

Rio Tinto Iron Ore

Yandicoogina Environmental Management Plan

- Water Discharge Monitoring and Management
- Vegetation and Groundwater Dependent Ecosystems Monitoring and Management

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1 Introduction

This Environmental Management Plan (EMP) describes the management of riparian and groundwater dependent ecosystems as part of Rio Tinto's Yandicoogina iron ore mining operations. The scope of the EMP is to address the requirements of conditions 6 and 7 of Statement 914 pursuant to the provisions of the *Environmental Protection Act 1986* (EP Act).

The EMP specifically addresses:

- water discharge, monitoring and management associated with the disposal of surplus water from mine pit dewatering into Marillana Creek and Weeli Wolli Creek; pursuant to condition 6-5.
- vegetation and groundwater dependent ecosystems monitoring and management associated with Marillana Creek and Weeli Wolli Creek; pursuant to condition 7-4.

In accordance with conditions 6-7 and 7-6, the EMP shall be implemented 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 of the Environmental Protection Authority (EPA).

The EMP is consistent with Rio Tinto's internal standards and Pilbara Surface Water Management Strategy, and also complies with other State and Commonwealth environmental approvals commitments, licences and reporting requirements.

This EMP forms a subset of the overall Environment Management Program for Rio Tinto's Yandicoogina iron ore mines, and is designed to be implemented within the overarching management framework of this wider program. This EMP is applicable to the life-of-mine phase of Rio Tinto's Yandicoogina operations. A separate closure plan will address environmental management relating to mine decommissioning and closure.

2 Background

2.1 Yandicoogina project overview

Rio Tinto's Yandicoogina project site is located in the central Pilbara region of Western Australia, approximately 90 km north-west of Newman and 300 km south-east of Dampier. Mineralisation occurs in an extensive Channel Iron Deposit (CID) located along a palaeochannel adjacent to, and in some areas intersecting, the downstream reaches of Marillana Creek. The ore resource is predominantly below the watertable (BWT).

The Yandicoogina deposits currently targeted by Rio Tinto include:

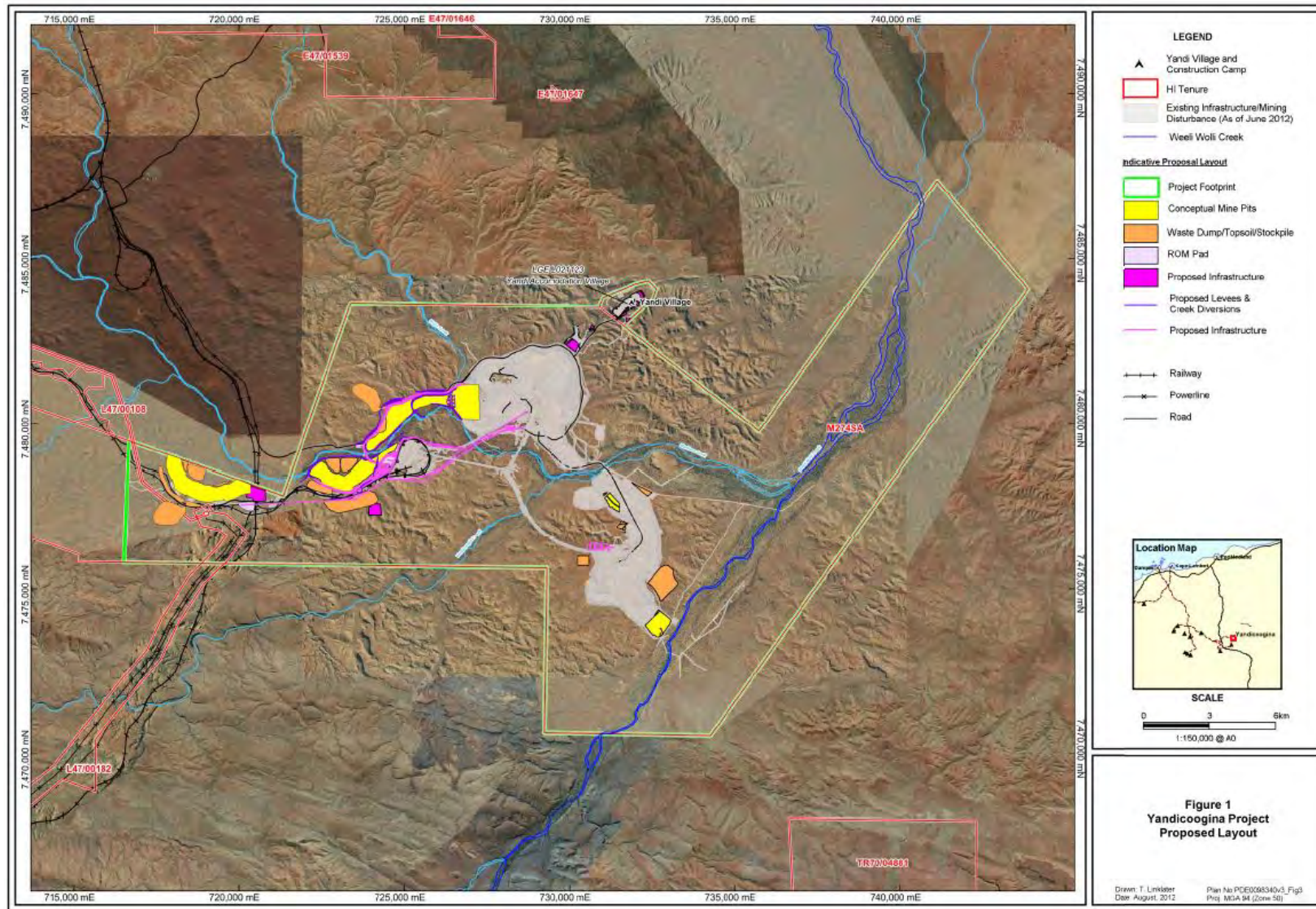
- Junction Central (JC)
- Junction South East (JSE)
- Junction South West (JSW)
- Oxbow.

The spatial configuration of these deposits within the context of the current mining operations is shown in Figure 1. The entire mining operation is contained within ML274SA established under the *Iron Ore (Yandicoogina) Agreement Act 1996*.

Mining activities at JC and JSE commenced in 1998 and 2006, respectively. Mining at JSW and Oxbow is scheduled to commence in Q2 2013. The integrated Yandicoogina operations include the following major components:

- open cut iron ore mines at JC and JSE (active), and JSW and Oxbow (scheduled)
- a dewatering system to lower the water table so that the ore reserves can be mined.
- a water management system including on-site reuse of abstracted groundwater and discharge of surplus volumes into local creek systems using a series of discharge outlets along Marillana Creek
- temporary out-of-pit waste dumps and in-pit waste backfilling of mined areas.
- topsoil and subsoil stockpiles for mine site rehabilitation
- roads including light vehicle / heavy vehicle access and haul roads, and several floodways across Marillana Creek
- flood protection bunding within Marillana Creek, and minor stream diversion away from the pits and into Marillana Creek
- infrastructure associated with drilling/blasting, loading and haulage/conveying ore to processing facilities at JC and JSE, and rail load out facilities south-east of JSW
- power and communications infrastructure
- other minor supporting infrastructure such as administration buildings, maintenance workshop(s) and associated utilities and services.

Figure 1 Overview of Rio Tinto's Yandicoogina mining operations



2.2 Environmental approvals

Rio Tinto has progressively obtained approvals under the *Environmental Protection Act 1986* (EP Act) for mining of the different Yandicoogina deposits, summarised as follows:

- mining at JC received approval from the Minister for the Environment on 25 May, 1996 (Statement 417), with subsequent project modifications approved on 1 October, 1999 (Statement 523)
- mining at JSE received approval from the Minister for the Environment on 22 October, 2005 (Statement 695).
- mining at JSW and Oxbow received approval from the Minister for the Environment on 18 October, 2012 (Statement 914).

The implementation conditions of Statement 914 superseded those of Statements 417, 523 and 695, in accordance with section 45B of the EP Act. As a consequence, Statement 914 currently provides a regulatory framework for environmental management across the entire Yandicoogina operations (Appendix 1).

2.3 Environmental values statement

Condition 6-2 of Statement 914 mandated that Rio Tinto develop an Environmental Values Statement (EVS) for the Weeli Wolli Creek System, defining the environmental values of the Weeli Wolli Creek System, to the satisfaction of the CEO of the Office of the Environmental Protection Authority (OEPA) in consultation with the Department of Environment and Conservation (DEC).

The EVS was approved by the CEO on 14 September 2012. The EVS is provided in Appendix 2. The values of the Weeli Wolli Creek System in areas with the potential to be impacted by Rio Tinto's Yandicoogina iron ore mining operations are summarised as follows:

- Value 1 – Hydrology – the project area includes major creek systems that ultimately drain into the Fortescue Marsh Priority Ecological Community (PEC).
- Value 2 – Flora and Vegetation – the project area includes individuals of DRF (Declared Rare Flora) *Lepidium catapycnon* and a riparian vegetation community of elevated conservation significance.
- Value 3 – Fauna – the project area contains a number of stygofauna species known only from the Marillana-Weeli Wolli Catchment. Riparian habitat provides a conduit for the movement of microbats and other fauna. In the wider catchment, the Weeli Wolli Spring (upstream from the Project area) is known to support a significant microbat species assemblage.
- Value 4 – Heritage and Social – the local creek systems have cultural and spiritual significance for traditional owners.

2.4 Conditions for surface water discharge

Statement 914 condition 6 addresses management provisions relating to surface water discharge to local creek systems. The elements of condition 6 are described in Table 1.

The overarching purpose of condition 6 is to ensure the environmental values of the creek systems are protected, and discharges are managed to constrain the extent of surface water expression in downstream areas. This includes ensuring that any dewater discharged to the environment does not exceed the Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC/ARMCANZ 2000) or baseline water quality levels.

Table 1 Conditions for surface water discharge monitoring and management

Condition Ref.	Description
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.
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.
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.
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)) <i>Australian Water Quality Guidelines for Fresh and Marine Waters</i> and its updates; or (2) baseline levels identified pursuant to condition 6-6(3).
6-5	The proponent shall prepare a Water Discharge Monitoring and Management Plan.
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 conditions 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 conditions 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)) <i>Australian Water Quality Guidelines for Fresh and Marine Waters</i> and its updates;

Condition Ref.	Description
	<p>(4) require the proponent to monitor the hydrology, extent of discharges and ecology of the Weeli Wolli Creek System;</p> <p>(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.</p>
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.
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 <i>Yandicoogina iron Ore Environmental Management Program (March 2011)</i> .
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.

2.5 Conditions for riparian vegetation protection

Statement 914 condition 7 addresses management provisions relating to riparian vegetation and groundwater dependent ecosystems. The elements of condition 7 are described in Table 2.

The overarching purpose of condition 7 is to ensure the loss of riparian vegetation outside of the approved clearing footprint is minimised, and that management and mitigation occurs to ensure that areas affected by dewatering and discharge can recover (if impacted).

Table 2 Conditions for riparian vegetation monitoring and management

Condition Ref.	Description
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.
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.
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.
7-4	The proponent shall prepare a Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan.

Condition Ref.	Description
7-5	<p>The Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan required pursuant to condition 7-4 shall:</p> <p>(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;</p> <p>(2) when implemented, require the proposal to monitor to substantiate whether conditions 7-1, 7-2 and 7-3 are being met;</p> <p>(3) require the proponent to minimise impact to riparian vegetation and groundwater dependent ecosystems from groundwater abstraction and dewatering discharge;</p> <p>(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;</p> <p>(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;</p> <p>(6) identify potential impact monitoring and control sites between the Oxbow pit and the Fortescue Marsh;</p> <p>(7) require the proponent to design a survey to acquire baseline biotic data, including health and abundance parameters and environmental data;</p> <p>(8) define health and abundance parameters;</p> <p>(9) define monitoring frequency and timing;</p> <p>(10) identify criteria to measure any decline in health;</p> <p>(11) define critical correlative environmental parameters, including groundwater drawdown;</p> <p>(12) define trigger levels for no impact;</p> <p>(13) define trigger levels for no irreversible impact;</p> <p>(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</p> <p>(15) provide details of management actions and strategies to be implemented should trigger levels defined pursuant to condition 7-5(13) be exceeded within Zones 1, 2, 2a, 3, 3a, 4 or 5.</p>
7-6	<p>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.</p>
7-7	<p>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.</p>
7-8	<p>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 <i>Yandicoogina Iron Ore Environmental Management Program (March 2011)</i>.</p>

Condition Ref.	Description
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.
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.

2.6 Riparian management zones

Rio Tinto has identified five riparian management zones where indirect impacts on environmental values may occur as a result of dewatering and discharge activities (Table 3). Dewatering causes groundwater drawdown in a zone extending out from the points of abstraction. Discharge causes groundwater mounding and/or prolonged waterlogged conditions in all or part of the soil profile within affected parts of the riparian zone. Both these processes are associated with active mining operations and will cease following the cessation of mining. Discharge volumes are influenced by water supply demands (on-site or external) and could be reduced or eliminated during the life-of-mine if additional demand requirements eventuate.

Hydrogeological models have been used to predict the extent of drawdown. Hydrological models have been used to predict the extent of surface water expression (from discharge) in riparian systems adjacent to and downstream from the various Yandicoogina mining areas. The respective modelling outputs were used to define the management zone boundaries.

Riparian vegetation can potentially access water from two sources:

1. Stored soil water in the unsaturated profile, derived from surface inputs (rainfall and flooding)
2. Groundwater associated with local aquifer systems, and the capillary fringe above the watertable.

Drawdown has the potential to cause declines in the health and composition of riparian vegetation, or loss of riparian vegetation, by reducing the availability of water from source (2). Discharge has the potential to cause declines in the health and composition of riparian vegetation, or loss of riparian vegetation, by reducing the availability of water from source (1). This is due to the inability of many plant species to maintain functioning root systems in saturated soil. Different species vary in their tolerance to the extent (i.e. partial or complete root system exposure) and duration of waterlogged soil conditions.

Both drawdown and discharge processes may favour some plant species over others, depending on their functional water use strategies, resulting in structural vegetation changes. Possible changes could include:

- Decreased water availability:
 - health decline and isolated deaths of overstorey Eucalypts and *Melaleuca argentea*. *Eucalyptus victrix* may be favoured due to a lowered level of dependence on water from source (2) in comparison with *E. camaldulensis* and *M. argentea*.
 - changed species recruitment patterns beyond natural range of variation.
- Increased water availability/soil saturation:
 - increase in cover/abundance of *Eucalyptus* and *Melaleuca* saplings
 - increase in cover/abundance of waterlogging tolerant species such as *Typha* sp beyond natural range of variation.
 - increase in cover/abundance of some aquatic macrophytes beyond natural range of variation.
 - isolated death of overstorey Eucalypts (especially *E. victrix* which is considered the least water-logging tolerant of the three tree species). Tree deaths are expected to be restricted to substrates that are fully saturated for prolonged periods.

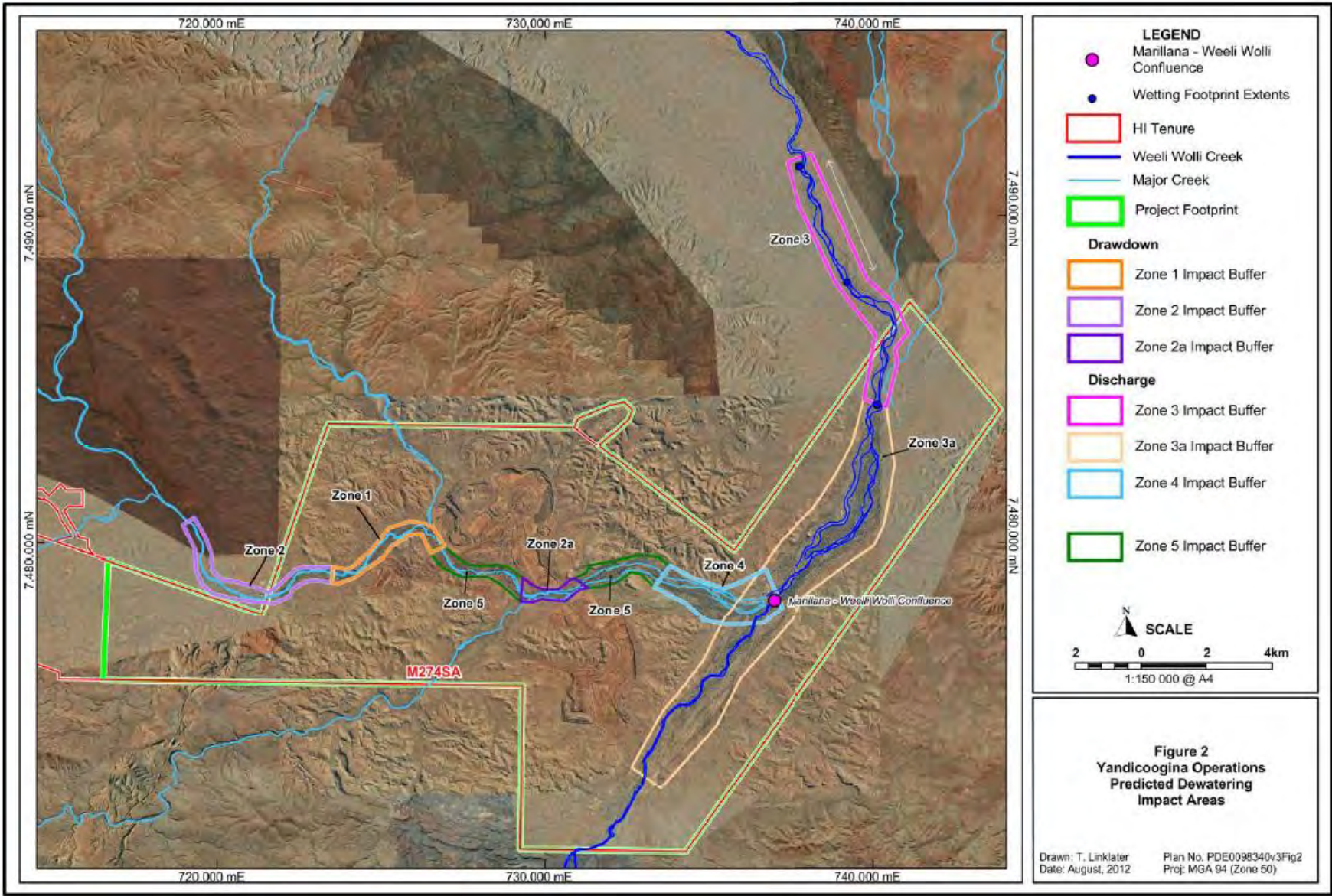
By affecting habitat (surface or subsurface) drawdown and discharge processes could also affect aquatic and subterranean fauna assemblages. Discharge has the potential to cause erosion and sedimentation in downstream creek systems.

Table 3 Riparian management zones defined for Rio Tinto's Yandicoogina mining operation

Management Zone	Area (ha)	Potential impact process	Description
Zone 1	110	Drawdown	<ul style="list-style-type: none"> • The primary zone of drawdown - associated with close proximity to abstraction bores. The magnitude and duration of drawdown will be most pronounced in this zone. • Located where the Marillana creekline (part of the alluvial aquifer) intersects the underlying CID aquifer (which is also the CID orebody). • Natural leakage occurs from the Marillana creekline into the underlying CID aquifer. Drawdown is predicted to increase leakage rates, resulting in shorter incidence of surface water ponding. • Drawdown may reduce the availability of water for riparian vegetation, with the potential to cause structural vegetation changes or vegetation loss. The impact of drawdown on vegetation will be influenced by the reliance of the vegetation on direct access to the watertable (and associated capillary fringe). • This area has been historically influenced by discharge from existing (upstream) BHP Billiton Iron Ore (BHPBIO) Yandi operations.
Zone 2	190	Drawdown	<ul style="list-style-type: none"> • Areas of predicted drawdown more distant than Zone 1, with only partial connection between the Marillana creekline and CID aquifer. • Incorporates the modelled extent of drawdown (worst-case) beyond natural watertable fluctuations and where some overlapping sections of the CID and alluvial aquifer occur. • In comparison with Zone 1, the magnitude and duration of drawdown is predicted to be less. • Impacts on riparian vegetation from drawdown are predicted to be less pronounced than in Zone 1. • This area has been historically influenced by dewatering from existing (upstream) BHPBIO Yandi operations.
Zone 2a	65	Drawdown	<ul style="list-style-type: none"> • Located between the JC and JSE mining areas, including an area where the Marillana creekline intersects the underlying CID aquifer. • Drawdown will be caused by the JSE abstraction borefield. • In comparison with Zone 1, the magnitude and duration of drawdown is predicted to be less.

Management Zone	Area (ha)	Potential impact process	Description
Zone 3	160	Discharge	<ul style="list-style-type: none"> • Located in Weeli Wolli Creek downstream from the Marillana Creek confluence. • Area approximating the creek section predicted to be exposed to increased discharge associated with mining at JSW and Oxbow (i.e. over and above the existing predicted cumulative modelled wetting extent associated with existing operations at BHPBIO Yandi, Hope Downs 1 and RTIO Yandicoogina). • Channel vegetation will be exposed to increased frequency of saturated soil profiles.
Zone 3a	1140	Discharge	<ul style="list-style-type: none"> • Located in Weeli Wolli Creek from near JSE to the southern boundary of Zone 3. • Area approximating the creek section historically influenced by discharge from existing operations at Hope Downs 1 and Yandicoogina (BHPBIO and RTIO).
Zone 4	190	Discharge	<ul style="list-style-type: none"> • Located in the lower reach of the Marillana Creek downstream from the mine pits. • Channel vegetation will be exposed to increased frequency of saturated soil profiles.
Zone 5	210	Reduced discharge	<ul style="list-style-type: none"> • Located in areas between JSW, JC and JSE separating other Zones. • These areas will experience reduced discharge associated with the scheduled relocation of discharge outlets (D05 & D08) from 2012. • Vegetation density/foliar cover supported by historical discharge regimes is expected to decline in association with reduced water availability.

Figure 2 Yandicoogina riparian management zones



3 Responsibilities

Accountabilities for the implementation and review of this EMP are as follows:

- General Manager Operations (GMO) – responsible for overall environmental performance and implementation of the EMP.
- Superintendent Environment (SE) – East Pilbara – responsible for achieving consistency in the development and implementation of company EMPs across the Yandicoogina and, where applicable, Hope Downs 1 operations.
- Site Environmental Advisor (SEA) - responsible for day to day verification that the environmental performance of the site complies with the intent of the EMP.
- Monitoring Officer (MO) - responsible for day to day environmental monitoring and recording.
- Hydro Technical Officer (HTO) - responsible for day to day hydrogeological monitoring and recording.
- Heritage Officer (HO) – responsible for implementing the Heritage Management Plan
- During construction and upgrades, the environmental accountabilities will include a Project Manager responsible for environmental performance and implementation of the EMP for the duration of the construction/upgrade. A separate Construction EMP may be developed where necessary, and if so will be consistent with this EMP.
- Accountabilities for specific management actions are specified in Table 4 (surface water management) and Table 8 (vegetation and GDE management).

4 Review and improvement of environmental outcomes

4.1 Document review

This EMP will be reviewed as required throughout the duration of the Yandicoogina Project at intervals not exceeding 5 years to the approval of the CEO of the EPA. Upon review, the document will be revised and re-issued where appropriate. In addition, continued review and revision of the plan will occur in response to environmental incident resolutions, audit findings, monitoring results, continuous improvement and changes in regulatory and corporate requirements.

The OEPA, DEC and Department of Water (DoW) will be advised of any minor changes to the plan and provided with the revised document if necessary. Major changes will be developed in consultation with the DEC.

4.2 Compliance Reporting

Compliance reporting is required to help determine environmental performance and compliance with the conditions. Regular reports are to be submitted in accordance with a compliance assessment plan, prepared to the satisfaction of the CEO as per condition 4 of Statement 914.

The project compliance assessment plan addresses:

- the frequency of compliance reporting;
- the approach and timing of compliance assessments;
- the retention of compliance assessments;
- the method of reporting potential non-compliance and corrective actions taken;
- the table of contents of compliance assessment reports; and
- public availability of compliance assessment reports.

5 Reporting

5.1 Internal reporting

Through the Rio Tinto Business Solution¹ (RTBS), reported environmental incidents, including near hit/miss events, are classified according to their actual consequence and their maximum reasonable outcome. Regardless of the classification of the environmental incident, all undergo some form of investigation to determine the causal factor/s and/or root cause/s. The investigations are undertaken by suitably qualified personnel.

Once the investigation is complete, actions to correct the identified causal factor/s and/or root cause are implemented as appropriate. These actions are assigned to accountable personnel with specified completion dates. A separate person is then responsible for checking the action to ensure it has been completed.

Progress of all reported environmental incidents and corrective actions are tracked to completion using RTBS.

5.2 External reporting

Monitoring results are assessed against criteria stipulated in the site's operating licence, which is regulated by the DEC. These monitoring results are reported annually to relevant regulatory authorities in accordance with licence conditions.

Rio Tinto will submit to the CEO of the EPA a compliance assessment report by 30 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 Statement 914, notwithstanding that the first reporting may be less than 12 months.

¹ RTBS provides a company-wide standard for information and technology management.

The compliance assessment report shall:

- 1) be endorsed by the 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 of Statement 914.

By 18 April 2013 (i.e. within six months of the issue of Statement 914) and for the remainder of the life of the proposal Rio Tinto will 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 implementation of Statement 914.

6 Water discharge monitoring and management

6.1 Description

The Yandicoogina mines are located in the lower portion of the Marillana Creek catchment, which extends west from Yandicoogina to within about 20 km of the Great Northern Highway. The total catchment area is 2,230 km².

Marillana Creek is the dominant drainage feature in the project area. It enters from the west near the Oxbow deposit and drains in a predominantly easterly direction into Weeli Wolli Creek, downstream of the Yandicoogina mining areas. Two significant tributaries, Phil's Creek and Yandicoogina Creek, enter Marillana Creek near the western and southern edges of the JC mining area respectively (Figure 3). Weeli Wolli Creek ultimately discharges into the Fortescue Marshes, located approximately 40 km further north from the Marillana Creek confluence.

Marillana Creek is estimated to contribute approximately 50% of the flow into the Fortescue Marshes from the overall Weeli Wolli Creek system (RTIO 2008 & 2010). Large flows in Marillana Creek are correlated with rain bearing depressions or high intensity cyclonic events, which bring heavy rain over a large area of the catchment. Peak flow generally occurs within 24 hours; however flow recession is such that minor stream flow can continue for days after the peak has passed. Retention basins in the upper catchment, such as the Munjina Claypan, can sustain flows into the dry season in some years by reducing peak discharges associated with lower rainfall events (up to 1 in 10 year ARI²) and delaying the time to the peak of runoff. In the lower catchment major flow events can cause transient water table rises in the alluvium of up to 10 m. The lateral extent of these flows defines a greater creekline floodplain, within which preferred pathways transmit smaller flow events. In the Project area within ML274SA the floodplain is well defined at its boundaries and ranges from 200 m to 400 m in width. Estimated natural peak flow volumes near Oxbow, at the western edge of the Project area within ML274SA, are 70 m³/s for a two year ARI event and greater than 2,000 m³/s for a 100 year ARI flood (Rio Tinto 2011).

Creekline flow regimes are complicated by historical and current water disposal activities associated with mining within the wider locality. Marillana Creek has received discharges from mine pit dewatering associated with the JC mine and upstream BHPBIO operation since the mid 1990's. The Weeli Wolli Creek upstream from Yandicoogina has received discharge from the Hope Downs 1 operation since 2007. The current network of discharge outlets in the Project area within ML274SA includes some direct discharge into Weeli Wolli Creek. In combination these discharges have contributed to changes in the composition of creek vegetation along sections of the Marillana and Weeli Wolli creeks. In particular, increased water availability has contributed to increased recruitment of riparian plant species downstream of the discharge areas.

² Average recurrence interval

6.2 Environmental aspects to be managed

Mining and associated activities at Yandicoogina have the potential to affect the flow paths, quantity and quality of water within the major creeklines through:

- discharge of the mine pit dewatering surplus
- construction and operation of flood protection structures and creek crossings
- increased erosion associated with earthworks
- runoff/surface water contamination
- creekline diversions, such as the temporary diversion of Phil's creek required for mining at JSW.

Note that current and proposed mining has been designed to preserve the structural integrity of the Marillana Creek floodplain (i.e. mining to stand-off the floodplain). With the exception of flood protection bunding, overland conveyor, dewatering pipeline and two floodways in the JSW area, Rio Tinto maintains an exclusion zone around the creek.

6.3 Environmental performance objectives

The environmental management objectives for surface water are:

1. preserve the environmental values of the Weeli Wolli creek system as identified in the EVS³
2. prevent discharge from causing water flow or pooling further than 17 kilometres⁴ downstream from the Marillana Creek and Weeli Wolli Creek System confluence
3. ensure water discharged to the environment meets specified water quality requirements
4. maintain major creekline floodflows⁵ in Marillana Creek, by protecting the structural integrity of the creek.

Note that the maximum extent of discharge is contingent on assumptions regarding the maximum amount of discharge from the BHPBIO Yandi mine and Hope Downs 1 mine, as described in Appendix 10 of the Yandicoogina Junction South West and Oxbow Iron Ore Project Public Environmental Review (PER) document (Rio Tinto 2011).

6.4 Implementation strategy and management actions

Management actions to achieve the environmental management objectives for surface water are described in Table 4. Key performance indicators and accountabilities are also described.

³ Note that the protection of riparian vegetation is addressed separately in Section 7

⁴ Figure derived on approved licence limits as of 10 October 2011

⁵ Major creekline floodflows is defined as the 50yr ARI

6.5 Monitoring and reporting

The monitoring program of surface water will focus on the quality and quantity of surface flows in the major creeks (Table 5). The scope of monitoring includes the hydrology, extent of discharges and ecology of the Weeli Wolli Creek System.

Key monitoring parameters will include:

- Water quality from discharge outlets and river pools in accordance with Discharge Licence L7340/1997 plus the following additional analytes (Table 6):
 - Nutrients - Total-P, Total-N, NO₃ and NH₃
 - Metals and metalloids - Se and Hg

All sampling will be undertaken in accordance with the Rio Tinto Iron Ore Water Monitoring Procedure (RTIO-HSE-0010722).

- Stygofauna habitat parameters
- Creek channel profile parameters
- Erosion at discharge outlets – evaluated based on visual inspection and qualitative severity rating
- Erosion and sedimentation in major creek systems - evaluated based on visual inspection and qualitative severity rating.

A number of other environmental parameters will also be measured to support the interpretation of monitoring results for the key monitoring parameters, and the design of appropriate management responses to monitoring findings where necessary:

- Monthly rainfall (on-site rainfall gauge and regional Bureau of Meteorology stations).
- Groundwater levels and water quality parameters as per the Yandicoogina Groundwater Operating Strategy (GWOS) prepared in accordance with DoW Groundwater Licence GWL 166205.
- Flow events using pressure transducers, at locations selected on the basis of hydrographic criteria.
- Monthly discharge volumes.

6.6 Triggers and contingency actions

Contingency actions will be initiated in the event that surface water environmental targets are not being achieved (Table 7). These actions 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.

Three trigger levels are used to prompt management responses to protect environmental values. The levels and generic management actions are:

- **Trigger 1: Focus** - establish a watching brief. Determine the cause of the trigger level exceedence. Determine whether the trigger event is the effect of mining activities or caused by changes in the natural environment. The focus trigger ensures that appropriate monitoring and management attention is given to the event or issue. No significant or irreversible environmental impacts are foreseen.

- **Trigger 2: Investigate** - detailed investigation required. Causal investigations to be undertaken with increased monitoring focus. Remedial actions may be taken where necessary. The investigate trigger ensures that the event or issue is understood and appropriate response measures are developed. No significant or irreversible environmental impacts are foreseen.
- **Trigger 3: Action** - highest investigation level with advisory notification of event or issue to regulatory agencies and other appropriate stakeholders including the relevant Traditional Owners. Active intervention/contingency measures required. The Action trigger is to ensure appropriate countermeasures are deployed.

With respect to water quality triggers, the ANZECC/ARMCANZ (2000) *Australian Water Quality Guidelines* provide default guidelines (also referred to as trigger values - TVs) for a range of water and sediment quality analytes for the protection of aquatic ecosystems. The default TVs are to be applied to systems for which there are no baseline data or where baseline data are insufficient to adequately describe the natural or existing seasonal or annual fluctuations in water quality. They provide a conservative guide for informing management decisions, rather than 'pass/fail' compliance criteria. If exceeded, these values “trigger the incorporation of additional information or further investigation to determine whether or not a real risk to the ecosystem exists and, where possible, to adjust the trigger values into regional, local or site-specific guidelines” (ANZECC/ARMCANZ (2000) – Ch 3 page 3.1-17).

Local conditions vary naturally between river systems as influenced by geology, hydrology, ecosystem process and historical land uses. For this reason site specific trigger levels are preferable to the default guideline values contained in the ANZECC/ARMCANZ (2000) *Australian Water Quality Guidelines*, as depicted in the preferred hierarchy for deriving trigger values shown in Figure 4.

Rio Tinto has collected baseline (or reference) water quality data from the Yandicoogina groundwater and creek systems since 1998. The existing baseline data is being used to develop interim site specific water quality TVs for the analytes shown in Table 6, consistent with the ANZECC/ARMCANZ (2000) *Australian Water Quality Guidelines*. Note that in the absence of sufficient data, default values from the ANZECC/ARMCANZ (2000) *Australian Water Quality Guidelines* for the protection of slightly to moderately disturbed ecosystems will be used.

Additional high frequency water quality monitoring will be undertaken for a period prior to commencing discharge from JSW and Oxbow, to supplement the existing dataset and contribute to the formulation of operational site specific water quality TVs. These values will be provided in a separate addendum to be submitted to the CEO once sufficient data has been collected and will be used to establish water quality baselines applicable to the western margin of the project area (BHPBIO discharges) and the southern margin of the project area within Weeli Wolli Creek (Hope Downs 1 Discharges). Once operational site specific water quality TVs have been established, a hazard analysis will be conducted, post commencement of dewatering, to evaluate actual concentrations of analytes in the water of the creek systems and confirm the most suitable sampling frequency for ongoing monitoring. The proposed decision support framework for applying water quality guideline trigger values is shown in Figure 5.

Table 4 Management actions, key performance indicators and responsibilities for surface water management

Condition addressed	Management objective	Actions	Timing	Applicable management area(s)	Key performance indicators	Accountable person
6-1	Preserve the environmental values of the Weeli Wolli creek system as identified in the EVS	Establish baseline conditions for the environmental values of the Weeli Wolli Creek System including: <ul style="list-style-type: none"> Subterranean habitat for stygofauna Heritage values Water quality Channel profile 	Q4 2012	All Zones	Baseline or reference conditions characterised for: <ul style="list-style-type: none"> Subterranean habitat status Heritage values described as a component of the Yandicoogina Heritage Management Plan Water quality – consistent with conditions 6-4 and 6-6(3); refer to Table 7 Channel cross sectional profiles - surveyed and documented 	SEA, MO & HTO
6-6 (1) & 6-6 (4)		Monitor change in environmental conditions in the Weeli Wolli Creek System relating to: <ul style="list-style-type: none"> Subterranean habitat for stygofauna Heritage values 	Life-of-mine	Zones 1 and 2	Subterranean habitat monitoring records and data analysis reports.	SEA
			Life-of-mine	All Zones	Implementation of Yandicoogina Heritage Management Plan	SEA & HO

Condition addressed	Management objective	Actions	Timing	Applicable management area(s)	Key performance indicators	Accountable person
6-6 (2)		<p>Respond to change in Weeli Wolli Creek System environmental conditions relating to:</p> <ul style="list-style-type: none"> Subterranean habitat for stygofauna Heritage values 	<p>If trigger values exceeded (as per Table 7)</p> <p>If trigger values exceeded (as per Table 7)</p>	<p>Zones 1 and 2</p> <p>All Zones</p>	<p>Documentation of trigger exceedences and response actions taken</p> <p>Records of relevant consultation with stakeholders</p> <p>Stygofauna habitat parameters representative of baseline conditions persist beyond the life-of-mine</p> <p>Implementation of Yandicoogina Heritage Management Plan (including consultation with stakeholders)</p>	<p>SEA</p> <p>HO & SEA</p>

Condition addressed	Management objective	Actions	Timing	Applicable management area(s)	Key performance indicators	Accountable person
6-3 & 6-6 (4)	Prevent discharge from causing water flow or pooling further than 17 km downstream from the Marillana Creek and Weeli Wolli Creek System confluence	Monitor the extent of the discharge footprint in Weeli Wolli ⁶ Creek in Zone 3, where 'discharge footprint' is defined as the saturated creek bed once steady state conditions are established	While discharging to creek systems	Zone 3	Surface wetting front monitoring records and data analysis reports	HTO
6-6 (2)		Respond to the extent of the surface wetting front in Weeli Wolli Creek if a trigger exceedence or potential for trigger exceedence is identified (as per Table 7)	If trigger values exceeded (as per Table 8)	Zone 3	Documentation of trigger exceedences and response actions taken Records of relevant consultation with stakeholders Discharge of excess water from <i>mining operations</i> does not cause water flow or pooling further than 17 km downstream from the Marillana Creek and Weeli Wolli Creek System Confluence, (taking into account natural flows)	SEA

⁶ where 'discharge footprint' is defined as saturated creek bed once steady state conditions are established.

Condition addressed	Management objective	Actions	Timing	Applicable management area(s)	Key performance indicators	Accountable person
6-4 & 6-6 (3)	Ensure water discharged to the environment meets specified water quality requirements.	Monitor water quality at all discharge outlets and selected downstream locations	Life-of-mine	All zones	Water quality monitoring records and data analysis reports	MO
		Respond to any water quality issues if a trigger exceedence or potential for trigger exceedence is identified (as per Table 7)	If trigger values are exceeded	All Zones	Documentation of trigger exceedences and response actions taken Records of relevant notification/consultation with stakeholders Dewater discharged to the environment meets specified water quality requirements during life-of-mine	SEA
6-6 (2), 6-6 (5) & 7-5 (5)	Maintain major creekline floodflows in Marillana Creek, by protecting the overall structural integrity of the creek.	Monitor Marillana Creek channel form	Life-of-mine	Zones 1, 2a, 4 and 5	Channel cross sectional area profiles records Erosion and sedimentation records	HTO
		Channel integrity (as inferred by cross sectional area profiles) is not significantly changed due to mining activities	Life-of-mine	Zones 1, 2a, 4 and 5	Flow path of Marillana Creek is maintained during the life-of-mine	HTO

Condition addressed	Management objective	Actions	Timing	Applicable management area(s)	Key performance indicators	Accountable person
		Prevent erosion at discharge outlets using rock outfall structures	Life-of-mine	Zones with outlets	Rock protected outfall structures are maintained during the life-of-mine	SEA
		Prevent erosion and sedimentation in creekline caused by mining activities	Life-of-mine	Zones 1, 2a, 4 and 5	Flow path of Marillana Creek is maintained during the life-of-mine	HTO

Table 5 Monitoring actions for surface water management

Item	Parameter(s)	Frequency	Location	Critical correlative environmental parameters	Purpose
Stygofauna	Subterranean habitat parameters (water levels and water quality)	Annually	Monitoring locations shown in Figure 3	Monthly rainfall Proximal groundwater levels Flood events Monthly discharge volumes Discharge water quality parameters as per Table 6 Additional groundwater quality parameters as per GWOS Stygofauna assemblages (opportunistic)	Assessment of time series change in subterranean habitat quantity and quality
Heritage Values	Addressed by the Yandicoogina Heritage Management Plan				
Extent of surface wetting front (discharge footprint)	Distance that the discharge footprint extends from Marillana and Weeli Wolli Creek confluence; where 'discharge footprint' is defined as saturated creek bed once steady state conditions are established.	1-monthly	Zone 3	Monthly rainfall Groundwater levels Flood events Monthly discharge volumes	Assessment of the extent of the surface wetting front in Weeli Wolli Creek downstream from the Yandicoogina mines.

Item	Parameter(s)	Frequency	Location	Critical correlative environmental parameters	Purpose
Discharge water quality	As per Table 6	3-monthly As per Table 6	Monitoring locations shown in Figure 3	Monthly rainfall Groundwater levels Flood events Monthly discharge volumes Groundwater quality parameters as per GWOS & licensing Water samples from transient surface pools (opportunistically)	Assessment of time series change in water quality Comparison between management zones and reference sites.
Marillana Creekline integrity	Channel cross sectional area	Bi-annually (at end of wet season ~March and end of dry season ~Nov)	Monitoring locations shown in Figure 3	Opportunistic channel cross sectional measurements e.g. immediately following winter rainfall and major flood events	Assessment of time series change in channel profile relative to baseline
Erosion at discharge outlets	Inspection and photographic record (Appendix 3)	6-monthly and after major flood events	All discharge outlets (as per Figure 3)	Monthly rainfall Flood events Monthly discharge volumes	Assessment of structural integrity of outlets
Erosion and sedimentation	Inspection and photographic record (Appendix 3)	6-monthly and after major flood events	Monitoring locations shown in Figure 3	Monthly rainfall Flood events Monthly discharge volumes	Assessment of creekline erosion and/or sediment accumulation
Riparian vegetation	Refer to Section 7				
Groundwater levels	As per Yandicoogina Groundwater Operating Strategy				
Groundwater quality	As per Yandicoogina Groundwater Operating Strategy				

Table 6 Yandicoogina water quality monitoring parameters

Parameter class	Surface water Parameter(s)	Monitoring sites	Frequency	Ground water Parameter(s)	Monitoring locations	Frequency
Solids/EC/pH	total dissolved solids (TDS), total suspended solids (TSS), electrical conductivity (EC), pH	D03, D06, D09, BHPBIO Yandi DO (Western margin of tenement), Weeli Wolli south of D06, WRM monitoring points, Wetting front extent along Weeli Wolli Levee Bank (TDS, TSS & pH only) (Refer to Figure 3)	Quarterly	electrical conductivity (EC), pH, temperature, (run hours, cumulative flow, instantaneous Rate flow, Water Level Elevation) total dissolved solids (TDS), electrical conductivity (EC), pH	As per Figure 3 and GWOS	Monthly Annually
Nutrients	Total-P, Total-N, NO ₃ , NH ₃	As above	6-monthly	NO ₃ -	As per Figure 3 and GWOS	Annually
Major ions	Na, K, Ca, Mg, SO ₄ ,	As Above	6-monthly	Na, K, Ca, Mg, CL, CO ₃ , HCO ₃ , SO ₄ ,	As per Figure 3 and GWOS	Annually
Metals and metalloids	Fe, Al, Cu, Zn, As, Cr, Pb, Cd, Hg, Se, Mo, Mn	As Above Levee Bank	6-monthly	-	-	
Oils and lubricants	total recoverable hydrocarbons (TRH) (range C ₆ -C ₃₆)	Levee Bank	6-monthly	-	-	

Table 7 Contingency actions for surface water management

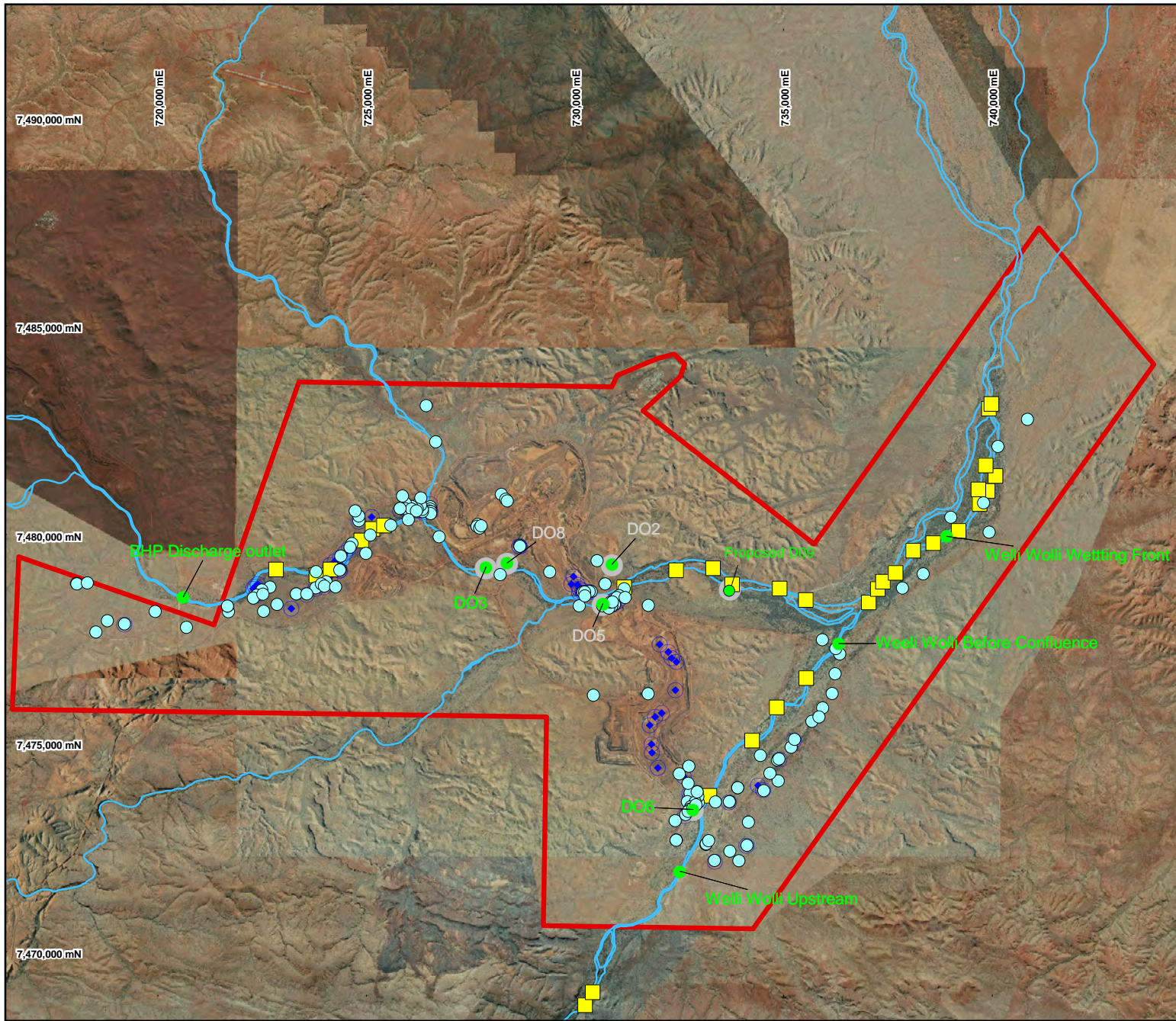
Management objective	Trigger parameter	Trigger	Action	Applicable management area(s)
Preserve the environmental values of the Weeli Wolli creek system as identified in the EVS 1. Stygofauna	Habitat parameters change outside “natural” variability	<p>Focus: Water quality outside baseline range (<i>As per water quality below</i>)</p> <p>Water quantity (water levels) outside predicted range</p>	<p>Water Quality change - As per water quality focus actions below)</p> <p>Water level change - Determine if linked to specific events (e.g. rains, flood or change in discharge regimes from Rio Tinto Yandicoogina operations or other mines in the catchment).</p>	All Zones
		<p>Investigate: Water quality outside baseline range for successive monitoring events (<i>As per water quality below</i>)</p> <p>Water quantity (water levels) outside predicted range for successive monitoring events</p>	<p>Water Quality change - As per water quality focus actions below)</p> <p>Water level change - Investigate and establish the potential cause of water level deviation from predicted natural range. If Rio Tinto Yandicoogina operations are identified as a potential cause of detrimental water level change then operations will identify options for modifying water levels to maintain sufficient groundwater habitat.</p> <p>Compare against critical correlative environmental parameters as per Table 5</p>	

Management objective	Trigger parameter	Trigger	Action	Applicable management area(s)
		<p>Action: Water quality outside baseline range for successive monitoring events (<i>As per water quality below</i>) with no reversible trend</p> <p>Water Quantity (water levels) outside predicted range for successive monitoring events with no reversible trend</p>	<p>Consult with relevant stakeholders</p> <p>Water Quality change - As per water quality focus actions below)</p> <p>Water level change - Rio Tinto Yandicoogina operations will implement selected management options (as identified in the investigations stage) to remediate groundwater habitat impacts.</p>	
<p>Preserve the environmental values of the Weeli Wolli creek system as identified in the EVS</p> <p>2. Heritage</p>	Heritage Management Plan	<p>Action: Heritage Management Plan not prepared and operationally implemented</p>	<p>Ensure that a Heritage Management Plan is prepared and operationally implemented</p>	
<p>Prevent discharge from causing water flow or pooling further than 17 kilometres downstream from the Marillana Creek and Weeli Wolli Creek System confluence</p>	Distance of persistent water flow or pooling from the Marillana Creek and Weeli Wolli Creek System confluence	<p>Focus: persistent water flow or pooling occurs >15 km from the Marillana Creek and Weeli Wolli Creek System confluence</p>	<p>Determine if linked to specific events (e.g. rains, flood or change in discharge regimes from Rio Tinto Yandicoogina operations or other mines in the catchment)</p>	Zone 3








Management objective	Trigger parameter	Trigger	Action	Applicable management area(s)
		Investigate: persistent water flow or pooling occurs within >16 km from the Marillana Creek and Weeli Wolli Creek System confluence	Investigate and establish the potential cause of persistent water flow or pooling Compare against critical correlative environmental parameters (as per Table 5)	
		Action: persistent water flow or pooling occurs ≥17 km from the Marillana Creek and Weeli Wolli Creek System confluence	Consult with relevant stakeholders (DoW, DEC & OEPA Compliance branch) If extent of persistent water flow or pooling is attributable to Rio Tinto Yandicoogina operations, modify discharge regime to meet management objective in consultation with the relevant stakeholders.	
Ensure water discharged to the environment meets specified water quality requirements	Selected analytes as per Table 6	Focus: Analyte concentration at any discharge outlet or creekline monitoring point is above/outside the trigger threshold criteria (refer to Section 6.6).	Initiate investigations into the potential cause(s) of water quality change Re-sample to confirm accuracy of investigation results Compare against critical correlative environmental parameters as per Table 5	All Zones
	Selected analytes as per Table 6	Investigate: Analyte concentration at any discharge outlet or creekline monitoring point is above/outside the trigger threshold criteria (refer to Section 6.6) for successive monitoring events	Investigate potential contamination sources or other factors contributing to the trigger breach If Rio Tinto Yandicoogina operations is identified as a potential source then operations will remove potential source/s of contamination from the most likely pathway and re-sample	

Management objective	Trigger parameter	Trigger	Action	Applicable management area(s)
			Hydrologists to determine geographic extent of contamination RTIO ecologist to investigate potential ecotoxicity effects that may impact on health of aquatic ecosystem	
	Selected analytes as per Table 6	Action: Analyte concentration at any discharge outlet or creekline monitoring point is above/outside the trigger threshold criteria (refer to Section 6.6) for successive monitoring events with no reversible trend	Consult with relevant stakeholders If Rio Tinto Yandicoogina operations is identified as a potential source then remove potential source/s of contamination from the most likely pathway and re-sample Remediate impacts of contamination if necessary Site hydrogeologist to evaluate water treatment options where necessary, if the cause attributable to Rio Tinto Yandicoogina operations	
Maintain major creekline floodflows in Marillana Creek, by protecting the structural integrity of the creek.	Erosion at discharge outlets	Focus: Erosion visually identified at discharge outlets (severity rating \geq medium)	Determine if linked to a specific event (e.g. flood)	Marillana Creek
		Investigate: Erosion assessed to be a result of surplus water discharge	Assess whether erosion continuing or accelerating through comparison over multiple inspections	

Management objective	Trigger parameter	Trigger	Action	Applicable management area(s)
		Action: Erosion assessed to be a result of surplus water discharge and continuing / worsening	Consult with relevant stakeholders Assess requirement for, and options for, relocation and / or remedial works in consultation with relevant stakeholders Undertake rehabilitation works as required and as permitted	
	Erosion and/or sedimentation in major creek channels	Focus: Erosion and/or sedimentation visually identified in major creek channels (severity rating \geq medium)	Determine if linked to an event (e.g. flood)	Marillana Creek
		Investigate: Erosion assessed to be a result of surplus water discharge	Assess whether erosion continuing or accelerating through comparison over multiple inspections	
Erosion and/or sedimentation in major creek channels	Action: Erosion assessed to be a result of surplus water discharge and continuing / worsening	Consult with relevant stakeholders Assess requirement for and options for relocation and / or remedial works in consultation with relevant stakeholders Undertake rehabilitation works as required and permitted	Marillana Creek	



LEGEND

-  Groundwater Monitoring bores
-  Existing Discharge outlets
-  Proposed discharge monitoring sites
-  Production Bores
-  WRM surface water monitoring site
-  Major Creek line
-  Project Footprint

LOCATION MAP



SCALE



1:100,000 @ A4

Rio Tinto

Figure 3
Yandicoogina
Groundwater and
surface water
monitoring

Drawn: MB
 Date: Oct 12

Plan No.
 Proj:

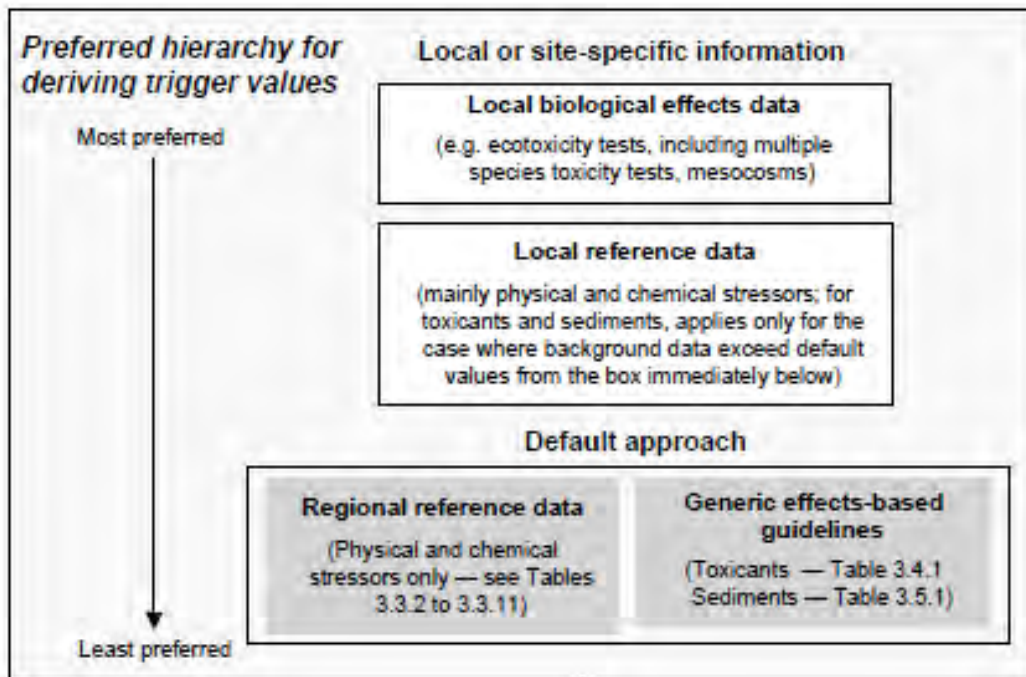
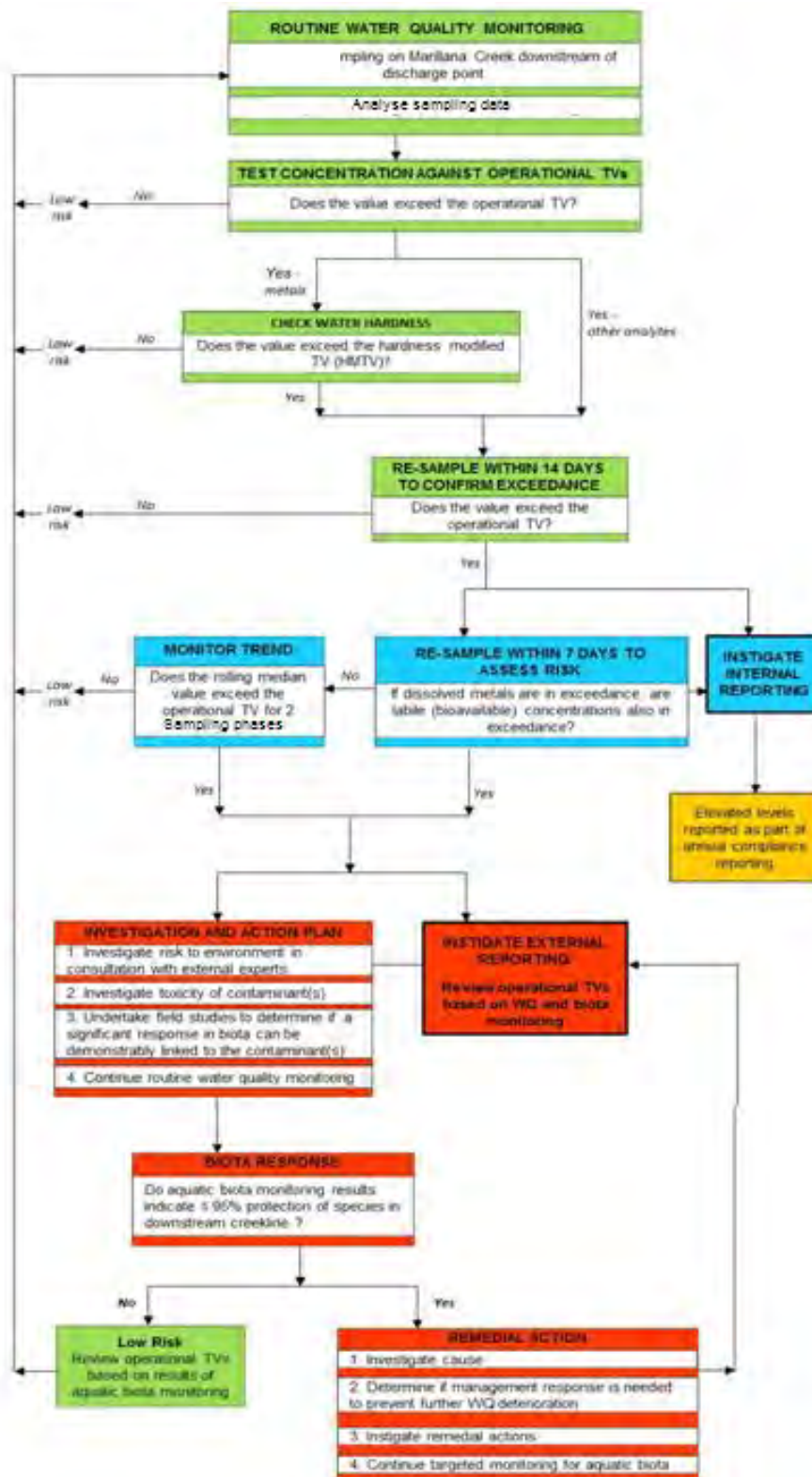


Figure 4 Procedures for deriving trigger values for protection of aquatic ecosystems (reproduced from ANZECC/ARMCANZ (2000) *Australian Water Quality Guidelines*).

Figure 5 Decision support framework for applying water quality guideline trigger values (from WRM 2012)



7 Vegetation and groundwater dependent ecosystems monitoring and management

7.1 Description

Riparian vegetation along Marillana and Weeli Wolli Creeks is considered locally significant, due to the relatively limited extent of this vegetation type compared with other locally occurring vegetation types and the ecological services that it provides. For management purposes, the condition of the riparian vegetation is considered to reflect the wider ecological condition and functionality of riparian ecosystems.

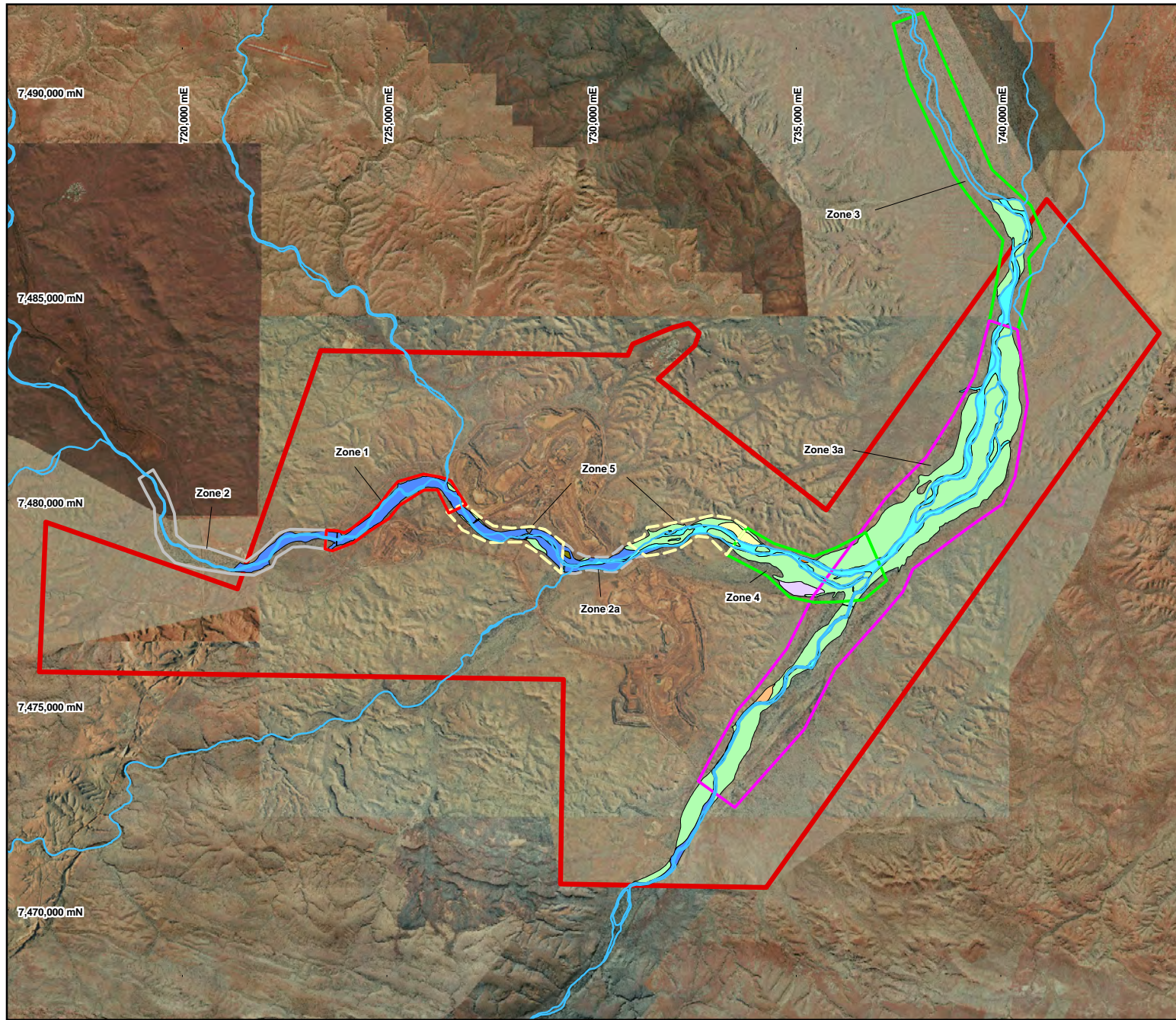
The ecosystem services provided by riparian vegetation include:

- the provision of structural habitat elements, such as tree hollows and corridors for fauna movement (e.g. microbats)
- the protection of streambanks from erosion
- protection of water quality through sediment trapping and nutrient stripping
- transfer of subterranean water and nutrients to the surface environment by some of the dominant tree species
- provision of carbon for food webs
- mediation of microclimate.

Vegetation mapping has been completed along the entire riparian system located in the Project area within ML274SA (Figure 6). Five main groups of riparian vegetation communities have been identified within this area (Biota 2012). The extent of each vegetation type within each management zone is described in Table 8 and depicted in Figure 6. One vegetation unit EcEvMaMg (*Eucalyptus camaldulensis*, *E. victrix* woodland over *Melaleuca argentea*, *M. glomerata* low open woodland) is considered to have elevated conservation significance (EPA 2012).

Table 8 Extent of riparian vegetation units in each management zone

Vegetation unit	Area extent in management zone (ha)						
	1	2	2a	3	3a	4	5
R1: EcEvMaMgAc Major creekline supporting <i>Eucalyptus camaldulensis</i> , <i>E. victrix</i> woodland over <i>Melaleuca argentea</i> , <i>M. glomerata</i> low open woodland)	103	56*	43	-	0.4	-	76
R2: EvAciMgCEc Scoured creek channel supporting <i>Eucalyptus camaldulensis</i> , and/or <i>E. Victrix</i> scattered trees over <i>Acacia citrinoviridis</i> , <i>A. coriacea</i> , <i>Melaleuca glomerata</i> scattered tall shrubs over mixed scattered tussock grasses and <i>Triodia pungens</i> .	-	-	14	53* Extent of mapping	225* (32ha overlap with 4)	68	40
R3: EvAciAprAThCEc Floodplain supporting <i>Eucalyptus Vitrix</i> or <i>E. Xerothermica</i> scattered trees over <i>Acacia citrinoviridis</i> , <i>A. pruinocarpa</i> , <i>A. aneura</i> , <i>Atalaya hemilauca</i> low woodland	2	-	7	82* Extent of mapping	895* 103ha overlap with 4)	207	77
R4: AprAsclTp Borderline riparian floodplain supporting <i>Acacia pruinocarpa</i> low open woodland over <i>A. Sclerosperma</i> tall open shrubland over <i>Triodia pungens</i> open hummock grassland	-	-	-	-	2 (2ha overlap with 4)	25	-
R5: ATC Borderline riparian floodplain supporting <i>Acacia pruinocarpa</i> low open woodland	-	-	-	-	9	-	-



LEGEND

- R1: Major Creekline Vegetation
- R2: Scoured creekline Vegetation
- R3: Floodplain vegetation
- R4: Borderline riparian zone
- R5: Borderline riparian zone
- Major Creek line
- Project Footprint

LOCATION MAP



SCALE



1:100,000 @ A4

Rio Tinto

Figure 6
Yandicoogina
Extent of Riparian
Vegetation in each
Management zone

Drawn: MB
 Date: Oct 12

Plan No.
 Proj:

7.2 Environmental aspects to be managed

Drawdown can potentially reduce the availability of groundwater to plants able to access this water source. *E. camaldulensis* and *M. argentea* are generally considered to be groundwater dependent species, and both of these species occur in some areas within mine pit dewatering drawdown footprints. *E. victrix* may also have a dependency on groundwater in some situations. Experience at Yandicoogina suggests that individual trees will respond differently to drawdown, ranging from no discernible impact to severe stress or tree death in extreme cases. In addition to the survival of mature trees, drawdown may influence tree recruitment dynamics and vegetation structure.

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. Dense vegetation growth in channels can alter stream flow characteristics. Experience at Yandicoogina suggests that individual trees will respond differently to waterlogging stress, ranging from no discernible impact to severe stress or tree death in extreme cases. *E. victrix* may be more susceptible to prolonged waterlogging than *E. camaldulensis* and *M. argentea*.

Riparian vegetation is responsive to water availability. At the cessation of dewatering and/or discharge the vegetation would be expected to gradually revert back to a pre-disturbance condition (e.g. structural composition, functional behaviour, habitat elements and recruitment dynamics). However there is likely to be threshold level of disturbance beyond which impacts to the vegetation are irreversible. Scientific knowledge is not sufficiently developed to enable this 'threshold level' of disturbance to be specified with confidence. The following criteria are proposed to define an irreversible impact threshold for operational purposes over the life of mining at Yandicoogina:

- Death of 30 % of mature trees (DBH [Diameter Breast Height] >10 cm) per zone in excess of tree deaths recorded at reference sites
- Across all monitoring sites, a ≥ 50 % loss⁷ of native perennial understory and ground cover not reasonably attributable to natural stochastic events (e.g. prolonged drought and flood flows) and not evident at regional reference sites.
- Invasion and domination⁸ of understory by weed species not previously recorded within the project area (as of November 2012) and identified as having High Ecological Impact and Low Feasibility of Control under the DEC (2009) weed prioritisation for the Pilbara Bioregion.

The suitability of these criteria will be subject to critical review over the life of the Yandicoogina mines in accordance with adaptive management principles.

⁷ Relative to baseline

⁸ >80% of total understory cover

7.3 Environmental performance objectives

The environmental management objectives for riparian vegetation are:

1. Prevent clearing or loss of vegetation or GDEs outside Zones 1, 2, 2a, 3, 3a, 4 and 5 resulting from drawdown or discharge
2. Prevent irreversible⁹ impact to riparian vegetation or GDEs within Zones 1, 2 and 2a resulting from drawdown
3. Prevent irreversible impact to riparian vegetation or GDEs within Zones 3, 3a, 4 and 5 resulting from discharge (including modified discharge)
4. Maintain the abundance, diversity, geographical distribution and productivity of vegetation communities in the project area by avoiding or managing adverse impacts.

7.4 Implementation strategy and management actions

Management actions to achieve the environmental management objectives for riparian vegetation are described in Table 9. Key performance indicators and accountabilities are also described.

The characterisation of baseline or reference conditions for riparian vegetation at Yandicoogina will be informed by historical monitoring records (spanning the past decade).

7.5 Monitoring and reporting

The scope of the monitoring program for riparian vegetation water includes overstorey species health and riparian vegetation floristics including weed cover (Table 10).

Key monitoring parameters will include:

- Digital Cover Photography (DCP) - provides quantitative measurements of the canopy gap fraction in tree foliage, which can be used to infer canopy foliage density.
- Transect surveys – using belt-transects of 10 quadrats (each 100 m² in area) aligned perpendicular to the creek line. Within each quadrat the following parameters are measured:
 - tree species
 - tree height (cm)
 - tree condition and DBH (cm) of each stem on all trees (where DBH ≥ 2cm)
 - condition of tree saplings (saplings greater than 130 cm in height; <2 cm DBH)
 - % original canopy present on each stem (calculated by estimating the percentage remaining of each stem's original canopy cover)
 - % of contribution of epicormic growth to total canopy on each stem.
 - understorey species (shrubs, grasses, herbs and forbs; including weeds)
 - percentage alive and dead foliage cover (calculated by estimating the percentage of the quadrat being surveyed covered by each understorey species).

⁹ Refer to Section 8 for definition of irreversible impact

A number of other environmental parameters will also be measured to support the interpretation of monitoring results for the key monitoring parameters, and the design of appropriate management responses to monitoring findings where necessary:

- Monthly rainfall (on-site rainfall gauge and regional Bureau of Meteorology stations)
- Groundwater levels and water quality parameters as per the Yandicoogina Groundwater Operating Strategy (GWOS) prepared in accordance with DoW Groundwater Licence GWL166205.
- Flood events (peak flow, flow duration)
- Monthly discharge volumes
- Discharge water quality parameters as per Section 6
- Fire disturbance
- Grazing disturbance
- Digital Multi-Spectral Imagery (DMSI) - captured annually at the end of the dry season.

7.6 Triggers and contingency actions

Contingency actions will be initiated in the event that riparian vegetation environmental targets are not being achieved (Table 11); pursuant to conditions 7-5 (14) and 7-5 (15). These actions include provisions for remediating riparian vegetation to ensure that identified environmental values associated with the Marillana and Weeli Wolli creeks are maintained.

Three trigger levels are used to prompt management responses to protect environmental values. The levels and generic management actions are:

- **Trigger 1: *Focus*** - establish a watching brief. Determine the cause of the trigger level exceedence. Determine whether the trigger event is the effect of mining activities or caused by changes in the natural environment. The focus trigger ensures that appropriate monitoring and management attention is given to the event or issue. No significant or irreversible environmental impacts are foreseen.
- **Trigger 2: *Investigate*** - detailed investigation required. Causal investigations to be undertaken with increased monitoring focus. Remedial actions may be taken where necessary. The investigate trigger ensures that the event or issue is understood and appropriate response measures are developed. No significant or irreversible environmental impacts are foreseen.
- **Trigger 3: *Action*** - highest investigation level with advisory notification of event or issue to the DEC and other appropriate stakeholders including the relevant Traditional Owners. Active intervention/contingency measures required. The action trigger is to ensure appropriate countermeasures are deployed, to the satisfaction of the CEO of the EPA pursuant to condition 7-10.

Table 9 Management actions, key performance indicators and responsibilities for riparian vegetation

Condition addressed	Management objective	Actions	Timing	Applicable management area(s)	Key performance indicators	Accountable person
7-1, 7-2 & 7-5 (1-3; 7)	Prevent clearing or loss of vegetation outside Zones 1, 2, 2a, 3, 3a, 4 & 5 resulting from drawdown or discharge	Establish baseline riparian vegetation condition outside Zones 1, 2, 2a, 3, 3a, 4 & 5	Life-of-mine	Project area within ML274SA	Baseline or reference conditions for riparian vegetation outside Zones 1, 2, 2a, 3, 3a, 4 & 5 characterised	RTIO Ecologist
		Monitor riparian vegetation condition outside Zones 1, 2, 2a, 3, 3a, 4 & 5	Annually	Project area within ML274SA	Vegetation condition is maintained for life-of-mine	SEA
		Respond to any clearing or loss of vegetation or GDEs outside Zones 1, 2, 2a, 3, 3a, 4 & 5	On detection of any clearing or loss	Project area within ML274SA	Any clearing or loss of vegetation or GDEs outside Zones 1, 2, 2a, 3, 3a, 4 & 5 is detected and the affected area rehabilitated	SEA
7-3 & 7-5 (1-3; 7)	Prevent irreversible impact to riparian vegetation within Zones 1, 2 and 2a resulting from drawdown	Establish baseline riparian vegetation condition in Zones 1, 2 and 2a	Prior to dewatering	Zones 1, 2 and 2a	Baseline or reference conditions for riparian vegetation in Zones 1, 2 and 2a characterised	RTIO Ecologist
		Monitor riparian vegetation condition in Zones 1, 2 and 2a	Life-of-mine	Zones 1, 2 and 2a	Monitoring records and data analysis reports for riparian vegetation condition assessments	SEA
		Respond to change in riparian vegetation condition	If trigger values exceeded (as per Table 11)	Zones 1, 2 and 2a	Documentation of trigger exceedences and response actions taken Records of relevant consultation with stakeholders	SE

Condition addressed	Management objective	Actions	Timing	Applicable management area(s)	Key performance indicators	Accountable person
					Drawdown does not cause irreversible impact to riparian vegetation or GDEs within Zones 1, 2 and 2a	
7-3 & 7-5 (1-3; 7)	Prevent irreversible impact to riparian vegetation or GDEs within Zones 3, 3a, 4 and 5 resulting from discharge (including modified discharge)	Establish baseline riparian vegetation condition in Zones 3, 3a, 4 and 5	Prior to dewatering	Zones 3, 3a, 4 and 5	Baseline or reference conditions for riparian vegetation in Zones 3, 3a, 4 and 5 characterised	RTIO Ecologist
		Monitor riparian vegetation condition in Zones 3, 3a, 4 and 5	Life-of-mine	Zones 3, 3a, 4 and 5	Monitoring records and data analysis reports for riparian vegetation condition assessments.	SEA
		Respond to change in riparian vegetation condition.	If trigger values exceeded (as per Table 11)	Zones 3, 3a, 4 and 5	Documentation of trigger exceedences and response actions taken Records of relevant consultation with stakeholders Drawdown does not cause irreversible impact to riparian vegetation or GDEs within Zones 3, 3a, 4 and 5	SE

Condition addressed	Management objective	Actions	Timing	Applicable management area(s)	Key performance indicators	Accountable person
7-5 (4)	Maintain the abundance, diversity, geographical distribution and productivity of vegetation communities in the project area by avoiding or managing adverse impacts.	Define limits of acceptable disturbance (irreversible loss) for each mapped riparian vegetation unit in the Project area within ML274SA associated with clearing and indirect impacts	Q1 2013	Project area within ML274SA	Limits of acceptable disturbance (in hectares) defined for each mapped riparian vegetation unit in the Project area within ML274SA	SEA
		Monitor the extent of disturbance (irreversible loss) for each mapped riparian vegetation community in the Project area within ML274SA	Ongoing	Project area within ML274SA	Cumulative disturbance (irreversible loss) for each mapped riparian vegetation community in the Project area within ML274SA is recorded and continuously checked against defined limits of acceptable disturbance.	SEA
		Respond to any disturbance (irreversible loss) exceeding defined limits of acceptable disturbance for affected riparian vegetation communities	If trigger values exceeded (as per Table 11)	Project area within ML274SA	Documentation of trigger exceedences and response actions taken Records of relevant consultation with stakeholders Cumulative disturbance (irreversible loss) for each mapped riparian vegetation community in the Project area within ML274SA remains within defined limits of acceptable disturbance for life-of-mine.	SE

Table 10 Monitoring actions for riparian vegetation

Item	Parameter(s)	Frequency	Location	Critical correlative environmental parameters	Purpose
Riparian vegetation condition	Digital Cover Photography (DCP)	Quarterly	Monitoring locations shown in Figure 7	Monthly rainfall Groundwater levels Flood events Fire disturbance Monthly discharge volumes Digital Multi-Spectral Imagery (DMSI) Fire disturbance Grazing disturbance	Comparison against baseline and regional reference sites
	Community structure, species diversity and abundance (transect surveys)	6-monthly	Monitoring locations shown in Figure 7	Monthly rainfall Groundwater levels Flood events Fire disturbance Monthly discharge volumes Fire disturbance Grazing disturbance	Comparison against baseline and regional reference sites
Riparian vegetation disturbance (irreversible loss)	Sum of approved clearing areas within riparian vegetation communities	On-going	Project area within ML274SA	n/a	Track extent of project disturbance on riparian vegetation communities
	Validation of approved disturbance within riparian vegetation communities	annually	Project area within ML274SA	n/a	Ensure that disturbance is contained within approved boundaries

Table 11 Contingency actions for riparian vegetation management

Management objective	Trigger parameters	Trigger	Action	Applicable management area(s)
Prevent clearing or loss of vegetation or GDEs outside Zones 1, 2, 2a, 3, 3a, 4 and 5 resulting from discharge	Extent of discharge beyond 17 km from Marillana and Weeli Wolli Creek confluence	Action: Discharge extends beyond 17 km	<p>As per Table 7:</p> <ul style="list-style-type: none"> Consult with relevant stakeholders (DoW, DEC & OEPA Compliance branch) If extent of persistent water flow or pooling is attributable to Rio Tinto Yandicoogina operations, modify discharge regime to correct the exceedence in consultation with the relevant stakeholders. <p>Quantify extent of discharge beyond 17km. Evaluate if clearing or loss has occurred in the effected zone for a period of 12 months following corrective actions.</p>	All Zones
Prevent clearing or loss of vegetation or GDEs outside Zones 1, 2, 2a, 3, 3a, 4 and 5 resulting from drawdown	Extent of drawdown west beyond Zone 2 ¹⁰	Action: Drawdown extends beyond western boundary of Project area	<p>Quantify extent of drawdown west of Zone 2. Confirm cause of drawdown. Evaluate if clearing or loss has occurred in the effected zone for a period of 12 months following corrective actions.</p>	All Zones

¹⁰ Drawdown relates to RTIO Yandicoogina operations only and does not encompass impacts from BHPBIO mining within this area (including future BHPBIO dewatering requirements to facilitate mining)

Management objective	Trigger parameters	Trigger	Action	Applicable management area(s)
Prevent irreversible impact to riparian vegetation or GDEs within Zones 1, 2 and 2a resulting from drawdown	Canopy foliage cover	Focus: ±15% change in mean foliage cover for indicator species at each DCP monitoring site relative to baseline ¹¹ .	Context decline in foliage cover with regional tree health monitoring results (whilst considering events such as fire, seasonal rainfall, and regional changes) Review occurrence of fire and other perturbations Review groundwater abstraction and discharge operations/volumes	Zones 1, 2 and 2a
		Investigate: ±25% change in indicator tree species foliage cover from baseline, decline localised only and not part of regional trend or reasonably attributable to other perturbation	Context decline in foliage cover with regional tree health monitoring results (whilst considering events such as fire, seasonal rainfall, and regional changes) Review occurrence of fire and other perturbations Review groundwater abstraction and discharge operations/volumes Initiate monthly qualitative assessment of local riparian vegetation Review remote sensing and vegetation monitoring data Evaluate water availability and increase discharge from spurs or modify distribution if required	Zones 1, 2 and 2a

¹¹ Baseline values are specific to each site and typically represent the mean canopy foliage cover measured at T₀

Management objective	Trigger parameters	Trigger	Action	Applicable management area(s)
		Action: $\geq \pm 40\%$ change in indicator tree species foliage cover from baseline, decline localised only and not part of regional seasonal trend or reasonably attributable to other perturbation.	Notify relevant stakeholders Initiate relevant additional monitoring i.e. <ul style="list-style-type: none"> • Soil moisture • Qualitative health assessment Review of hydrogeological model Undertake rehabilitation works as required and permitted.	Zones 1, 2 and 2a
Prevent irreversible impact to riparian vegetation or GDEs within Zones 1, 2 and 2a resulting from drawdown	Flora species composition and abundance	Focus: Changes in cover/abundance of riparian species relative to baseline ¹² . Appearance of invasive species.	Initiate control of invasive species. Context change with reference sites, increase frequency of visual inspection and Initiate frequent qualitative assessment of local riparian vegetation	Zones 1, 2 and 2a
		Investigate: Displacement of native species by weed species and/or excessive recruitment of riparian tree species (relative to reference sites).	Continue control of invasive species, consider removal of riparian tree seedlings to emulate stocking rates at reference sites.	Zones 1, 2 and 2a
		Action: Significant shift in vegetation community structure and/or composition from reference sites including dominance of weed species and seedlings of riparian tree species.	Consult with relevant stakeholders Undertake rehabilitation works as required and permitted	Zones 1, 2 and 2a

¹² Baseline values are specific to each site and typically represent the mean canopy foliage cover measured at T₀

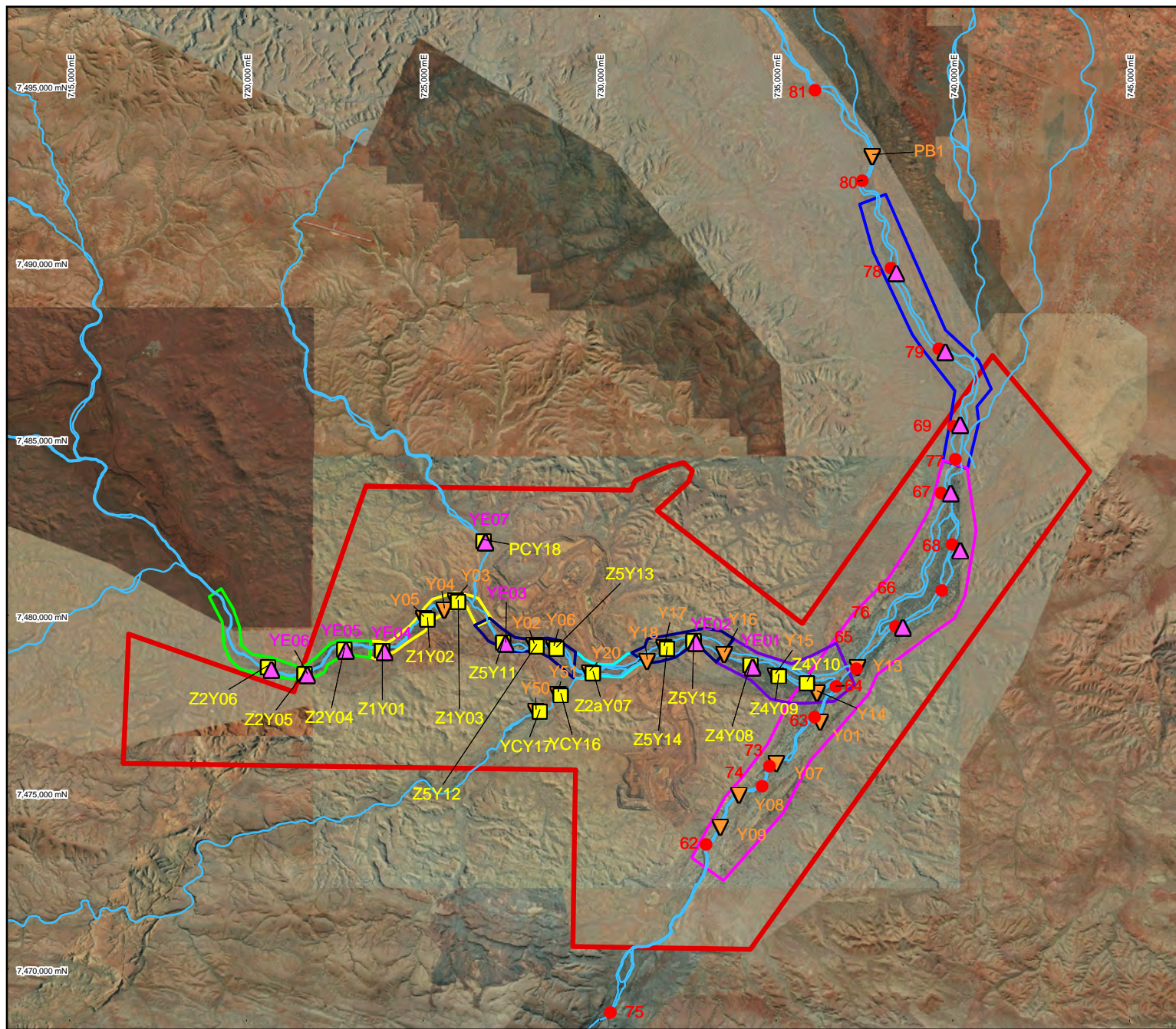
Management objective	Trigger parameters	Trigger	Action	Applicable management area(s)
Prevent irreversible impact to riparian vegetation or GDEs within Zones 3, 3a, 4 and 5 resulting from discharge (including modified discharge)	Canopy foliage cover	Focus: Focus: $\pm 15\%$ change in mean foliage cover for indicator species at each DCP monitoring site relative to baseline ¹³	Context decline in foliage cover with regional tree health monitoring results (whilst considering events such as fire and regional changes) Review occurrence of fire and other perturbations Review groundwater abstraction and discharge operations/volumes	Zones 3, 3a, 4 and 5
	Canopy foliage cover	Investigate: $\pm 25\%$ change in indicator tree species foliage cover from baseline, decline localised only and not part of regional trend or reasonably attributable to other perturbation	Initiate monthly qualitative assessment of local riparian vegetation Review remote sensing and vegetation monitoring data Evaluate water availability and increase discharge from existing discharge points	Zones 3, 3a, 4 and 5
		Action $\geq \pm 40\%$ change in indicator tree species foliage cover from baseline, decline localised only and not part of regional seasonal trend or reasonably attributable to other perturbation.	Notify relevant stakeholders Initiate relevant additional monitoring i.e. <ul style="list-style-type: none"> • Soil moisture • Qualitative health assessment Review of hydrogeological model Undertake rehabilitation works as required and permitted	Zones 3, 3a, 4 and 5

¹³ Baseline values are specific to each site and typically represent the mean canopy foliage cover measured at T₀

Management objective	Trigger parameters	Trigger	Action	Applicable management area(s)
Prevent irreversible impact to riparian vegetation or GDEs within Zones 3, 3a, 4 and 5 resulting from discharge (including modified discharge)	Flora species composition and abundance	Focus: Changes in cover/abundance of riparian species relative to baseline ¹⁴ . Appearance of invasive species.	Initiate control of invasive species. Context change with reference sites, increase frequency of visual inspection and Initiate frequent qualitative assessment of local riparian vegetation	Zones 3, 3a, 4 and 5
		Investigate: Displacement of native species by weed species and/or excessive recruitment of riparian tree species (relative to reference sites).	Continue control of invasive species, consider removal of riparian tree seedlings to emulate stocking rates at reference sites.	Zones 3, 3a, 4 and 5
	Flora species composition and abundance	Action: Significant shift in vegetation community structure and/or composition from reference sites including dominance of weed species and seedlings of riparian tree species.	Consult with relevant stakeholders Undertake rehabilitation works as required	Zones 3, 3a, 4 and 5

¹⁴ Baseline values are specific to each site and typically represent the mean canopy foliage cover measured at T₀

Management objective	Trigger parameters	Trigger	Action	Applicable management area(s)
Maintain the abundance, diversity, geographical distribution and productivity of vegetation communities in the project area by avoiding or managing adverse impacts.	Clearing request	Focus: Clearing request made for riparian vegetation community	Check area request against defined limits of acceptable disturbance for riparian vegetation community (refer to Table 9)	Project area within ML274SA
	Clearing approved internally	Investigate: clearing approved internally for riparian vegetation community	Validate that approved disturbance is contained within approved boundaries	Project area within ML274SA
	Cleared area validation	Action: Disturbance occurs outside approved clearing area	Notify relevant stakeholders Rehabilitate disturbed area outside approved clearing area	Project area within ML274SA



LEGEND

- Existing DCP sites
- Proposed DCP sites
- MCPL transects
- MCPL new transects
- Zone 1
- Zone 2
- Zone 2a
- Zone 3
- Zone 3a
- Zone 4
- Zone 5
- Major Creek line
- Project Footprint

LOCATION MAP



SCALE

1:150,000 @ A4

Rio Tinto

Figure 7
Yandicoogina
Riparian Vegetation
monitoring locations

Drawn: MB Plan No.
 Date: Oct 12 Proj:

8 Definitions

Baseline water quality levels: Water quality as defined by the inputs from upstream Mining operations which discharge surplus water into the Marillana and Weeli Wolli Creek systems (including at the western margin of the tenement: BHPBIO Yandi, and including the southern margin of the project area within Weeli Wolli creek: BHPBIO Jinidi operations and HMS Hope Downs 1 operation), and measured at locations depicted in Figure 3.

Irreversible impacts: an impact resulting in a permanent loss of environmental value(s); or where intensive, and/or un-proven management intervention, potentially over a long timeframe, would be required to restore the environmental value(s).

Life-of-Mine: Includes the time period from the start of construction until the end of active operations for the Yandicoogina JC, JSE, JSW and Oxbow deposits.

Major creekline flood flows: is defined as the 50yr ARI

Project Area: Encompasses the project footprint within ML248SA as delineated in Figure 1.

17 km discharge: The discharge footprint is defined as the saturated creek bed once steady state conditions are established, The 17 km limit is defined based on the modelled discharge extent from the Yandicoogina operations during *dry conditions*; at a dewatering rate of 53G/a; and as of October 2012 approved licence limits of other operations within the catchment (BHPBIO Yandi, Hope Downs 1).

9 References

ANZECC/ARMCANZ 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Agriculture and Resource management Council of Australia and New Zealand and Australian and New Zealand Environment and Conservation Council, Canberra

EPA 2012, *Yandicoogina Iron Ore Project - Expansion to include Junction South West and Oxbow Deposits*, Report 1448, Environmental Protection Authority, Perth

EPA 2007, *Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia*, Guidance Statement No. 54a, Environmental Protection Authority, Perth

Rio Tinto 2008 Marillana Creek Catchment Hydrology and Local Catchment impacts: Yandicoogina +52 Mtpa Expansion Prefeasibility, Junction South West (Stage 1) and Oxbow Deposits, January 2008, Rio Tinto Iron Ore, Perth.

Rio Tinto 2010 Marillana Creek Regional Flow Balance – pre and Post-mining comparison, May 2010, Rio Tinto Iron Ore, Perth

Rio Tinto 2011, *Yandicoogina Junction South West and Oxbow Iron Ore Project - Public Environmental Review*, Rev 6.0 September 2011, Rio Tinto, Perth

WRM 2011, Preliminary Water Quality guidelines for dewatering discharge into Marillana Creek (Draft report). Wetland Research and Management, Perth.

Appendix 1 Ministerial Statement 914



MINISTER FOR ENVIRONMENT; WATER

Statement No. 914

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF THE *ENVIRONMENTAL PROTECTION ACT 1986*)

YANDICOOGINA IRON ORE PROJECT – EXPANSION TO INCLUDE JUNCTION SOUTH WEST AND OXBOW DEPOSITS

Proposal: The proposal includes the existing Hamersley Yandicoogina iron ore project and proposed expansion. The existing project includes open pit mining at the Junction Central and Junction South East operations and associated infrastructure, dewatering activities, closure and rehabilitation. The expansion includes the development of new pits at Junction South West and Oxbow, temporary waste landforms, the development of new infrastructure, additional dewatering and water disposal activities. The proposal is located in the central Pilbara region of Western Australia, on mining lease 274SA.

The proposal is further documented in Schedule 1 of this statement.

Proponent: Hamersley Iron Pty. Limited

Proponent Address: Level 22
Central Park 152-158 St Georges Terrace,
PERTH WA 6000

Assessment Number: 1726

Previous Assessment Numbers: 979, 1174, 1590

Report of the Environmental Protection Authority: 1448

Previous Reports of the Environmental Protection Authority: 809, 946, 1195

Previous Statement Numbers: 417, 523, 695 (Published on 25 May 1996, 1 October 1999, 25 October 2005 respectively).

The implementation conditions of this statement supersede the implementation conditions of Statements 417, 523 and 695 in accordance with section 45B of the *Environmental Protection Act 1986*. The proposal referred to in the above reports of the Environmental Protection Authority may be implemented. The implementation of these proposals is subject to the following implementation conditions and procedures, unless specifically stated otherwise within this Statement and Schedule 2 details definitions of terms and phrases used in the implementation conditions and procedures.

Published on

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.

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.

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.
- 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.
- 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.
- 4-3 The proponent shall assess compliance with conditions in accordance with the compliance assessment plan required by condition 4-1.

- 4-4 The proponent shall retain reports of all compliance assessments described in the 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.
- 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.

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.
- 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.

Surface Water Discharge (Protection of Weeli Wollie Creek)

- 6-1 The proponent shall ensure that the discharge of excess water from the Yandicoogina Iron Ore Project – Expansion to Include Junction SouthWest and Oxbow Deposits as a result of mining does not cause long term impacts to environmental values of the Weeli Wollie Creek System.

- 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.
- 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.
- 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).
- 6-5 The proponent shall prepare a Water Discharge Monitoring and Management Plan.
- 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.
- 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.

- 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)*.
- 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.

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.
- 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.
- 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.
- 7-4 The proponent shall prepare a Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan.
- 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 7-1, 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 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.
- 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.
- 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)*.
- 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.
- 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.

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 the DEC 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.

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 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.
 - 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.
 - 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;
 - (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.

- 9-5 The proponent shall make revisions of the Yandicoogina Decommissioning and Rehabilitation Plan required by condition 9-1 publicly available.

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.
- 10-2 The contribution shall be paid in full by 31 December 2013, unless otherwise agreed by the CEO.



**HON BILL MARMION MLA
MINISTER FOR ENVIRONMENT; WATER**

18 OCT 2012

**Schedule 1
The Proposal (Assessment No. 1725)**

Table 1: Summary of proposal

Proposal Title	Yandicoogina Iron Ore Project - Expansion to Include Junction South West and Oxbow Deposits
Short description	<p>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.</p> <p>Terrestrial infrastructure includes:</p> <ul style="list-style-type: none"> • 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; • accommodation camps; • access roads; and • an airstrip. <p>The location of the various project components is shown in Figures 1, 2 and 3.</p>

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

Column 1	Column 2	Column 3
Element	Location	Authorised Extent
Clearing	Figure 2	<ul style="list-style-type: none"> • Up to 5,600 ha within Restricted Clearing Area 1; and • up to 60 ha within Restricted Clearing Area 2.
Dewatering from Junction South East and Junction Central operations	Figure 3	No more than 35 GL/y
Dewatering from Junction South West A, Junction South West C and Oxbow operations	Figure 3	No more than 18 GL/y
Surface Water Discharge from Junction South West A, Junction South West C and Oxbow operations	Figure 3	Up to 16 GL/y

Table 3: Abbreviations

Abbreviation	Term
Ha	hectare
GL/y	Gigalitres per year

Figures (attached)

Figure 1: Yandicoogina Operations Development Envelope and Predicted Dewatering Impact Areas

Figure 2: Yandicoogina Operations Proposed Clearing Areas

Figure 3: Location of the Junction South West (JSW A and JSW C), Oxbow, Junction Central and Junction South East pits.

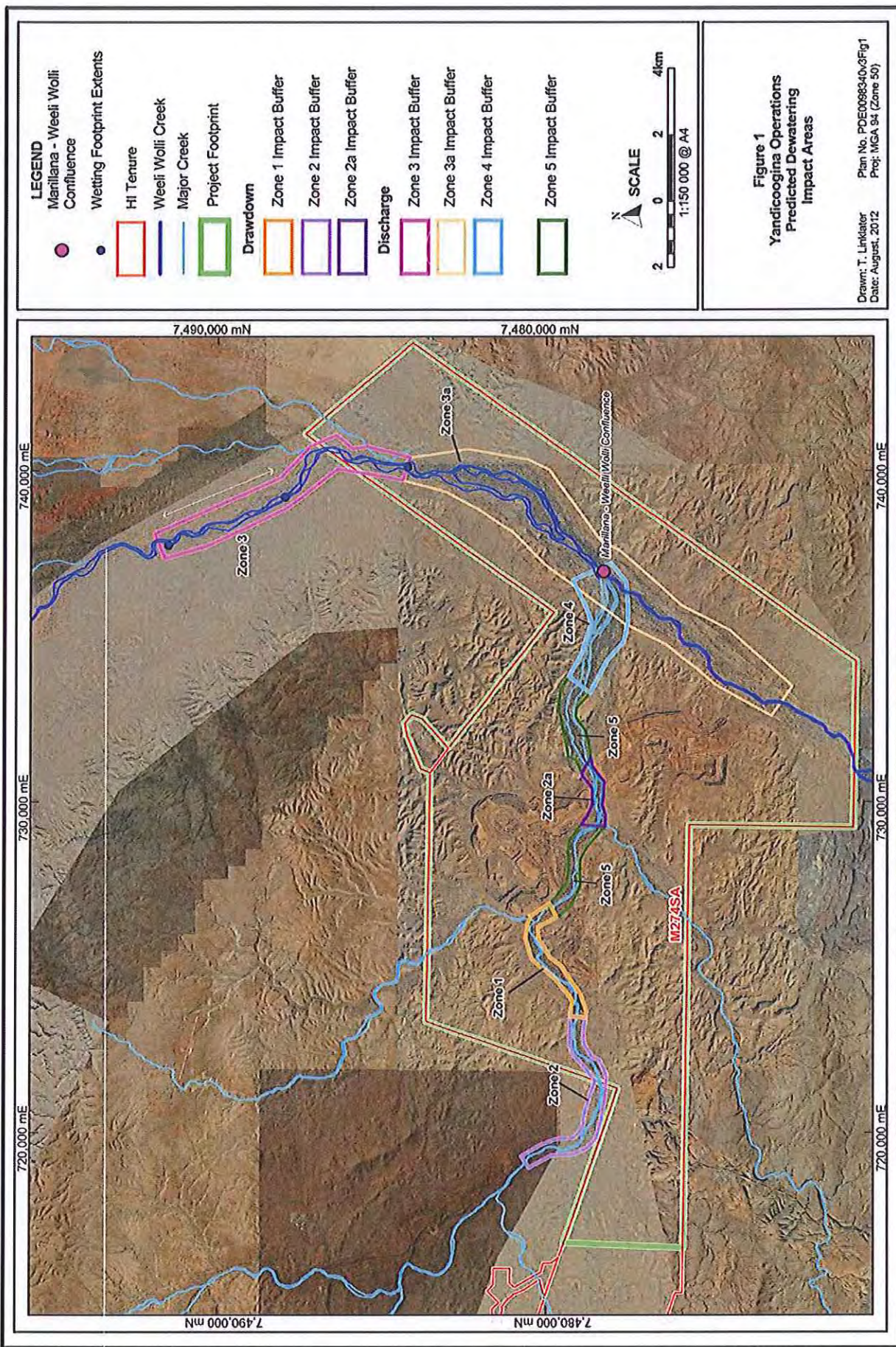


Figure 1: Yandicoogina Operations Development Envelope and Predicted Dewatering Impact Areas

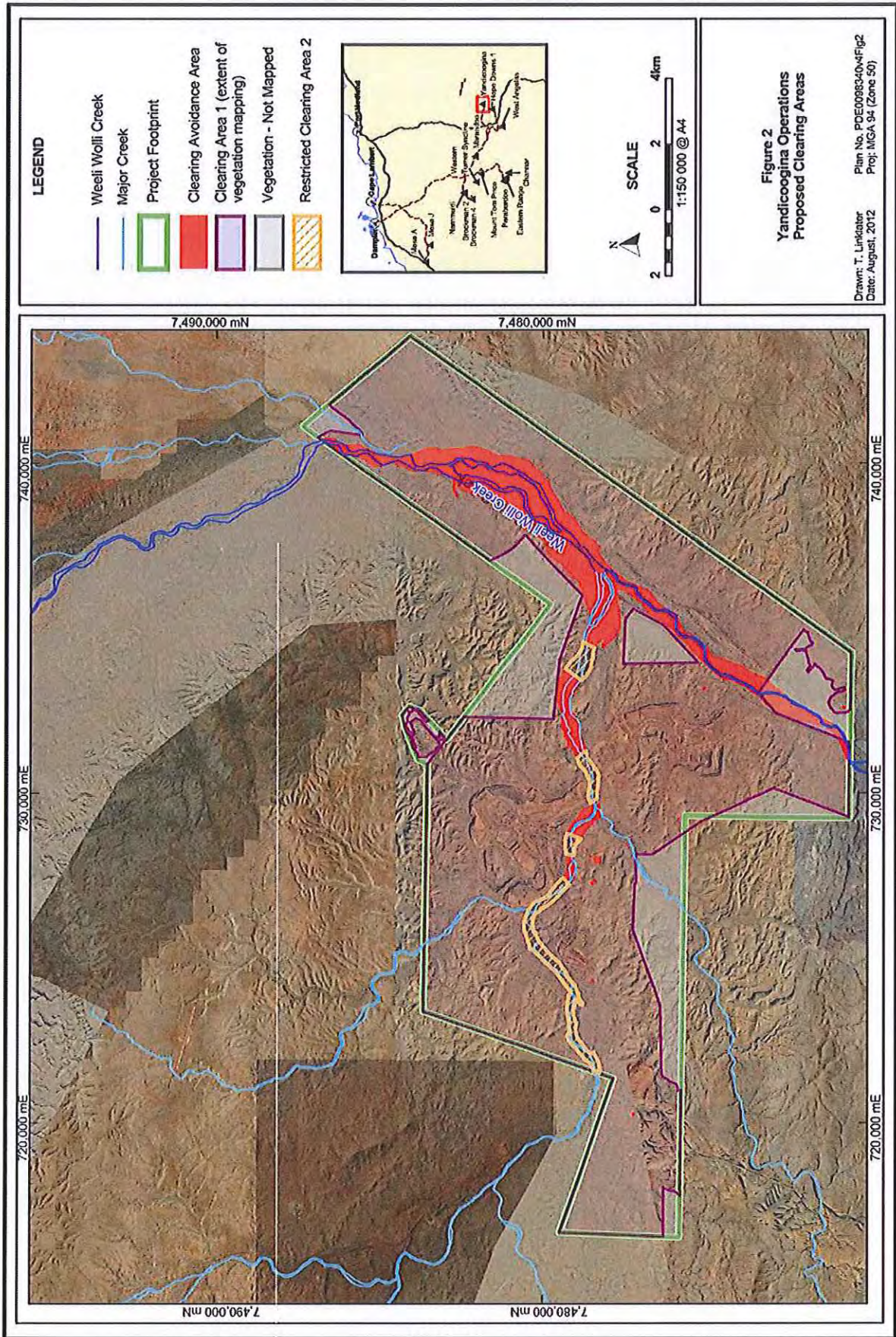


Figure 2: Yandicoogina Operations Proposed Clearing Areas

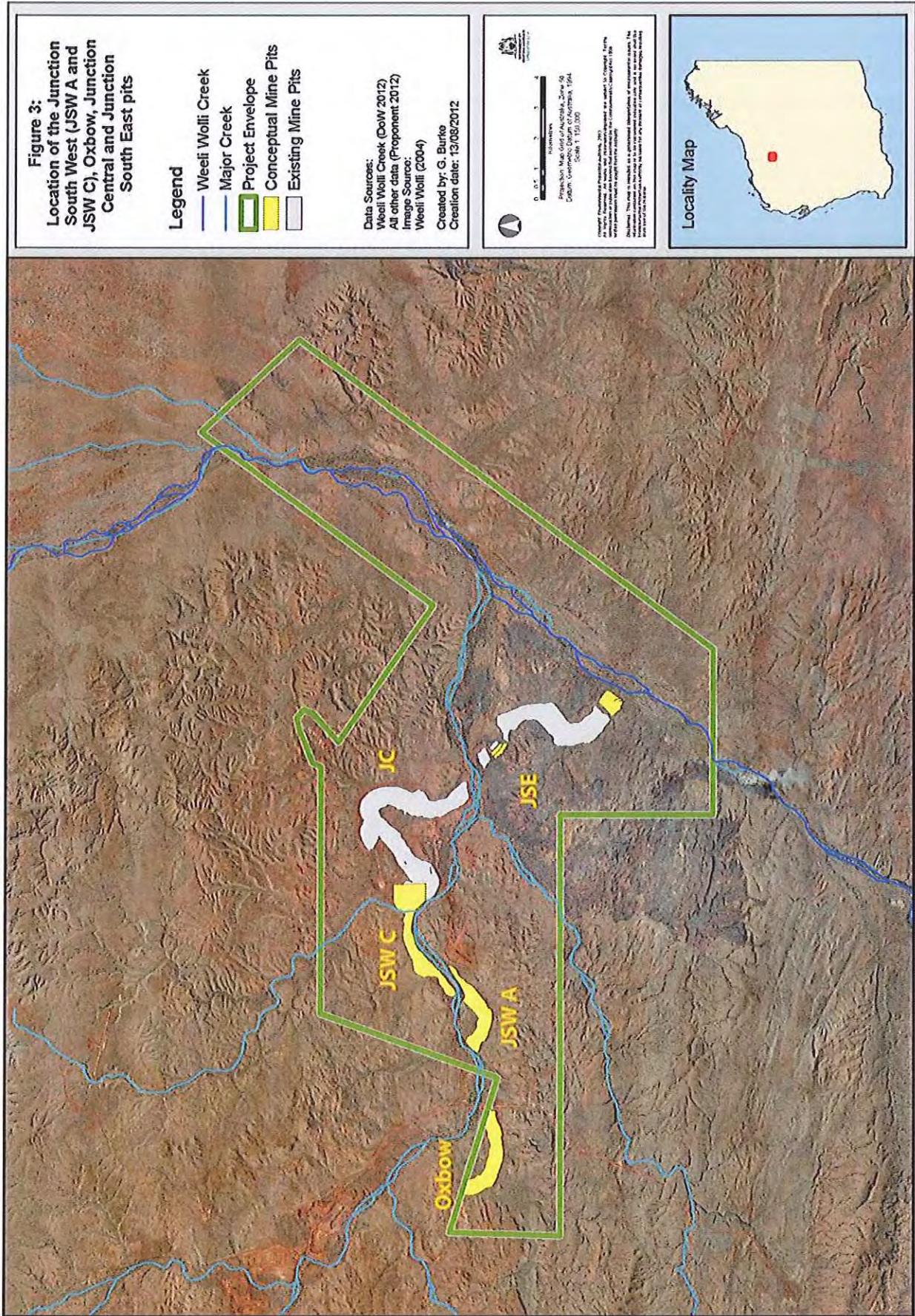


Figure 3: Location of the Junction South West (JSW A and JSW C), Oxbow, Junction Central and Junction South East Pits

Schedule 1

Term or Phrase	Definition
Approved Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan	The Vegetation and Groundwater Dependent Ecosystems Monitoring and Management Plan for which the proponent has received written notification from the CEO that it meets the requirements of condition 7-5.
Approved Water Discharge Monitoring and Management Plan	The Water Discharge Monitoring and Management Plan for which the proponent has received written notification from the CEO that it meets the requirements of condition 6-6.
CEO	The Chief Executive Officer of the Department of the Public Service of the State responsible for the administration of section 48 of the <i>Environmental Protection Act 1986</i> , or his delegate.
DEC	Department of Environment and Conservation
Junction Central	Delineated in Figure 3 as JC.
Junction South East	Delineated in Figure 3 as JSE.
Junction South West A	Delineated in Figure 3 as JSW A.
Junction South West C	Delineated in Figure 3 as JSW C.
Marillana Creek and Weeli Wolli Creek System Confluence	Delineated in Figure 1 as Marillana – Weeli Wolli Confluence.
MGA	Map Grid of Australia
No Clearing Area	Delineated in Figure 2 as No Clearing Area.
OEPA	Office of the Environmental Protection Authority.
Oxbow	Delineated in Figure 3 as Oxbow.
Proposal Area	Delineated in Figure 1 as Project Footprint.
Restricted Clearing Area 1	Delineated in Figure 2 as Restricted Clearing Area 1.
Restricted Clearing Area 2	Delineated in Figure 2 as Restricted Clearing Area 2.
Riparian Vegetation	The distinctive vegetation associated with a wetland or watercourse. (Department of Environment and Conservation – <i>Native vegetation clearing legislation in Western Australia</i> (Version 2 April 2010).
'Walk Away' Solution	Means that the site shall either no longer require management at the time the proponent ceases mining operations, or if further management is deemed necessary, the proponent shall make adequate provisions so that the required management is undertaken with no liability to the State.
Weeli Wolli Creek System	Delineated in Figure 1 as Weeli Wolli Creek.
Zone 1	Delineated in Figure 1 as Zone 1 and defined by MGA co-ordinates for Zone 1 in Schedule 2.
Zone 2	Delineated in Figure 1 as Zone 2 and defined by MGA co-ordinates for

	Zone 2 in Schedule 2.
Zone 2a	Delineated in Figure 1 as Zone 2a and defined by MGA co-ordinates for Zone 2a in Schedule 2.
Zone 3	Delineated in Figure 1 as Zone 3 and defined by MGA co-ordinates for Zone 3 in Schedule 2.
Zone 3a	Delineated in Figure 1 as Zone 3a and defined by MGA co-ordinates for Zone 3a in Schedule 2.
Zone 4	Delineated in Figure 1 as Zone 4 and defined by MGA co-ordinates for Zone 4 in Schedule 2.
Zone 5	Delineated in Figure 1 as Zone 5 and defined by MGA co-ordinates for Zone 5 in Schedule 2.

**Yandicoogina Junction South West and Oxbow
Zone 1**

Prepared 14 August 2012

Co-ordinates defining *Zone 1* are prescribed below, noting that the correct recreation of the boundary requires the sequential connection of the co-ordinates as per its co-ordinate number.

All co-ordinates are listed in Map Grid of Australia Zone 50 (MGA Zone 50), datum of Geodetic Datum of Australia 1994 (GDA94).

Co-ordinate		
No.	Easting	Northing
1	723522.48	7479273.82
2	723778.20	7479261.64
3	723956.79	7479212.94
4	724151.63	7479322.53
5	724638.70	7479712.19
6	724898.48	7480004.44
7	725052.72	7480219.55
8	725271.90	7480459.04
9	725896.98	7480645.75
10	726351.58	7480564.57
11	726566.69	7480477.78
12	726939.78	7479896.35
13	726516.39	7479693.86
14	726233.87	7480256.09
15	725905.10	7480252.03
16	725308.44	7479882.66
17	725060.84	7479566.07
18	724561.58	7479241.34
19	724192.21	7478969.40
20	723668.61	7478770.51
21	723490.01	7478819.22
22	723522.48	7479273.82

END OF CO-ORDINATE LISTING

**Yandicoogina Junction South West and Oxbow
Zone 2**

Prepared 14 August 2012

Co-ordinates defining *Zone 2* are prescribed below, noting that the correct recreation of the boundary requires the sequential connection of the co-ordinates as per its co-ordinate number.

All co-ordinates are listed in Map Grid of Australia Zone 50 (MGA Zone 50), datum of Geodetic Datum of Australia 1994 (GDA94).

Co-ordinate No.	Easting	Northing
1	723522.48	7479277.88
2	723494.07	7478811.09
3	723007.00	7478876.04
4	722698.51	7478855.74
5	722304.79	7478608.14
6	722199.26	7478388.96
7	721752.77	7478173.83
8	721200.74	7478210.36
9	720413.31	7478332.14
10	719828.82	7478478.26
11	719536.57	7478750.21
12	719353.91	7479164.23
13	719317.38	7479817.73
14	719106.32	7480215.50
15	718943.95	7480532.10
16	719288.97	7480755.34
17	719629.93	7480178.97
18	719804.47	7479687.83
19	719861.29	7479147.99
20	720161.65	7478900.39
21	720656.85	7478827.34
22	721322.52	7478604.08
23	721566.06	7478510.73
24	721947.59	7478794.86
25	722373.79	7479204.82
26	722641.69	7479298.17
27	723522.48	7479277.88

END OF CO-ORDINATE LISTING

**Yandicoogina Junction South West and Oxbow
Zone 2a**

Prepared 14 August 2012

Co-ordinates defining *Zone 2a* are prescribed below, noting that the correct recreation of the boundary requires the sequential connection of the co-ordinates as per its co-ordinate number.

All co-ordinates are listed in Map Grid of Australia Zone 50 (MGA Zone 50), datum of Geodetic Datum of Australia 1994 (GDA94).

Co-ordinate

No.	Easting	Northing
1	729316.44	7478971.23
2	729469.66	7478861.78
3	729554.09	7478771.10
4	729866.79	7478627.26
5	730204.50	7478611.62
6	730389.00	7478611.62
7	730579.75	7478739.84
8	730776.74	7478908.69
9	730898.70	7478943.08
10	731316.68	7478650.92
11	731120.72	7478624.13
12	730989.38	7478545.95
13	730779.87	7478380.23
14	730617.27	7478258.27
15	730185.75	7478277.04
16	729913.69	7478311.43
17	729619.76	7478214.49
18	729257.02	7478227.00
19	729316.44	7478971.23

END OF CO-ORDINATE LISTING

**Yandicoogina Junction South West and Oxbow
Zone 3**

Prepared 14 August 2012

Co-ordinates defining *Zone 3* are prescribed below, noting that the correct recreation of the boundary requires the sequential connection of the co-ordinates as per its co-ordinate number.

All co-ordinates are listed in Map Grid of Australia Zone 50 (MGA Zone 50), datum of Geodetic Datum of Australia 1994 (GDA94).

Co-ordinate No.	Easting	Northing
1	737365.29	7491641.81
2	738101.04	7491917.07
3	739789.09	7488078.97
4	740730.85	7487208.30
5	741086.23	7486408.70
6	740677.53	7485911.17
7	740730.84	7485466.94
8	740411.00	7484152.03
9	739718.02	7484383.03
10	739913.47	7485431.40
11	740056.38	7486354.96
12	739131.64	7487545.90
13	738847.34	7487954.59
14	737745.67	7490282.33
15	737365.29	7491641.81

END OF CO-ORDINATE LISTING

**Yandicoogina Junction South West and Oxbow
Zone 3a**

Prepared 14 August 2012

Co-ordinates defining *Zone 3a* are prescribed below, noting that the correct recreation of the boundary requires the sequential connection of the co-ordinates as per its co-ordinate number.

All co-ordinates are listed in Map Grid of Australia Zone 50 (MGA Zone 50), datum of Geodetic Datum of Australia 1994 (GDA94).

Co-ordinate No.	Easting	Northing
1	732610.18	7473145.31
2	732923.39	7473740.85
3	733560.26	7474876.14
4	734003.30	7475374.56
5	734764.78	7476371.40
6	735401.65	7477645.14
7	736398.49	7478988.10
8	737187.65	7480054.17
9	738170.65	7481051.00
10	738849.05	7482103.22
11	739361.32	7483044.68
12	739719.85	7484391.49
13	740406.58	7484172.12
14	740482.75	7483556.94
15	740658.21	7482396.36
16	740344.29	7480566.42
17	740039.69	7479915.72
18	739278.23	7479389.60
19	737852.20	7478323.54
20	737602.99	7477769.74
21	737104.58	7477174.40
22	735955.44	7475886.82
23	735193.97	7474405.41
24	733501.13	7472501.85
25	732610.18	7473145.31

END OF CO-ORDINATE LISTING

**Yandicoogina Junction South West and Oxbow
Zone 4**

Prepared 14 August 2012

Co-ordinates defining *Zone 4* are prescribed below, noting that the correct recreation of the boundary requires the sequential connection of the co-ordinates as per its co-ordinate number.

All co-ordinates are listed in Map Grid of Australia Zone 50 (MGA Zone 50), datum of Geodetic Datum of Australia 1994 (GDA94).

Co-ordinate		
No.	Easting	Northing
1	733793.61	7479334.18
2	734462.81	7478946.40
3	735433.52	7478629.57
4	735622.26	7478710.46
5	735972.79	7478845.28
6	736700.81	7479216.04
7	737213.13	7478043.11
8	736646.89	7477571.24
9	735932.35	7477517.31
10	735440.26	7477510.57
11	734840.30	7477638.64
12	734287.54	7478164.45
13	733299.14	7478674.90
14	733793.61	7479334.18

END OF CO-ORDINATE LISTING

**Yandicoogina Junction South West and Oxbow
Zone 5**

Prepared 14 August 2012

Co-ordinates defining *Zone 5* are prescribed below, noting that the correct recreation of the boundary requires the sequential connection of the co-ordinates as per its co-ordinate number.

All co-ordinates are listed in Map Grid of Australia Zone 50 (MGA Zone 50), datum of Geodetic Datum of Australia 1994 (GDA94).

Co-ordinate

No.	Easting	Northing
1	731330.05	7478642.02
2	730902.64	7478946.02
3	731276.22	7479115.83
4	731354.96	7479342.36
5	731688.76	7479396.84
6	732490.83	7479544.02
7	732980.39	7479640.01
8	733450.74	7479553.62
9	733796.94	7479336.58
10	733300.72	7478676.22
11	732867.20	7479090.30
12	732587.92	7479131.18
13	732383.56	7478981.32
14	732135.66	7478814.49
15	731732.52	7478699.30
16	731330.05	7478642.02
17	726464.49	7479723.60
18	726886.85	7479925.18
19	727247.41	7479614.83
20	727606.78	7479378.04
21	728048.34	7479320.44
22	728534.86	7479362.78
23	728861.83	7479294.66
24	729318.22	7478967.70
25	729256.92	7478225.20
26	728969.85	7478485.32
27	728582.54	7478804.21
28	728269.20	7478981.33
29	727875.55	7478984.48
30	727472.21	7478974.51
31	726838.85	7479282.04
32	726704.47	7479454.83
33	726464.49	7479723.60

END OF CO-ORDINATE LISTING

Notes

The following notes are provided for information and do not form a part of the implementation conditions of the statement:

- The proponent for the time being nominated by the Minister for Environment under section 38(6) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal unless and until that nomination has been revoked and another person is nominated.
- If the person nominated by the Minister, ceases to have responsibility for the proposal, that person is required to provide written notice to the Environmental Protection Authority of its intention to relinquish responsibility for the proposal and the name of the person to whom responsibility for the proposal will pass or has passed. The Minister for Environment may revoke a nomination made under section 38(6) of the *Environmental Protection Act 1986* and nominate another person.
- To initiate a change of proponent, the nominated proponent and proposed proponent are required to complete and submit *Post Assessment Form 1 – Application to Change Nominated Proponent*.
- The General Manager of the Office of the Environmental Protection Authority was the Chief Executive Officer of the Department of the Public Service of the State responsible for the administration of section 48 of the *Environmental Protection Act 1986* at the time the statement was signed by the Minister for Environment.

**Appendix 2 Environmental Values Statement (EVS) for
the Weeli Wolli Creek System**

Yandicoogina: High Level Values Statement Weeli Wolli Creek catchment October 2012

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 40km downstream of Yandicoogina.

Flora & 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 *Environment 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 conservation 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 macro invertebrates 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 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 distribution of the Chocolate Wattle Bat (*Chalinobolus morio*).

No threatened fauna are known from the Weeli Wolli & 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.

Appendix 3 Yandi Erosion Assessment Guide

Yandicoogina Operations

Erosion Assessment Guide



October 2012

1. Purpose

The Yandicoogina Iron Ore Project mining operation undertakes groundwater abstraction to enable mining of the below water table ore body. This excess groundwater is either utilised within the operations or is discharged to Marillana, Yandicoogina and Weeli Wolli Creeks via designated discharge outlets. The heightened flow rates, created by dewatering, increases the risk of erosion to the streambed and banks of the creeks that receive the discharged waters.

This erosion assessment guide outlines how the Yandicoogina operations will collate and assess information to monitor for potential erosion issues at dewatering discharge outlets within the Yandicoogina operation.

This strategy intends to utilise a qualitative process to assess the potential impacts from both natural (e.g. flood event) and artificial (e.g. dewatering) water flows.

This document provides a strategy for erosion assessment, outlining:

- data collection processes and field datasheets;
- sampling design; and
- data management.

2. Data Collection

Erosion assessments will be undertaken on a quarterly basis at each dewatering discharge outlet and will be based upon three key components. These components are: the creek channel; the stream bed; and the stream banks.

A visual observation and assessment will be made of both sides of the creek channel and recorded in a field datasheet (Figure 1). The completed field datasheets will be stored in the Rio Tinto Iron Ore document management system.

This field datasheet is divided into four tables, which reflect the three key components for assessment in addition to assessment details.

Section 1: Sample details

This section provides metadata about each assessment record (a location at a particular point in time). Assessors are to complete each field for every assessment record, including the visual observations field. This is used to store information unique to that sample record which is not captured in any other field on the datasheet such as extreme weather conditions or nearby construction activities. Rainfall data will be observed from the onsite weather station in conjunction with regional rainfall data from the Bureau of Meteorology.

Photographs will be taken during the inspection to ensure that an accurate historical representation is captured. The photographs will be included in the relevant field data sheets.

Section 2: Channel

This section stores information specific to the water channel. The visual observations field is to record information specific to the channel for that particular record. This may include fallen trees intercepting the channel, new control measures or other factors which impact the channel..

Section 3: Stream bed

This section stores information specific to the stream bed, assuming that the bed can be observed visually and the visual assessment is not obstructed by deep water.

Assessors will make note of soil types, and sediment sizes. It is important to note that the soil type and sediment size assessment will only be based on the predominant category for both type and size.

Visual observations are specific to the stream bed of that record such as newly formed islands.

Section 4: Banks

This section stores information specific to the creek bank. Assessors will make visual observations of the banks on both sides of the channel. Aspects for assessment include vegetation type and cover, soil type, gradient towards the channel (cross-sectional), signs of erosion and any notable change from previous sample records.

The visual observations field is to store information specific to the creek banks for that record, which is not adequately expressed in other data fields. This includes evidence of pastoral grazing or other observed changes to the bank.

3. Data interpretation

Individual field datasheets will provide “point-in-time” information for each dewatering discharge outlet. As a guide, this qualitative information can be used to identify erosion risk at each sample point utilising the matrix in Table 1 below. This will allow operations to identify the need for potential control measures at high risk assessment points.

Table 1: Erosion assessment risk matrix

	<i>No bed scouring, no bank erosion</i>	<i>Minor bed scouring; no bank erosion</i>	<i>No bed scouring, minor bank erosion</i>	<i>Minor bed scouring, minor bed erosion</i>	<i>Significant bed scouring, minor bank erosion</i>	<i>Mild bed scouring, significant bank erosion</i>	<i>Significant bed scouring, significant bank erosion</i>
<i>Slow flow</i>	Low	Low	Low	Medium	Medium	Medium	High
<i>Moderate flow</i>	Low	Low	Low	Medium	Medium	Medium	High
<i>Fast flow</i>	Low	Low	Low	Medium	Medium	High	High

Figure 1. Field Datasheet

Section 1: Assessment details			
Assessor name(s):		Date:	
Assessment point:		Time:	
Rainfall (past 24 hours) (mm):			
Rainfall (past 7 days) (mm):			
Visual observations:			
Other notes:			
Assessment of erosion risk: (using matrix as guide)	Low / Medium / High		
Section 2: Channel			
Approximate width (m)		Approximate depth (m)	
Flow Rate	Pooled / Slow / Moderate (walk speed) / Fast	Contour	Straight / Slight Bend / Sharp Bend
Slope	Flat / Slight / Significant		
Stream distribution	Single Stream / Multiple Streams / Stream(s) and Pooling		
Visual observations			
Section 3: Stream bed			
Soil Type	Pebble / Gravel / Clay / Other (specify):		
Sediment size	Large only / Mixed sizes / Abundance of fine particles		
Contour gradient	Slight (broad channel) / Moderate / Steep (thin channel)		
Scouring of stream bed	No Scouring / Minor Scouring / Significant Scouring		
Visual Observations			
Section 4: Stream banks			
Vegetation type (circle all present)	Grass / Low strata (shrub) / High strata (Eucalypt)		
Erosion status (compared to last assessment)	Significant Erosion / Minor Erosion / Stable / Minor Deposition / Significant Deposition		
Current processes	Eroding / Stable / Depositing		
Location of erosion / Deposition	Toe of bank (undercutting) / Lower Bank / Upper Bank / Whole Bank / Nil		
Soil type	Pebble / Gravel / Clay / Other (specify):		
Gradient towards channel	Slight / Moderate / Steep		
Visual observations			
Photographs from the field assessment must be attached to this assessment.			