Mulgara (*Dasycercus blythi*) • Star Swift (*Neochmia ruficaudo*) • Fork-tailed Swift (*Apus pacificus)* • Western Pebble-mound Mouse (*Pseudomys chapman*) • Olive Python (Pilbara subspecies) (*Liasis olivaceus barroni*) • Rainbow Bee-eater (*Merops arnatus*) • Any other Priority fauna species identified in a Level 1 survey as likely to occur in the Proposal Area.	Sections 15.2 to 15.4; Appendix 3; Biota (2015b)
	2. For each relevant conservation significant species, provide baseline information on their abundance (including known occurrences), distribution, ecology, and habitat preferences at both the site and regional levels.	Sections 15.2 to 15.4; Appendix 3; Biota (2015b)
	3. Conduct a Level 1 reconnaissance vertebrate and SRE invertebrate fauna survey and mapping of habitats including specialised	Sections 15.2 to 15.4; Appendix 3; Biota

Environmental factor	Work required	PER reference
	habitats within the development envelopes, identification and mapping of important, rare or unusual habitat types within areas to be impacted, in accordance with Guidance Statements 56 and 20. This should also consider other areas outside the proposed disturbance footprint to determine whether the most suitable areas have been chosen for location of infrastructure.	(2015b)
	4. Consider habitat types that provide important ecological function e.g. riparian vegetation, protected area buffer zones, refugia, important habitat corridors, wetlands, areas of conservation significance or geological features which may support unique ecosystems. Analyse the extent of clearing, including percentages of habitat types to be cleared or otherwise impacted, to assist in determination of significance of impacts. Information, including maps, must also differentiate habitat on the basis of use e.g. breeding habitat, migration pathways, feeding habitat. Consider whether the remaining habitat has adequate carrying capacity.	Sections 15.2 to 15.6
	5. Conduct Level 2 fauna surveys in areas that are likely to be directly or indirectly impacted as a result of the proposal. Surveys are to be undertaken in accordance with Guidance Statements 20 and 56. Additional targeted surveys for conservation significant fauna that are known to or likely to occupy habitats in the Project area may be required based on the results of the survey.	Sections 15.2 to 15.4; Appendix 3; Biota (2015b)
	6. For each relevant conservation significant species, provide: • information on the conservation value of each habitat type from a local and regional perspective, including the percentage representation of each habitat type on-site in relation to its local and regional extent; and • if a population of a conservation significant species is present on the site, its size and the importance of that population from a local and regional perspective and potential percentage loss of the conservation significant species locally due to loss of habitat.	Sections 15.2 to 15.6
	7. Discuss known existing threats to the species, whether or not attributable to the proposed action with reference to relevant impacts from the proposed action (including taking into consideration any relevant guidelines, policies, plans and statutory provisions).	Sections 15.2 to 15.4
	8. Discuss potential direct/indirect (including downstream) and cumulative impacts to fauna as a result of the proposal, and provide quantitative data on impacts of the proposal to species of conservation significance.	Sections 15.5 and 15.6
	9. Discuss proposed management, monitoring and mitigation methods to be implemented including an assessment of the effectiveness of the methods, any statutory or policy basis for the methods.	Section 15.7
Subterranean Fauna	1. Conduct surveys within areas to be impacted and in surrounding areas in accordance with Guidance Statement 54a.	Sections 16.2 and 16.3; Appendix 3; Biota (2015c, 2015d)
	2. Present the results of the subterranean fauna surveys and discuss the potential for direct and indirect impacts to subterranean fauna including consideration of altered water regimes and nutrient flows.	Sections 16.2 to 16.4
	3. Assess any impacts to subterranean fauna in accordance with EAG 12. For species which are likely to be impacted, provide	Sections 16.2 to 16.4

Environmental factor	Work required	PER reference
	information, including detailed geological maps on habitat continuity and an appropriate explanation of the likely distribution of species within those habitats.	
	4. Discuss proposed management, monitoring and mitigation methods to be implemented.	Section 16.5
Hydrological Processes and Inland Waters Environmental Quality	1. Provide information on the current status and outcomes of surface water discharge management actions required by Ministerial Statement 914 Condition 6 - Surface Water Discharge (Protection of Weeli Wolli Creek).	Section 13.2.4
	2. Provide a detailed description of the design and location of the proposal with the potential to impact surface water or groundwater.	Sections 13.2 and 13.3
	3. Characterise baseline hydrological and hydrogeological regimes.	Section 13.2
	4. Develop a conceptual model of the surface and groundwater systems, incorporating the extent of connectivity between surface and ground water systems.	Section 13.2; Appendix 3; URS (2015)
	5. Discuss the effectiveness of the current water management scheme and provide a comparison of its actual operation versus what was predicted including discussion of accuracy. Also detail any problems with how the system has operated and what management measures have been taken when it is not operating as expected.	Section 13.2
	6. Present information on predicted annual dewatering requirements and surplus water quantities over the life of the operations.	Sections 13.2 and 13.3
	7. Provide a conceptual mine water balance over the life of the proposal to discuss the capacity to reuse surplus mine dewater.	Section 13.2.4
	8. Discuss the potential environmental impacts and benefits of identified surplus water management options (i.e. reuse on-site, local water supply, aquifer recharge etc.) and discuss the most appropriate water management strategy for the proposal.	Sections 13.3 and 13.5
	9. Discuss the impacts to Weeli Wolli Creek and the potential impacts on Fortescue Marsh considering worst case conditions, including natural flow conditions and maximum anthropogenic inputs. Describe methods used to minimise the impacts to Weeli Wolli Creek, including minimising the period of surface discharge. Quantify the period of surface discharge required, as well as the extent of surplus mine dewater release (wetting front) and changes to flows within Weeli Wolli Creek.	Section13.3
	10. Model the impact of different flooding scenarios during operations and post- closure on infrastructure and final landforms. Note the for any storm water infrastructure on-site and provide an explanation, including reference to standards and guideline documents, for the chosen criteria.	Section13.3
	11. Detail and assess the geotechnical criteria of the bund or levee that will be located next to Weeli Wolli Creek. Discuss the permanency of the bund or levee in the catchment. Identify the likely source of the material that will be used to build the bund or levee, and describe how the design and structural integrity will withstand large storm events. If the bund or levee is part of a closure strategy assess the Iona term integrity of the bund taking into consideration different flooding scenarios or a worst case	Section 4.2.8 and 13.3

Environmental factor	Work required	PER reference
	scenario.	
	12. Investigate groundwater drawdown due to ground water abstraction associated with the proposal. Analyse and discuss any impacts to groundwater levels and flows taking into consideration the cumulative impacts with other proposals.	Section13.3
	13. Develop a conceptual model of the surface and groundwater systems, incorporating groundwater quality and the extent of connectivity between surface and ground water systems and Fortescue Marsh.	Sections 13.2 and 13.3
	14. Have the surface and groundwater modelling for this assessment independently peer reviewed. Determine the scope, timing and the selection of the peer review in consultation with the Department of Water. The groundwater modelling should be consistent with Australian Government National Water Commission's Australian Groundwater Modelling Guidelines (2012). The surface water modelling should be in accordance with the Australian Rainfall and Runoff Guidelines.	Section 3; Appendix 3; WorleyParsons (2015) and Hydrogeologic (2015)
	15. Analyse, discuss and assess surface water and groundwater impacts, including changes in groundwater levels and changes to surface water flows associated with the proposal together with cumulative impacts with other projects and referred proposals (including the BHPBIO strategic proposal) for which relevant information is publicly available.	Sections 13.3 and 13.4
	16. Discuss the proposed management, monitoring and mitigation to prevent groundwater and surface water impacts as a result of implementing the proposal.	Section 13.5
	17. Characterise baseline water quality, including the analysis of groundwater quality that is proposed to be discharged into the surrounding environment.	Sections 13.2 and 13.3
	18. Develop a conceptual model of the surface and groundwater systems, incorporating groundwater quality and the extent of connectivity between surface and ground water systems and Fortescue Marsh (same requirement for hydrological processes).	Sections 13.2 and 13.3
	19. Undertake a hydrological investigation to determine what effect groundwater abstraction, and modified drainage will have on the surface water and groundwater quality and quantity of the area, including interactions between surface and groundwater.	Sections 13.2 and 13.3; Appendix 3; URS (2015)
	20. Have the surface and groundwater modelling for this assessment independently peer reviewed. Determine the scope, timing and the selection of the peer review in consultation with the Department of Water. The modelling should be consistent with Australian Government National Water Commission's Australian Groundwater Modelling Guidelines (2012) (same requirement for hydrological processes).	Section 3; Appendix 3; WorleyParsons (2015) and Hydrogeologic (2015)
	21. Undertake a comprehensive review of surface water and groundwater quality collected from the existing mining operation at the site. Identify any adverse changes caused by the mining operation and outline avoidance, minimisation and management methods to be used to prevent further impacts.	Sections 13.2 and 13.5
	22. Undertake waste characterisation studies of waste rock and other materials and carry out an acid and metalliferous drainage risk	Sections 13.3.7 and 17.2.2

Environmental factor	Work required	PER reference
	assessment. Detail where Potentially Acid Forming (PAF) material will be located and discuss stored and containment options, including sub-aqueous storage.	
	23. Provide a description of the design, location and extent of discharges of the proposed waste facilities, and any other elements of the proposal with the potential to impact surface water or groundwater quality.	Sections 13.3 and 13.5
	24. Model cumulative impacts with other mines in the catchment (currently operating and referred proposed mines, including the BHPBIO strategic proposal, where information is publicly available). Develop strategies and controls to minimise the impacts.	Sections 13.3 to 13.6
	25. Confirm whether or not pit lakes may form and provide details of potential backfill options. If pit lakes may form, provide an assessment of the long term contamination of any pit lakes and the potential impact on groundwater and surface water quality with particular attention to possible impacts on Fortescue Marsh. In addition, undertake a risk assessment in accordance with the most recent version of the joint DMP/EPA Mine Closure Guidelines and provide details of mitigation measures undertaken to reduce the risk of any pit lakes.	Section 17
	26. Discuss proposed management , monitoring and mitigation methods, including the identification of water quality trigger levels, to be implemented during construction, operation and following closure to ensure that the EPA's objective for this factor is met.	Section 13.5.
Rehabilitation and Closure	1. Provide information on the current status of Yandicoogina Decommissioning and Rehabilitation Plan required by Ministerial Statement 914 Condition 9 - Decommissioning and Rehabilitation.	Section 17.2.1
	2. Undertake a desktop study of successful and unsuccessful rehabilitation strategies and outcomes in similar geologies and vegetation types in the Pilbara, including any rehabilitation that has been conducted to date within the Development Envelope. Including a discussion of the different methodology and success rates for the various proposed disturbance types including: • created landforms (e.g. waste rock dump, tailings storage facility); • short term disturbances (e.g. borrow pits and access tracks); • long term disturbances (e.g. construction camp, permanent accommodation village and administration buildings); and • linear and/or fragmentation disturbances (e.g. roads, power lines, bore fields).	Appendix 4; Rio Tinto (2015c)
	3. Provide waste characterisation work including static, short term leaching and kinetic test results, and water quality monitoring results for drainage from existing waste storage facilities to enable a thorough assessment of acid and metalliferous drainage risk posed by the project. If PAF material is identified, provide mine scheduling detail to demonstrate that PAF material is not disturbed during mining and/or that effective strategies will be in place to ensure PAF material is adequately managed should it be exposed and/or disturbed.	Sections 13.3.7 and 17.2.2
	4. Provide the physical characteristics of the waste materials and proposed locations and geotechnical design detail (including slope	Section 17.2.3

Environmental factor	Work required	PER reference
	stability) for the waste landforms, including the WFSFs. Identify proposed management and monitoring for the waste landforms. Describe contingencies to make landforms secure and non-polluting in the event of unexpected or temporary closure.	
	5. Prepare a Rehabilitation and Mine Closure Plan consistent with the current version of the Department of Mines and Petroleum (DMP) and EPA Guidelines for Preparing Mine Closure Plans. Include completion criteria and closure objectives addressing native vegetation and habitat for significant flora and fauna and base the conclusions on the availability of suitable substrates and landform design. Establish and measure vegetation and fauna reference sites to inform completion criteria. Determine requirements for, and sources of, soil and seed for rehabilitation. A conclusive discussion on backfill options (including 'worst case scenario') is also required.	Appendix 4; Rio Tinto (2015c)
	6. Discuss proposed management, monitoring and mitigation methods to be implemented including post-mining land use and areas to be rehabilitated.	Section 17.4
	7. Discuss proposed monitoring of linkages of specialised habitats to demonstrate that rehabilitated areas function as ecological corridors for conservation significant fauna.	Section 17.4; Appendix 4; Rio Tinto (2015c)
Offsets (Residual Risk Management)	1. Examine residual impacts and, if required, develop a draft program of environmental offsets that adheres to the relevant policy/guidance document listed below.	Section 18
	2. Include the completed Environmental Offsets Reporting Form and any offsets required and proposed in the PER.	Section 18
Heritage (Indigenous)	Not stated (other environmental factor)	NA
Air Quality	Not stated (other environmental factor)	NA
Amenity	Not stated (other environmental factor)	NA

Appendix 3: Supporting studies

The following supporting documents are contained on CD inside the back cover of the PER:

Biota Environmental Sciences (Biota) 2011. *Yandicoogina Expansion Billiard Deposit Fauna Survey*. Report prepared for Rio Tinto, January 2011.

Biota Environmental Sciences (Biota) 2014. *Pocket and Billiard South Level 2 Seasonal Fauna Survey*. Report prepared for Rio Tinto, November 2014.

Biota Environmental Sciences (Biota) 2014. *Yandi Billiards – Interim Report on Conservation Significant Terrestrial Fauna.* Report prepared for Rio Tinto, September 2014.

Biota Environmental Sciences (Biota) 2014. *Yandi Billiards Targeted Northern Quoll Survey.* Report prepared for Rio Tinto, September 2014.

Biota Environmental Sciences (Biota) 2014. *Yandi Billiards Vegetation and Flora Survey – Phase 1 and Phase 2*. Report prepared for Rio Tinto, October 2014.

Biota Environmental Sciences (Biota) 2015. *Yandi Billiards Troglobitic Fauna Assessment*. Report prepared for Rio Tinto, April 2015.

Biota Environmental Sciences (Biota) 2015. *Yandi Operations Stygofauna Data Consolidation 2003 – 2014.* Report prepared for Rio Tinto, April 2015.

Biota Environmental Sciences (Biota) 2015. *Yandi Terrestrial Fauna Integration Report*. Report prepared for Rio Tinto, January 2015.

Biota Environmental Sciences (Biota) 2015. *Yandi Vegetation and Flora Integration Report*. Report prepared for Rio Tinto, March 2015.

Eastham J. 2015. *Understanding riparian vegetation responses to groundwater drawdown and discharge from below water table mining in the Pilbara*. Report prepared for Rio Tinto, July 2015.

Hydrogeologic Pty Ltd (Hydrogeologic) 2015. *Rio Tinto Yandi Mine Groundwater Flow Model Independent Review*. Report prepared for Rio Tinto, February 2015.

Rio Tinto Pty Ltd (Rio Tinto) 2014. *Revised discharge extent modelling in Weeli Wolli Creek based on measured channel loss rates*. Report prepared by Rio Tinto, December 2014.

Rio Tinto Pty Ltd (Rio Tinto) 2014. *Yandicoogina Billiard acid and metalliferous drainage risk*. Report prepared by Rio Tinto, June 2014.

Rio Tinto Pty Ltd (Rio Tinto) 2014. *Yandicoogina – Pocket and Billiards South model setup, calibration and estimation of dewatering requirements*. Report prepared by Rio Tinto, November 2014.

Rio Tinto Pty Ltd (Rio Tinto) 2015. *Riparian Vegetation of Marillana and Weeli Wolli Creeks: Mapping refinement and assessment of values and significance*. Report prepared by Rio Tinto, October 2015.

Rio Tinto Pty Ltd (Rio Tinto) 2015. *Supporting document for the Yandi Pocket and Billiard South Project Public Environmental Review (PER), Yandi Rehabilitation Review*. Report prepared by Rio Tinto, March 2015.

Rio Tinto Pty Ltd (Rio Tinto) 2015. *Weeli Wolli Creek Ecohydrology – Yandicoogina Pocket and Billiard South Pre-Feasibility Study.* Report prepared by Rio Tinto, April 2015.

RPS 2015. *Yandicoogina Billiard South Water Balance*. Report prepared for Rio Tinto, April 2015.

URS Australia Pty Ltd (URS) 2015. *Environmental risk assessment for riparian zones on Weeli Wolli Creek*. Report prepared for Rio Tinto, June 2015.

Wetland Research & Management (WRM) 2015. *Yandicoogina: Cumulative impacts of mining on Marillana and lower Weeli Wolli Creeks, Dry 2013 and Wet 2014 sampling*. Report prepared for Rio Tinto, July 2015.

WorleyParsons 2015. *Billiards South Pre-feasibility Study, Review of surface water modelling*. Report prepared for Rio Tinto, March 2015.

Appendix 4: Environmental management documents

The following environmental management documents are contained on CD inside the back cover of the PER:

- Yandicoogina Monitoring and Management Plan (MMP) (October 2015), which includes:
    - Yandicoogina Vegetation and Groundwater Dependant Ecosystems Monitoring and Management Plan; and
    - Yandicoogina Surface Water Discharge Monitoring and Management Plan;
- Yandicoogina Weed Action Plan (July 2012); and
- Rio Tinto Significant Species Management Plan (including Yandicoogina Significant Species Management Plan addendum) (September 2014).
- Yandicoogina Closure Plan (August 2015).

Appendix 5: EPA checklist for documents submitted for EIA on marine and terrestrial biodiversity

Checklist Item	Completed	PER reference
PART 1 – GENERAL QUALITY OF DOCUMENTS		
Ensure that the following standard elements are present in all documentation (including appendices):		
A clear and concise title that outlines basic information about the proposal and purpose of the document.	✓	Cover page
Date and document revision number.	✓	Cover page
Information identifying the document's author and publishing entity.	✓	Cover page
All issues identified in a scoping guideline or scoping document have been addressed and covered in the report.	✓	**Appendix 2**
Complete and correct tables of contents, maps, tables and figures.	✓	Table of Contents; Figure 1 to **Figure 80**; **Table 1** to **Table 47**
Suitably-sized scale maps placing the proposal into both a regional and local context.	✓	Figure 1 and **Figure 2**
Figures, plates, maps, technical drawings or similar including scale bar, legend, informative caption, labels identifying important or relevant locations/features referred to in the document text.	✓	Figure 1 to **Figure 80**
All survey site locations and derived data products (e.g. benthic habitat maps, vegetation maps) have been provided in map and appropriate GIS-based electronic database forms.	✓	GIS-based electronic data contained on CD inside back cover of PER
All survey data from terrestrial biological surveys have been provided in electronic database form (Access/Excel).	✓	Contained on CD inside back cover of PER

Checklist Item	Completed	PER reference
Proposed infrastructure is shown on scale maps and associated spatial data and are provided in an appropriate GIS-based electronic database form.	✓	**Figure 4**; GIS-based electronic data contained on CD inside back cover of PER
A list of references that have been cross-checked to ensure that all references in the Reference list are cited in the text (and vice versa).	✓	Section 27
All information based on ‘expert’ opinion/judgement are explicitly attributed, by name and qualification, to a person/s or organisation.	✓	Entire document
Where relevant, appendices are attached to the main EIA document that describe the details of technical work undertaken to underpin the content of the main document, and explicitly attributed by name to the author/s and (if applicable) their organisation.	✓	**Appendix 3**
Description(s) of the proposal are internally consistent throughout all documentation and are couched to allow potential environmental impacts to be placed in local and regional contexts, including cumulative impacts of existing and approved developments.	✓	Section 4
Descriptions of the local and regional environmental features most likely to be directly or indirectly affected by the proposal.	✓	Sections 5 to 7
PART 3 – TERRESTRIAL BIODIVERSITY ISSUES		
For proposals likely to impact on native flora and vegetation/plant communities, the EIA document describes how potential impacts have been addressed in the context of EPA Guidance Statement No. 51, *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (June 2004), including:		
Determining the level of flora and vegetation survey consistent with that expected in Table 3 of Guidance Statement No. 51 (Appendix 2);	✓	**Appendix 3**; Biota (2015a)
Describing the survey area and methodologies, including reference to timing, duration, survey effort, any survey limitations, and the nomenclature used (WA Herbarium);	✓	**Appendix 3**; Biota (2015a)
Maps and text describing the survey area/plot sites, location of significant species, vegetation mapping, vegetation condition assessment and predicted extent of impact on the vegetation;	✓	**Figure 43** to **Figure 56**; Sections 14.2 and 14.3
A comprehensive list of flora species identified and assessment of threatened, Priority or other significant flora / Ecological Communities (TECs, PECs) known or reasonably expected to occur in the area (as defined in Guidance Statement 51);	✓	Sections 14.2 and 14.3; further detail provided in **Appendix 3**, Biota (2015a)
Evaluating the impact of the proposal on the species/communities, including reference to the extent of regional clearing of the vegetation complex/type and ecological linkage; and	✓	Sections 14.3 and 0

Checklist Item	Completed	PER reference
All quadrat data used in reporting provided as electronic database in raw form, in addition to hardcopy reports.	✓	Contained on CD inside back cover of PER
For proposals likely to impact on vertebrate fauna or fauna habitat, the EIA document describes how potential impacts have been addressed in the context of EPA Guidance Statement No. 56, *Terrestrial Fauna Surveys for Environmental Impact Assessment* (June 2004) and *Technical Guide Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA and Department of Environment and Conservation 2010), including		
Determining the level of fauna survey consistent with that expected in Table 3 (Appendix 2) of Guidance Statement No. 56;	✓	**Appendix 3**; Biota (2015b)
Describing the survey methodologies in the context of EPA and DEC (2010), including reference to timing, duration and survey effort used to sample each of the fauna groups sampled, any survey limitations and the nomenclature used (WA Museum checklist except for birds which should follow Christidis and Boles 2008);	✓	**Appendix 3**; Biota (2015b)
Maps and text describing the survey area, sampling locations and fauna habitats; and	✓	**Figure 57** to **Figure 61**, **Figure 64** and **Figure 65**; Sections 15.2 and 15.4; further detail available in **Appendix 3**, Biota (2015b)
A comprehensive list and assessment of fauna known or reasonably expected to occur in the area, including Specially Protected and other significant fauna (as defined in Guidance Statement No. 56), and an evaluation of the impact of the proposal on the species and key habitat/s.	✓	Sections 15.2, 15.4 and 15.5; further detail available in **Appendix 3**, Biota (2015b)
For proposals with the potential to impact on short range endemic (SRE) invertebrate fauna or SRE habitat, the EIA document describes how potential impacts have been addressed in the context of EPA Guidance Statement No. 20, *Sampling of Short Range Invertebrate Fauna for Environmental Impact Assessment in Western Australia* (May 2009), including:		
Early initial assessment for restricted habitat types that have potential to support SRE fauna, including advice from the WA Museum and the DEC/OEPA.	✓	**Appendix 3**; Biota (2015b)
Maps and text describing the survey area, potential SRE habitats and regional context and extent of predicted impact on the habitat.	✓	**Figure 62** and **Figure 63**; Sections 15.3, 15.5.2.2 and 1.1.1; further detail available in Appendix 3, Biota (2015b)
Describing the survey methodologies, including reference to timing, duration and survey effort used to sample each of the SRE groups sampled, and any survey limitations.	✓	**Appendix 3**; Biota (2015b)
A survey report with assessment of SRE fauna found or reasonably expected to occur in the area, including any Specially Protected and other significant fauna, their known occurrence/habitats locally and their wider status if known, and an evaluation of the risk of the proposal to long term survival of the species and community.	✓	**Appendix 3**; Biota (2015b)

Checklist Item	Completed	PER reference
For proposals with the potential to impact on subterranean (stygofauna and troglofauna) fauna, the EIA document describes how potential impacts have been addressed in the context of EPA Guidance Statement No. 54 *Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia* (2003) and 54a, *Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia* (Draft 2007), including:		
Early initial desktop review to determine if the site has potentially suitable geology /substrate habitat that could support subterranean fauna, including advice from the WA Museum and the DEC/OEPA and a pilot study, if appropriate;	✓	**Appendix 3**; Biota (2015c,d)
A subterranean fauna survey report, if the site has a very high or high likelihood of supporting subterranean fauna, or a pilot study indicated that the site supports a significant subterranean fauna;	✓	**Appendix 3**; Biota (2015c,d)
Maps and text identifying and describing the survey sites/area, and the geology/ habitat supporting subterranean fauna, and extent of predicted impacts on the habitat (Note the survey area should extend beyond the predicted impact zone);	✓	further detail available **Appendix 3** Biota (2015c,d)
Describing the survey methodologies (see Guidance Statement No. 54a), including reference to timing, duration and survey effort used to sample each of the fauna groups sampled, species identification, and any survey limitations; and	✓	**Figure 66** to **Figure 76;** Sections **16.2** and **16.4;** further detail available **Appendix 3**; Biota (2015c,d)
A comprehensive list and assessment of subterranean fauna recorded or reasonably expected to occur in the area, including any Specially Protected and other significant fauna and their known occurrence/habitats locally and their wider status if known, and an evaluation of the risk of the proposal to long term survival of the species and community.	✓	Section 16.2, further detail available **Appendix 3**; Biota (2015c,d)

Appendix 6: Existing Ministerial Statement 914 environmental conditions and proposed environmental conditions for the Yandicoogina Iron Ore Project – Revised Proposal

Condition No.	Existing Condition	Proposed Condition	Reason for change
Proposal implementation			
1-1	When implementing the proposal, the proponent shall not exceed the authorised extent of the proposal as defined in Column 3 of Table 2 in Schedule 1, unless amendments to the proposal and the authorised extent of the Proposal has been approved under the EP Act.	When implementing the proposal, the proponent shall not exceed the authorised extent of the proposal as defined in Schedule 1, unless amendments to the proposal and the authorised extent of the Proposal **have** been approved under the EP Act.	Removal of Column 3 of Table 2. Update based on new Schedule 1
Contact details			
2-1	The proponent shall notify the CEO of any change of its name, physical address or postal address for the serving of notices or other correspondence within 28 days of such change. Where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State.	The proponent shall notify the CEO of any change of its name, physical address or postal address for the serving of notices or other correspondence within 28 days of such change. Where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State.	No Change
Time limit for proposal implementation			
3-1	The proponent shall not commence implementation of the proposal after the expiration of five years from the date of this statement, and any commencement, within this five year period, must be substantial.	**Remove**	Yandicoogina Operations is currently a brownfields site and substantially commenced operations in 1996. Consistent with other Brownfields operations contemporised Ministerial Statements (e.g. MS 1000).

3-2	Any commencement of implementation of the proposal, within five years from the date of this statement, must be demonstrated as substantial by providing the CEO with written evidence, on or before the expiration of five years from the date of this statement.		
Compliance reporting			
4-1	The proponent shall prepare and maintain a compliance assessment plan to the satisfaction of the CEO.	The proponent shall prepare and maintain a compliance assessment plan to the satisfaction of the CEO at least six (6) months prior to the first compliance assessment report required by condition 4-6. ~~**or prior to implementation, whichever is sooner.**~~	Condition contemporised between split of 4-1 and 4-2. The proposal is already implemented and hence the prior to implementation (of the proposal) is not possible.
4-2	The proponent shall submit to the CEO the compliance assessment plan required by condition 4-1 at least six months prior to the first compliance report required by condition 4-6, or prior to implementation, whichever is sooner. The compliance assessment plan shall indicate: (1) the frequency of compliance reporting; (2) the approach and timing of compliance assessments; (3) the retention of compliance assessments; (4) the method of reporting of potential non-compliances and corrective actions taken; (5) the table of contents of compliance assessment reports; and (6) public availability of compliance assessment reports.	The compliance assessment plan shall indicate: (1) the frequency of compliance reporting; (2) the approach and timing of compliance assessments; (3) the retention of compliance assessments; (4) the method of reporting of potential non-compliances and corrective actions taken; (5) the table of contents of compliance assessment reports; and (6) public availability of compliance assessment reports.	
4-3	The proponent shall assess compliance with conditions in accordance with the compliance assessment plan required by condition 4-1.	**After receiving notice in writing from the CEO that the compliance assessment plan satisfies the requirements of condition 4-2** the proponent shall assess compliance with conditions in accordance with the compliance assessment plan required by condition 4-1.	Condition contemporised to reflect more recent Ministerial Statements.
4-4	The proponent shall retain reports of all compliance assessments described in the	The proponent shall retain reports of all compliance assessments described in the	No Change

	compliance assessment plan required by condition 4-1 and shall make those reports available when requested by the CEO.	compliance assessment plan required by condition 4-1 and shall make those reports available when requested by the CEO.	
4-5	The proponent shall advise the CEO of any potential non-compliance within seven days of that non-compliance being known.	The proponent shall advise the CEO of any potential non-compliance within seven days of that non-compliance being known.	No Change
4-6	The proponent shall submit to the CEO a compliance assessment report by the end of April each year addressing compliance in the previous calendar year. The first compliance assessment report must be submitted by 30 April 2013 addressing compliance for the period from the date of issue of this statement, notwithstanding that the first reporting may be less than 12 months. The compliance assessment report shall: (1) be endorsed by the proponent's Managing Director / General Manager / Chief Executive Officer or a person delegated to sign on the Managing Director's / General Manager's / Chief Executive Officer's behalf; (2) include a statement as to whether the proponent has complied with the conditions; (3) identify all potential non-compliances and describe corrective and preventative actions taken; (4) be made publicly available in accordance with the approved compliance assessment plan; and (5) indicate any proposed changes to the compliance assessment plan required by condition 4-1.	The proponent shall submit to the CEO a compliance assessment report by the end of April each year addressing compliance in the previous calendar year. The compliance assessment report must address compliance for the period from the date of issue of this statement, notwithstanding that the first report may cover a period less or **more** than 12 months. The compliance assessment report shall: (1) be endorsed by the proponent's Managing Director / General Manager / Chief Executive Officer or a person delegated to sign on the Managing Director's / General Manager's / Chief Executive Officer's behalf; (2) include a statement as to whether the proponent has complied with the conditions; (3) identify all potential non-compliances and describe corrective and preventative actions taken; (4) be made publicly available in accordance with the approved compliance assessment plan; and (5) indicate any proposed changes to the compliance assessment plan required by condition 4-1.	Minor change if compliance assessment report covers 13 months if approval granted 1 month or less prior to compliance assessment reporting period.
Public availability of data			

5-1	Subject to condition 5-2, within six months of the issue of this statement and for the remainder of the life of the proposal the proponent shall make publicly available, in a manner approved by the CEO, all validated environmental data (including sampling design, sampling methodologies, empirical data and derived information products [e.g. maps]) relevant to the assessment of this proposal and implementation of this statement.	Subject to condition 5-2, within six months of the issue of this statement and for the remainder of the life of the proposal the proponent shall make publically available, in a manner approved by the CEO, all validated environmental data (including sampling design, sampling methodologies, empirical data and derived information products [e.g. maps]) relevant to the assessment of this proposal and implementation of this statement.	No Change
5-2	If any data referred to in condition 5-1 contains particulars of: (1) a secret formula or process; or (2) confidential commercially sensitive information The proponent may submit a request for approval from the CEO to not make this data publically available. In making such a request the Proponent shall provide the CEO with an explanation and reasons why the data should not be made publically available.	If any data referred to in condition 5-1 contains particulars of: (1) a secret formula or process; or (2) confidential commercially sensitive information The proponent may submit a request for approval from the CEO to not make this data publically available. In making such a request the Proponent shall provide the CEO with an explanation and reasons why the data should not be made publically available.	No Change
Surface water discharge (protection of Weeli Wolli Creek)			
6-1	The proponent shall ensure that the discharge of excess water from the Yandicoogina Iron Ore Project - Expansion to Include Junction South West and Oxbow Deposits as a result of mining does not cause long term impacts to environmental values of the Weeli Wolli Creek System.	The proponent shall ensure that the discharge of excess water from the Yandicoogina Iron Ore Project – **Revised Proposal** as a result of mining does not cause long term impacts to environmental values of the Weeli Wolli Creek system.	Change to reflect Revised Proposal name.
6-2	To verify that condition 6-1 is being met, the proponent shall develop an Environmental Values Statement for the Weeli Wolli Creek System that defines the environmental values of the Weeli Wolli Creek System to the satisfaction of the CEO in consultation with the DEC.	To verify that condition 6-1 is being met, the proponent shall **maintain** an Environmental Values Statement for the Weeli Wolli Creek system that defines the environmental values of the Weeli Wolli Creek system to the satisfaction of the CEO in consultation with **Parks and Wildlife**.	DEC changed to Parks and Wildlife.

6-3	The proponent shall ensure that dewatering discharge from the Yandicoogina Iron Ore Project - Expansion to Include Junction South West and Oxbow Deposits does not cause water flow or pooling further than 17 kilometres downstream from the Marillana Creek and Weeli Wolli Creek System Confluence.	The proponent shall ensure that dewatering discharge from the Yandicoogina Iron Ore Project – Revised Proposal does not cause water flow downstream from the Marillana Creek and Weeli Wolli Creek system Confluence further than the extent identified in Schedule 1 (under natural no flow conditions)	Contemporised condition in line with more recent Ministerial statements, with discharge extent included in proposed Schedule 1. Inclusion of ‘under natural no flow conditions’ to meet the intent of the condition and reflect the wording in Schedule 1. Removal of ‘pooling’ as localised natural pools can be created during rainfall events and can persist for extended periods due to variable basement geology.
6-4	The proponent shall ensure that any dewater discharged to the environment does not exceed whichever is greater of the following: (1) the default trigger for the protection of marine and freshwater ecosystems as per the Australian and New Zealand Environmental and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ (2000)) Australian Water Quality Guidelines for Fresh and Marine Waters and its updates; or (2) baseline levels identified pursuant to condition 6-6(3). (3) other criteria agreed by the CEO on the advice of the Department of Environment Regulation.	**Remove**	Condition contemporised to match more recent Ministerial Statements (e.g. MS 1000) and management under Part IV of the EP Act (by DER).
6-5	The proponent shall prepare a Water Discharge Monitoring and Management Plan.	**Remove**	Original condition is redundant as a Water Discharge Monitoring and Management Plan has been developed and implemented for the existing Yandicoogina Operations

6-6	The Water Discharge Monitoring and Management Plan required pursuant to condition 6-5 shall: (1) when implemented, require the proponent to monitor to substantiate whether condition 6-1, 6-3 and 6-4 are being met; (2) (when implemented, require the proponent to manage the implementation of the proposal to meet the requirements of condition 6-1, 6-3 and 6-4; (3) identify water quality baseline levels at the Western tenement boundary for the criteria measured under the Australian and New Zealand Environmental and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ (2000)) Australian Water Quality Guidelines for Fresh and Marine Waters and its updates; (4) require the proponent to monitor the hydrology, extent of discharges and ecology of the Weeli Wolli Creek System; (5) include provisions for remediating the Weeli Wolli Creek System to ensure that identified environmental values associated with the Weeli Wolli Creek System and any downstream ecosystems, including the Fortescue Marsh, are maintained.	**New Condition 6-4** **The proponent shall submit a revised** Water Discharge Monitoring and Management Plan **in consultation with the DoW, to the satisfaction of the CEO, to ensure that identified environmental values associated with the Weeli Wolli Creek system and any downstream ecosystems, including the Fortescue Marsh, are maintained. This plan shall:** **(1) describe the water discharge and monitoring program;** **(2) when implemented, demonstrate by monitoring, whether conditions 6-1 and 6-3 are being met;** **(3) when implemented, require the proponent to manage the implementation of the proposal to meet the requirements of conditions 6-1 and 6-3; and** **(4) detail management actions and strategies to be implemented should the monitoring required by condition 6-4 (2) indicate that condition 6-1 or 6-3 may not be met.**	Condition updated to reflect a revision of the existing approved and implemented Water Discharge Monitoring and Management Plan. Condition contemporised to match more recent Ministerial Statements.
6-7	Prior to commencing groundwater abstraction from or excavation below the water table at Junction South West A, Junction South West C and Oxbow and until advised otherwise by the CEO, the proponent shall implement the approved Water Discharge Monitoring and Management Plan.	**New Condition 6-5** The proponent shall implement the approved Water Discharge Monitoring and Management Plan **required by condition 6-4, and any subsequent approved revisions.**	Condition updated to reflect the updated Proposal and the existing approved and implemented Water Discharge Monitoring and Management Plan.

6-8	Commencing on the date of this statement and until it commences implementation of the approved Water Discharge Monitoring and Management Plan in accordance with condition 6-7, the proponent shall implement Section 1 Groundwater Management Plan and Section 2 Surface Water Management Plan of Part 3 - Management Plans of the *Yandicoogina Iron Ore Environmental Management Program (March 2011*).	**Remove**	Redundant as covered by the requirements of Condition 6-5.
6-9	The proponent shall annually submit the results of monitoring required by condition 6-6, in the compliance assessment report required by condition 4-6.	**Remove**	Redundant as covered by the requirements of Condition 4.
Riparian vegetation			
7-1	The proponent shall ensure that groundwater abstraction does not cause clearing or loss of vegetation or groundwater dependent ecosystems outside Zones 1, 2, 2a, 3, 3a, 4 and 5 as shown in Figure 1.	The proponent shall ensure that groundwater abstraction does not cause **long term impacts on the health or cover of riparian** vegetation or groundwater dependent ecosystems outside the **management** zones **as shown in Figure 80.**	Reference to clearing removed as condition relates to impacts of groundwater abstraction. Clearing of vegetation is managed under Schedule 1. Condition updated to reflect: • objectives in relation to riparian vegetation; • contemporised conditions. • the impacts recognised in the original MS914 approval (Report 1448) • impacts predicted to riparian vegetation (particularly artificially augmented vegetation); and • abundance changed to cover – to more accurately reflect measurable tree health monitoring parameters; and • new impact management zones.

7-2	The proponent shall ensure that dewatering discharge does not cause clearing or loss of vegetation or groundwater dependent ecosystems outside Zones 1, 2, 2a, 3, 3a, 4 and 5.	The proponent shall ensure that **surplus** water discharge does not cause **long term impacts on the health or cover of riparian** vegetation or groundwater dependent ecosystems outside the **management** zones **as shown in Figure 80**.	Reference to clearing removed as condition relates to impacts of surplus water discharge. Dewatering discharge changed to surplus water discharge as dewatering is a generic term covering both abstraction and discharge. Clearing of vegetation is managed under Schedule 1. Condition updated to reflect: • objectives in relation to riparian vegetation; • contemporised conditions; • the impacts recognised in the original MS914 approval (Report 1448); • impacts predicted to riparian vegetation (particularly artificially augmented vegetation); • abundance changed to cover – to more accurately reflect measurable tree health monitoring parameters; and • new impact management zones.
7-3	The proponent shall manage the proposal in a manner that ensures there is no irreversible impact to riparian vegetation or groundwater dependent ecosystems within Zones 1, 2, 2a, 3, 3a, 4 and 5.	The proponent shall manage the proposal in a manner that ensures there is no irreversible impact to riparian vegetation or groundwater dependent ecosystems **across the catchment as measured** within the **management** zones **as shown in Figure 80.**	Condition updated to reflect predicted localised impacts to riparian vegetation *within* the management zones, but no irreversible impact to the local catchment functioning (*across* the management zones).
7-4	The proponent shall prepare a Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan.	The proponent shall **submit a revised** Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan to the satisfaction of the CEO.	Revision only: the current Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan for Yandicoogina Operation has been approved and implemented.
7-5	The Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan required pursuant to condition 7-4 shall: (1) when implemented, require the proponent to manage the implementation of the proposal to meet the requirements of conditions 7-1, 7-2, and 7-3; (2) when implemented, require the proposal to monitor to substantiate whether conditions 7-	The Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan required pursuant to condition 7-4 shall: (1) when implemented, require the proponent to manage the implementation of the proposal to meet the requirements of conditions 7-1, 7-2, and 7-3; (2) when implemented, require the	Condition contemporised to match more recent Ministerial Statements. Clause (3) – (5) covered by conditions 7-1, 7-2, 7-3 and Condition 6. As per comments in Condition 7-1 & 7-2

1, 7-2 and 7-3 are being met;

(3) require the proponent to minimise impact to riparian Vegetation and Groundwater dependent ecosystems from groundwater abstraction and dewatering discharge;

(4) require the proponent to maintain the abundance, diversity, geographical distribution and productivity of vegetation communities through the avoidance or management of adverse impacts and improvement in knowledge;

(5) require the proponent to maintain the flow paths, quantity and quality of water within Marillana, Yandicoogina and Weeli Wolli Creeks and the underlying aquifers to protect the surface water and groundwater dependent ecological systems;

(6) identify potential impact monitoring and control sites between the Oxbow pit and the Fortescue Marsh;

(7) require the proponent to design a survey to acquire baseline biotic data, including health and abundance parameters and environmental data;

(8) define health and abundance parameters;

(9) define monitoring frequency and timing;

(10) identify criteria to measure any decline in health;

(11) define critical correlative environmental parameters, including groundwater drawdown;

(12) define trigger levels for no impact;

(13) define trigger levels for no irreversible impact;

(14) provide details of management actions and strategies to be implemented should trigger levels defined pursuant to condition 7 -5(12) be exceeded outside Zones 1, 2, 2a, 3, 3a, 4 and 5; and

(15) provide details of management actions and strategies to be implemented should trigger

proposal to monitor to substantiate whether conditions 7-1, 7-2 and 7-3 are being met;

(3) identify monitoring sites;

(4) require the proponent to design a survey to acquire baseline biotic data, including health and abundance parameters and environmental data;

(5) define health and cover parameters;

(6) define monitoring frequency and timing;

(7) identify criteria to measure any decline in health;

(8) define critical correlative environmental parameters, including groundwater drawdown;

(9) define trigger **and threshold** levels for ‘no irreversible impact’;

(10) provide details of management actions and strategies to be implemented should trigger **and threshold** levels defined pursuant to condition 7-5(9) be exceeded within the management zones.

	levels defined pursuant to condition 7-5(13) be exceeded within Zones 1, 2, 2a, 3, 3a, 4 or 5.		
7-6	Prior to commencing groundwater abstraction from or excavation below the water table at Junction South West A, Junction South West C and Oxbow and until advised otherwise by the CEO, the proponent shall implement the approved Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan.	The proponent shall implement the approved Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan.	Condition revised to reflect that an existing approved and implemented Groundwater Dependent Ecosystems Monitoring and Management Plan exists for the Yandicoogina Operations and that Yandicoogina Operations already implements dewatering activities.
7-7	The proponent shall review and revise the approved Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan at intervals not exceeding five years, to the approval of the CEO.	The proponent shall review and revise the approved Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan at intervals not exceeding five years, to the approval of the CEO.	No Change
7-8	Commencing on the date of this statement and until it commences implementation of the approved Vegetation and Groundwater. Dependent Ecosystems Monitoring and Management Plan in accordance with condition 7-6, the proponent shall implement Section 6 Riparian vegetation management Plan Part 3 - Management Plans of the Yandicoogina Iron Ore Environmental Management Program (March 2011).	Commencing on the date of this statement and until it commences implementation of the **revised** Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan in accordance with condition 7-6, the proponent shall **continue to** implement **the existing approved Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan.**	Condition revised to reflect that an existing approved and implemented Groundwater Dependent Ecosystems Monitoring and Management Plan exists for the Yandicoogina Operations and that Yandicoogina Operations already implements dewatering activities.
7-9	In the event that monitoring, undertaken pursuant to condition 7-6, identifies that trigger levels for no impact, defined pursuant to condition 7-5(12), have been or are being exceeded outside Zones 1, 2, 2a, 3, 3a, 4 and 5, the proponent shall implement management actions and strategies defined in condition 7-5(14) to the satisfaction of the CEO.	In the event that monitoring, undertaken pursuant to condition 7-6, identifies that trigger **and threshold** levels for no **irreversible impact,** defined pursuant to condition 7-5**(9)**, have been or are being exceeded **within the management** zones, the proponent shall implement management actions and strategies defined in condition 7-5**(10)** to the satisfaction of the CEO.	Condition is not feasible to measure outside of the management zones as monitoring extends only to the limit of conservative predicted impact extents. Impacts to riparian vegetation have been predicted in the original MS914 approval and the current approval. Intent of the condition is that there are no irreversible impacts.

7-10	In the event that monitoring, undertaken pursuant to condition 7-6, identifies that trigger levels for no irreversible impact, defined pursuant to condition 7-5(13), have been or are being exceeded within Zones 1, 2, 2a, 3, 3a, 4 or 5, the proponent shall implement management actions and strategies defined in condition 7-5(15) to the satisfaction of the CEO.	Remove	Captured in proposed Condition 7-9.
Weeds			
8-1	The proponent shall ensure: (1) no increase in the species of weeds (including both declared weeds and environmental weeds) in the Proposal Area as a result of the implementation of the proposal; (2) the cover of weeds (including both declared weeds and environmental weeds) within the Proposal Area does not exceed that on comparable, nearby land, determined by the CEO which has not been disturbed during implementation of the proposal; and (3) reference sites on nearby land are to be chosen in consultation with the OEPA, on advice from Parks and Wildlife and established within the Proposal Area and outside the impact area to the satisfaction of the CEO. The reference sites are to be monitored biennially to determine whether changes in weed cover and type are as a result of proposal implementation or broader regional changes.	The proponent shall ensure: (1) no increase in the species of weeds (including both declared weeds and environmental weeds) in the Proposal Area as a result of the implementation of the proposal; (2) the cover of weeds (including both declared weeds and environmental weeds) within the Proposal Area does **not increase as a result of** implementation of the proposal; and (3) **identification and establishment of** reference sites on nearby land **outside the impact area shall be undertaken** in consultation with the OEPA, on advice from Parks and Wildlife ~~and established within the Proposal Area and outside the impact area~~ to the satisfaction of the CEO. The reference sites are to be monitored biennially to determine whether changes in weed cover and type are as a result of proposal implementation or broader regional changes.	Condition revised to reflect the current weed baseline knowledge.
Decommissioning and rehabilitation			
9-1	Within 12 months following commissioning of the Junction South West or Oxbow pits, whichever is first, the proponent shall prepare and implement a Yandicoogina Decommissioning and Rehabilitation	**The proponent shall ensure that the proposal is decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed outcomes**	Condition contemporised to match more recent Ministerial Statements (e.g. MS 1000)

	Plan in accordance with the *Guidelines for Preparing Mine Closure Plans, June 2011* and any updates to the requirements of the CEO on advice of the Department of Mines and Petroleum.	**and land uses, and without unacceptable liability to the State of Western Australia, through the implementation of the Mine Closure Plan required by condition 9-2.**	
9-2	The Yandicoogina Decommissioning and Rehabilitation Plan required pursuant to condition 9-1 shall ensure that closure planning and rehabilitation are carried out in a coordinated, progressive manner and are integrated with development planning, consistent with current best practice, and the agreed land uses.	**The proponent shall prepare the Yandicoogina Mine Closure Plan in accordance with the *Guidelines for Preparing Mine Closure Plans*, *June 2015* and any updates, to the requirements of the CEO on advice of the Department of Mines and Petroleum.**	Condition contemporised to match more recent Ministerial Statements (e.g. MS 1000)
9-3	The Yandicoogina Decommissioning and Rehabilitation Plan required pursuant to condition 9-1 shall set out procedures to: (1) manage long term hydrogeological impacts of mining the channel iron deposit; (2) model the long term hydrological impacts, particularly the water levels and quality both in the pit void and downstream of waste material landforms; (3) manage over the long term the surface water systems affected by the open pit; (4) progressively rehabilitate all disturbed areas to a standard suitable for the agreed end land use(s), with consideration and incorporation of: (a) the characteristics of the pre-mining ecosystems within the Project area (through research and baseline surveys); (b) the performance of previously rehabilitated areas within the mining lease; (c) the performance of rehabilitation areas at the proponent's other operations in the Pilbara; and (d) best practice rehabilitation techniques used elsewhere in the mining industry. (5) develop and identify completion criteria; (6) monitor rehabilitation to assess the performance of all rehabilitated areas against the completion criteria;	The proponent shall review and revise the Yandicoogina Mine Closure Plan required by condition 9-**2** at intervals not exceeding three years**, or as otherwise specified by the CEO.**	Condition modifies 9-4 and contemporised to match more recent Ministerial Statements (eg. MS 1000)

	(7) report on the rehabilitation and monitoring results; (8) remove all infrastructure; (9) develop management strategies and/or contingency measures in the event that operational experience and/or monitoring identify any significant environmental impact as a result of the proposal; (10) manage and monitor mineral waste including physical characteristics and acid or neutral metalliferous drainage using national and international standards and updates; and (11) develop a 'walk away' solution for the decommissioned mine site.		
9-4	The proponent shall review and revise the Yandicoogina Decommissioning and Rehabilitation Plan required by condition 9-1 at intervals not exceeding three years.	**The proponent shall implement the latest revision of the Yandicoogina Mine Closure Plan, which the CEO has confirmed by notice in writing, satisfies the requirements of condition 9-2.**	Condition contemporised to match more recent Ministerial Statements (eg. MS 1000)
9-5	The proponent shall make revisions of the Yandicoogina Decommissioning and Rehabilitation Plan required by condition 9-1 publicly available.	**Remove**	Addressed by Condition 4 and 5.
Residual impact and risk management measures			
10-1	In view of the significant residual impacts and risks (permanent and temporary) to native vegetation including riparian vegetation as a result of the implementation of the proposal, the proponent shall contribute three million dollars ($AUD) to a strategic regional conservation initiative for the Pilbara as determined by the Minister for Environment on advice of the Environmental Protection Authority and the DEC.	**The 5,600 ha of clearing of native vegetation previously approved under Ministerial Statement 914 is exempt from the requirement to offset under condition 10-3.**	The previous approval under MS914 was subject to an upfront contribution of $AUD 3 Million to a strategic regional conservation initiative as agreed by the CEO.
10-2	The contribution shall be paid in full by 31 December 2013, unless otherwise agreed by the CEO.	**Remove**	

10-3	**<u>New Condition 10-2</u>** **In view of the significant residual impacts and risks as a result of implementation of the additional clearing for the Yandi PBS Proposal, the proponent shall contribute funds to offset the clearing of 'Good to Excellent' condition native vegetation, and calculated pursuant to condition 10-3. This funding shall be provided to a government-established conservation offset fund or an alternative offset arrangement providing an equivalent outcome as determined by the Minister.**	Condition contemporised to match more recent Ministerial Statements (e.g. MS 1000)
10-4	**<u>New Condition 10-3</u>** **The proponent's contribution to the initiative identified in condition 10-3 shall be paid biennially, the first payment due two years after commencement of the additional ground disturbance defined in Schedule 1. The amount of funding will be $1,500 AUD (excluding GST) per hectare of 'Good to Excellent' condition native vegetation and $3,000 AUD (excluding GST) per hectare of riparian zone vegetation cleared within the Development Envelope (delineated in Figure 1 and defined by the geographic coordinates in Schedule 2), within the Hamersley IBRA subregion.**	Condition contemporised to match more recent Ministerial Statements (e.g. MS 1000)