Rio Tinto Iron Ore

Yandicoogina Junction South West and Oxbow Iron Ore Project – Public Environmental Review

Response to Public Submissions

June 2012

Contents page

Tables

Figures

Appendices

1 Introduction

The following document describes responses by Hamersley Iron Pty Ltd (The Proponent) to public submissions made on the Yandicoogina Junction South West and Oxbow Iron Ore Project (the Proposal), as part of the public environmental review process for this proposal under the *Environmental Protection Act 1986* (EP Act). It also describes additional key studies completed for the Proposal since the release of project documentation for public review in October 2011, and addresses additional comments by the Office of the Environmental Protection Authority (OEPA).

1.1 Proposal overview

The Proponent's Yandicoogina iron ore mine is located approximately 90 kilometres north-west of the town of Newman. The Proponent has been mining the Channel Iron Deposits (CID) at Yandicoogina since 1998. The original Junction Central (JC) mine was approved under Statement 417, with later amendments detailed in Statement 523. The Junction South East (JSE) mine was approved under Statement 695, with mining commencing at this location in 2006.

The Proposal involves developing new iron ore mines at Junction South West (JSW) and Oxbow, which will sustain production from the overall Yandicoogina operations. The proposed new mines are located immediately west of the JC mine and existing ore processing infrastructure. The ore produced by the new mines will be processed and transported using a combination of new and existing facilities including:

- dry (crushing and screening) plant at the existing JC mine;
- new dry (and possibly secondary) crushing plants at JSW and Oxbow;
- stockpiling, tertiary crushing and screening, reclamation and rail load-out facilities immediately south of the JSW area; and
- transport to port facilities via the existing Pilbara Iron Yandicoogina railway line.

A combination of road haulage and new overland conveyors will connect the proposed JSW and Oxbow mine pits to the existing Yandicoogina ore processing infrastructure.

Depending on mine sequencing and integrated production rates across the entire Yandicoogina operations, the capacity of the existing processing facilities will need to be upgraded to manage higher volumes. Any expansions that are required will be subject to separate environmental approvals processes.

The reader is referred to the Yandicoogina Junction South West and Oxbow Iron Ore Project PER document (the PER Document; Rio Tinto 2011b) for a detailed description of the Proposal.

1.2 Assessment process

In January 2008 the Proposal was referred to the Environmental Protection Authority (EPA) under section 38 of *the Environmental Protection Act 1986* (WA) (EP Act). The EPA determined the Proposal would be assessed at the level of Public Environmental Review (PER) with an eight week public review period. A PER document was prepared which described the Proposal and its likely effects on the environment. The PER document was released for public comment on 10 October 2011 with the public submission period closing on 5 December 2011.

Five submissions on the PER Document were received, including submissions from the following State government agencies and one from a member of the public:

- Department of Environment and Conservation (DEC)
- Department of Indigenous Affairs (DIA)
- Department of Water (DoW)
- Department of Mines and Petroleum (DMP).

2 Additional studies completed since public release of the PER document

Since the PER Document was released for public comment, a number of additional actions and studies supporting the Proposal have been completed. These include:

- Review and update of biological baseline information;
- Detailed Hydrology (Stormwater) Study (BG&E 2012);
- Review of greenhouse gas emissions management (including energy efficiency opportunities);
- Additional mineral waste characterisation (Rio Tinto 2012a; Rio Tinto 2012b); and
- Closure options analysis:
    - mine planning (Mining One 2012)
    - hydrogeological modelling (RPS Aquaterra 2011) .

The relevant findings of these studies are described in Section 3; and study reports are provided as Appendices to this document.

The additional information gained from these studies is consistent with the environmental impact assessment and proposed environmental management framework described in the PER Document. No new environmental factors have been identified, and the significance of the various environmental factors discussed in the PER Document has not changed. None of the studies have identified a requirement to amend or add to the proposed environmental management measures described in the PER Document.

In accordance with the outcomes of these studies, and Rio Tinto's responses to public submissions described in Section 5, Rio Tinto holds the view that no material changes to the Proposal are required. However, to support the implementation of the Proposal a number of additional studies have been prioritised for implementation in 2012/2013. These are described in Section 3.7. Ongoing stakeholder consultation is planned and described in Section 4.

3 Supporting information

3.1 Review of biological baseline information

A review of the most current biological baseline information for the Marillana and Weeli Wolli creek systems relevant to the integrated Yandicoogina mining operation was undertaken by Rio Tinto in January 2012. The key components of the monitoring program are further described; and updated information to augment the PER Document is presented.

3.1.1 Baseline monitoring program

Rio Tinto maintains a comprehensive monitoring program targeting the riparian vegetation and aquatic fauna components of the Marillana and Weeli Wolli creek systems. The core elements of this program include:

- Digital Cover Photography (DCP) monitoring (Rio Tinto); which measures canopy foliage density of mature riparian Eucalypts. Foliage density in eucalypts is correlated with plant available water in accordance with the principle of ecological optimality (O'Grady *et al.* 2011; Ellis & Hatton 2008); and is regarded as a reliable indicator of water related stressors such as drought;
- Digital Multi-Spectral Imagery (DMSI) remote sensing of riparian vegetation (SpecTerra Services Pty Ltd); which provides a qualitative measure of change in vegetation condition based on a various spectral index;
- Riparian vegetation monitoring (Mattiske Consulting Pty Ltd); involving direct measurement of vegetation attributes (*e.g.* structure and composition) in transects within the riparian vegetation communities; and
- Aquatic Fauna Monitoring (Wetland Research Management Pty Ltd); involving direct measurement of aquatic fauna assemblages (fish, macro-invertebrates and micro-invertebrates) and water quality parameters (*e.g.* Dissolved Oxygen, Nitrogen, metals/metalloids) at sampling locations within the creek systems.

The details of these monitoring activities are captured in the Yandicoogina Mine Operations Environmental Management Plan and the Hope Downs 1 Water Management Plan.

The current coverage of the Monitoring Program includes the discharge footprint associated with existing mining activities (*i.e.* Yandicoogina JC and JSE; and Hope Downs 1). As described in the PER Document, dewatering discharge associated with the proposed JSW and Oxbow mines is predicted to increase the extent of the discharge footprint by up to 4 km further downstream in Weeli Wolli Creek. Additions to the existing set of ecological monitoring sites are warranted, and additional sites have been selected for inclusion in the 2012 sampling program. The Proponent intends to further discuss the location of new sampling sites with the DEC prior to their establishment and use.

Digital Cover Photography:

Digital Cover Photography (DCP) provides quantitative measurements of the canopy gap fraction in tree foliage, which can be used to infer canopy foliage density. DCP monitoring downstream of the confluence of Marillana and Weeli Wolli Creeks currently includes one site (Site Y13) immediately below the confluence and a second site at Pugs Bore (Site PB01) approximately 17 km downstream of the confluence (in addition to 19 existing monitoring sites upstream from the confluence).

Rio Tinto plans to establish a further six sites between the existing Y13 and PB01 sites prior to any additional discharge associated with the development of the JSW and Oxbow mines, in order to increase coverage within the proposed new discharge footprint (refer to Figure 3-8 in the PER Document).

Digital Multi-Spectral Imagery

DMSI imagery is currently captured annually at the end of the dry season (seasonally from 2002 – 2010 for Marillana creek; and from 2004 - 2010 for Weeli Wolli creek), including from the confluence of the two systems through to the southern margin of the Fortescue Marsh (Site PB01; refer to Figure 3-8 in the PER Document). Note that expert review of data in 2010 determined that wet season data capture was no longer warranted. By considering and comparing spectral indices with ground based measurements (*e.g.* DCP), DMSI imagery can be used to assess broader scale vegetation trends which cannot practically be measured with ground based plots. Capture of this imagery and qualitative interpretation of tree health, based on vegetation condition indices developed for this purpose, will continue and complements the ground based monitoring components. The coverage of DMSI acquisition includes the Yandicoogina operations area and large sections of the Weeli Wolli Creek system, extending well beyond the proposed extended discharge footprint. Non-impacted creeklines in the region (e.g. Mindy Mindy and Coondiner creek systems) are also captured to provide greater regional context and enable comparison of trends.

Riparian Vegetation transects:

Riparian vegetation monitoring is currently undertaken at 26 locations along the Weeli Wolli creek system and a further seven sites along selected reference creek system further to the east (three sites in Mindy Mindy Creek; and four sites in Coondiner Creek). This monitoring is undertaken by Mattiske Consulting Pty Ltd and employs a standard design using belt-transects of 10 quadrats (each 100 m^2 in area) aligned perpendicular to the creek line. Within each quadrat the following parameters are measured:

- Tree condition monitoring:
    - Tree species
    - Tree height (cm)
    - Tree condition and DBH[1] (cm) of each stem on all trees
    - 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[2] growth to total canopy on each stem.
- Understorey monitoring:
    - Understorey species (shrubs, grasses, herbs and forbs)
    - Percentage alive and dead foliage cover (calculated by estimating the percentage of the quadrat being surveyed covered by each understorey species).

Digital photographs from permanent points are also obtained to provide a visual time series record of vegetation change at each sampling site.

Three additional sampling locations will be added to the program to increase sampling coverage within the proposed extended discharge footprint. This includes two sampling locations beyond the predicted maximum discharge footprint, to provide an impact detection capability in downstream areas towards the Fortescue Marsh.

[1] Diameter at Breast Height (130 cm)

[2] Shoots from epicormic buds along trunks and stems, which typically occur in response to tree damage or severe stress

Discharge has the potential to increase biomass accumulation in the riparian zone by promoting the germination and growth of plants in response to increased water availability. To date, this phenomenon has been qualitatively captured in transect monitoring datasets from the Marillana and Weeli Wolli creek systems (and other riparian systems elsewhere in the Pilbara). An example of tree foliage cover changes through time at location Y5, a monitoring site located in Marillana Creek, is provided in Figure 5. This tree exhibited severe foliage loss due to the impact of fire and the effects of the abnormally dry summer of 2009/10, however a sustained trend of foliage recovery was observed during 2011 coinciding with increased rainfall. In Rio Tinto's view, the existing monitoring regime provides sufficient data on changes in biomass accumulation in the Marillana and Weeli Wolli systems for impact detection purposes. However allometric equations suitable for estimating vegetation biomass from canopy area measurements are available for a variety of Pilbara vegetation types (Adams *et al.* 2001). Rio Tinto is investigating the potential for adapting these to provide a quantitative biomass estimation method that complements the other measurements.

Aquatic Fauna monitoring

Aquatic fauna monitoring is undertaken biannually within the Weeli Wolli and Marillana creek systems. Twelve sampling sites are currently monitored along Marillana Creek and a further six sampling sites are monitored downstream of the confluence of Marillana and Weeli Wolli creeks (Figure 1); all of which are within the current maximum discharge footprint.

Aquatic fauna monitoring will be extended further north along Weeli Wolli Creek, to include downstream reaches within the predicted maximum discharge footprint associated with dewatering from the JSW and Oxbow mines. Additional sampling points will target a subset of available pools extending as far north as Site PB01 (refer to Figure 3-8 in the PER Document), as dictated by the number of pools available for sampling. Where possible sampling will be undertaken in existing pools prior to dewatering of the JSW and Oxbow deposits, to enable a comparison of aquatic fauna assemblages before and after new discharge associated with the Proposal. However the persistence of these pools (and hence their amenability to sampling) is strongly influenced by climate, and also affected by discharge from existing mines.

As with the riparian vegetation transect monitoring, reference sites in the Mindy Mindy and Coondiner creek systems (further to the east) will continue to be concurrently sampled for aquatic fauna and the results contrasted with the Marillana and Weeli Wolli creek systems.

3.1.2 Current monitoring data

The current baseline monitoring dataset includes data from recent monitoring events that were not presented in the PER Document (Section 3.6.4). Recently collated monitoring results, which update Figures 3-9 and 3-10 in the PER Document, are presented in Figures 2, 3 & 4 respectively[3]. The results are consistent with the trends observed since 2003 presented and discussed in the PER Document (pg 70-71); with a general trend of increasing foliage cover in 2011 correlated with above average wet season rainfall following the very dry year of 2010 (refer to Figure 6 for monthly rainfall information in the period 2007 to 2011).

The most recent monitoring results do not indicate any requirement to amend or add to the proposed environmental management measures described in the PER Document.

[3] Using a baseline defined as the mean foliage cover of measurements made in October 2005, October 2006 and February 2007.

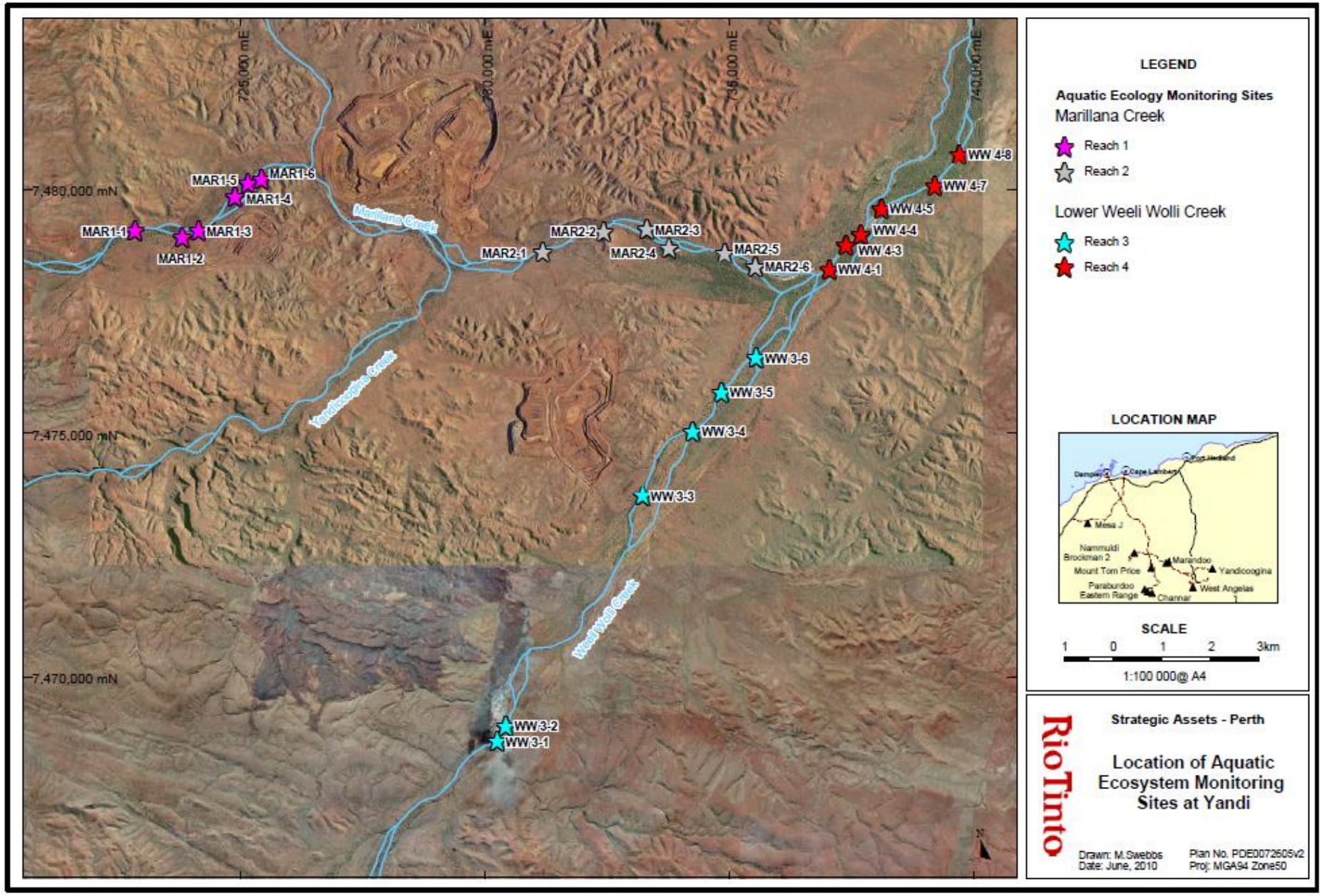

Figure 1 Location of Yandicoogina aquatic fauna monitoring sites

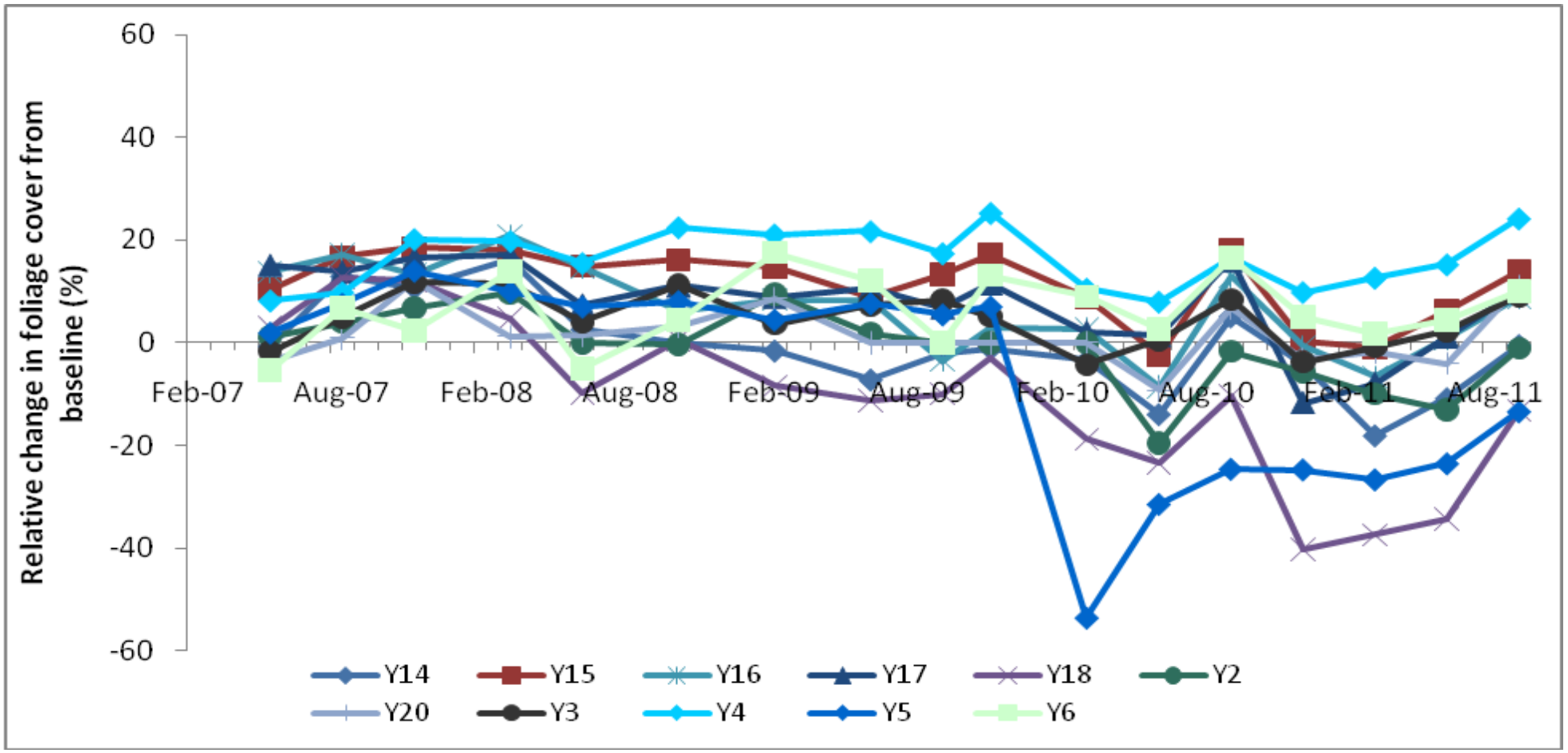

Figure 2 Changes in foliage cover through time at monitoring sites in the Marillana Creek

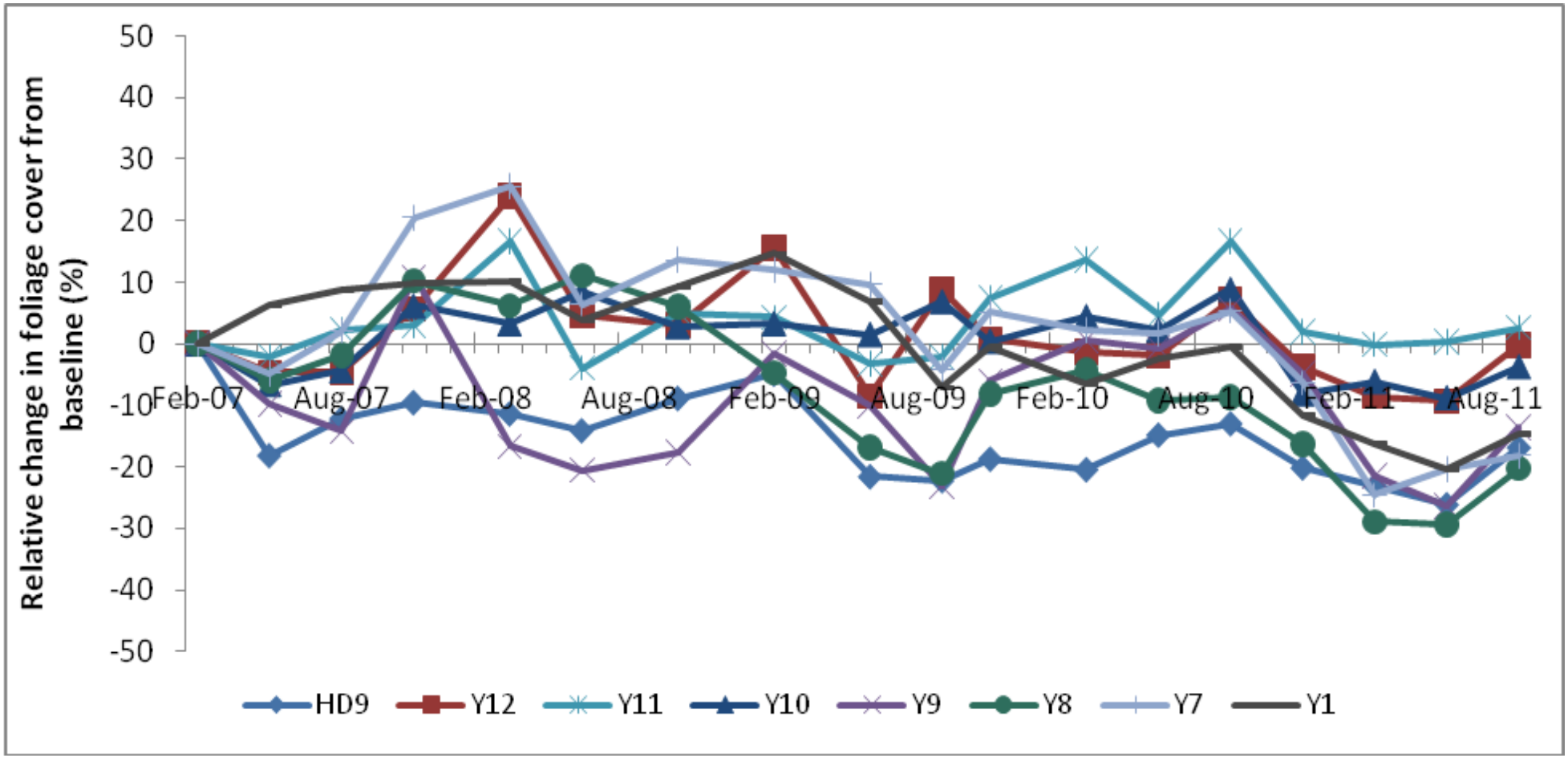

Figure 3 Changes in foliage cover through time at monitoring sites in the Weeli Wolli Creek (upstream from Marillana confluence)

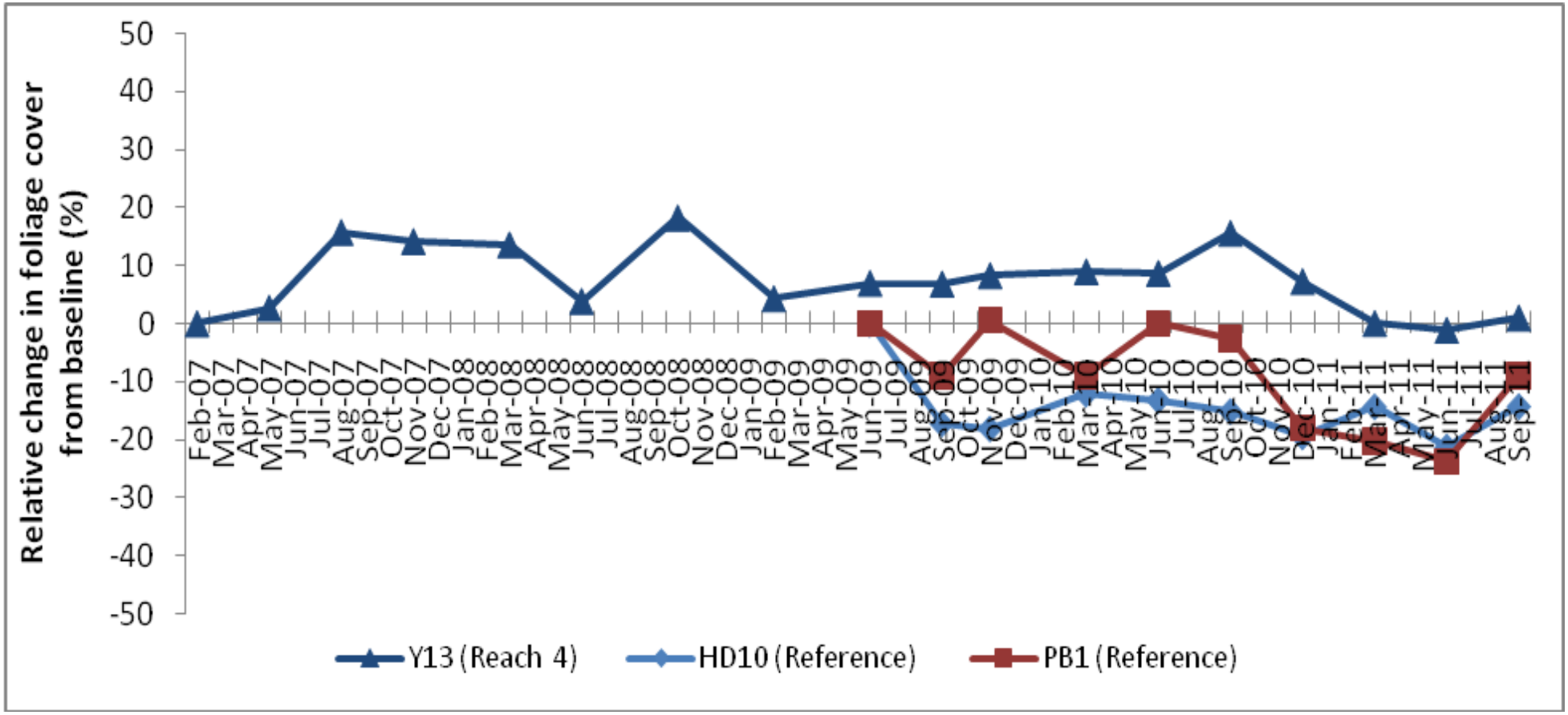

Figure 4 Changes in foliage cover through time at monitoring sites in the Weeli Wolli Creek (downstream from Marillana confluence)

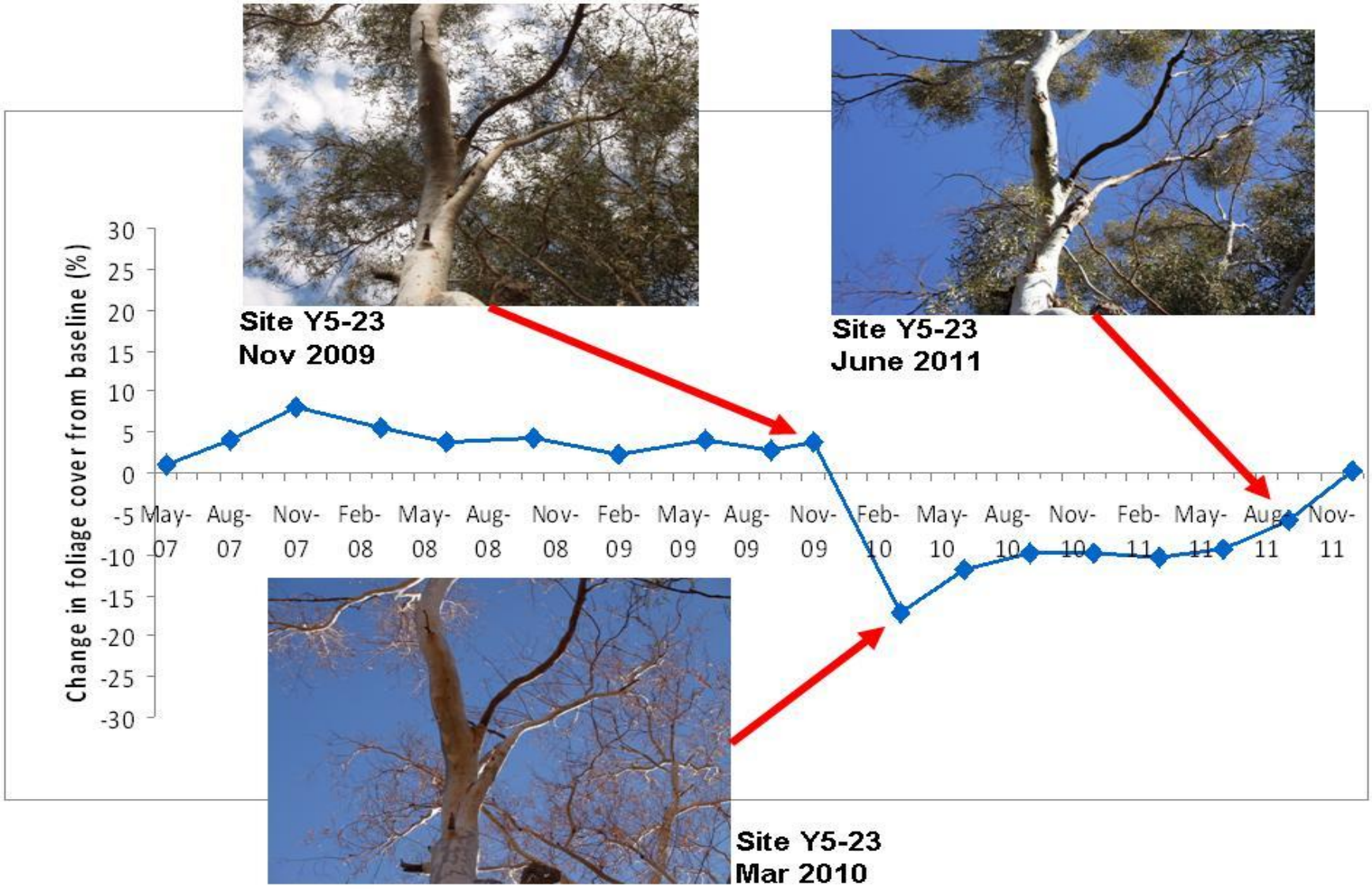

Figure 5 Example of changes in foliage cover through time at monitoring site Y5-23[4]

[4] Note that this is an example of an individual tree (23) within the Y5 site. The chart shows change on foliage cover which represents the entire group of trees monitored within this site.

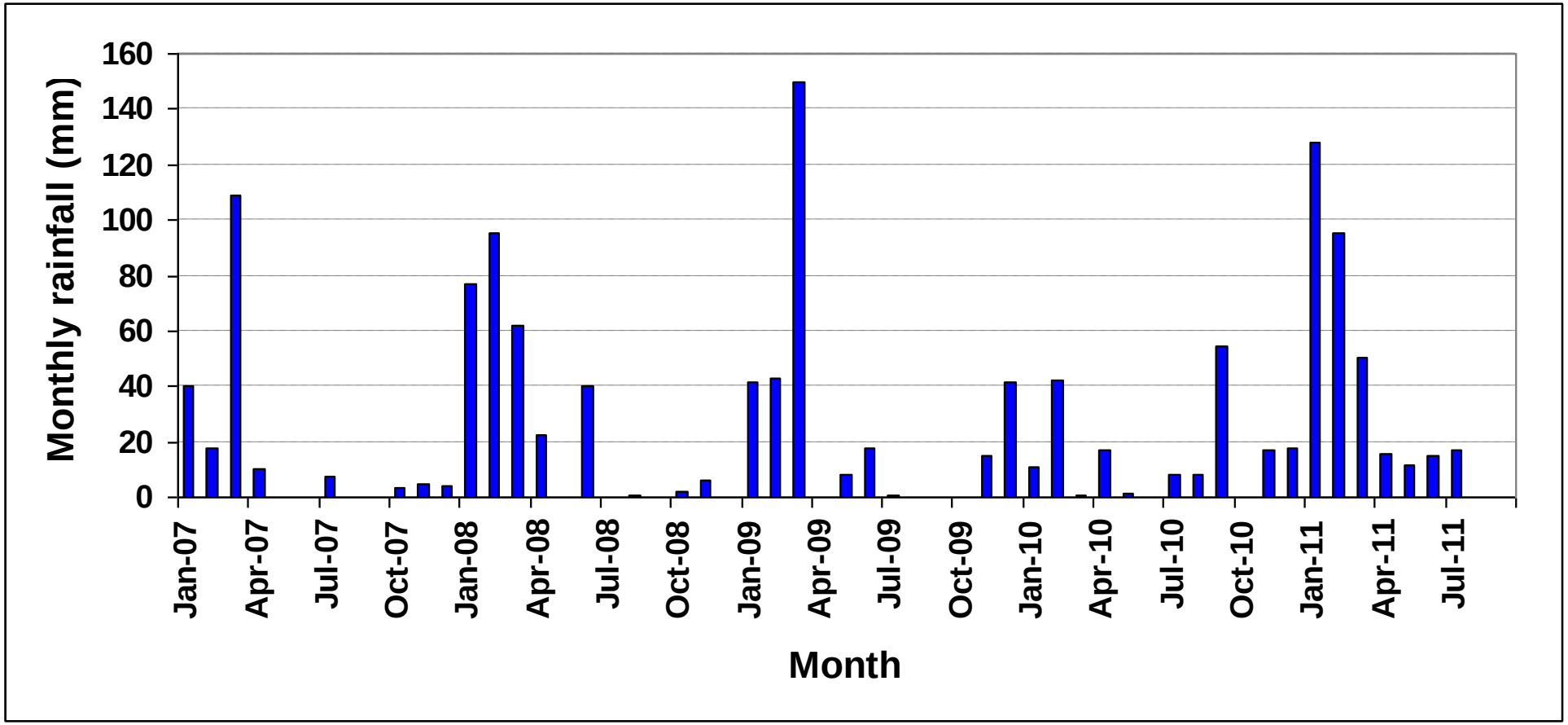

Figure 6 Monthly rainfall recorded at the BOM Marillana Weather Station[5] (January 2007 to September 2011)

[5] located ~30 km north-east of the Proposal area

3.2 Description of Predicted impacts as a result of Groundwater Drawdown and discharge

Drawdown can potentially reduce the availably of groundwater to species able to access this water source. Most Pilbara flora do not utilise groundwater but use stored soil moisture (derived from surface inputs) to meet their water use requirements. However the riparian tree species *Eucalyptus camaldulensis* and *Melaleuca argentea* are considered to be groundwater dependent species, and both of these species occur in some of the riparian vegetation units within the drawdown footprint shown in Figure 7-1 in the PER Document. Experience from Rio Tinto's riparian vegetation health monitoring program suggests that individual trees will respond differently to drawdown, ranging from no discernible impact to severe stress or tree death in extreme cases. At a community level, these effects are unlikely to significantly affect the species composition or extent of delineated vegetation types.

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. Where dense vegetation growth occurs the channel stream flow characteristics may be altered. Experience from Rio Tinto's riparian vegetation health monitoring program suggests that individual trees will respond differently to drawdown, ranging from no discernible impact to severe stress or tree death in extreme cases. As dictated by water availability, vegetation density would be expected to gradually revert back to pre-disturbance levels following the cessation of discharge.

Figure 7-1 in the PER Document shows the area of riparian vegetation that will be exposed to groundwater drawdown (worst case). Figure 7-2 in the PER Document shows the maximum (worst case) linear extent of creek systems that will be exposed to surface discharge water volumes. The spatial extents of these areas are further depicted in Appendix 15.

3.2.1 Drawdown

Drawdown refers to the lowering of the natural watertable caused by groundwater abstraction. Drawdown is most pronounced at the point of abstraction and diminishes with distance from the abstraction point. The area extent of dewatering associated with proposed mining at JSW and Oxbow was evaluated by Rio Tinto and is described in Section 7.1 (including Figure 7.1) of the PER document. This area extent was estimated based on:

- Evaluation of the predicted drawdown contours over the life of the proposed operations using the Yandicoogina Numerical Hydrogeological model, taking into account natural fluctuations in watertables within the CID and alluvial aquifers.
- The drawdown contours were then clipped to the boundary of the alluvial aquifer, such that the data would provide meaningful information with which to establish groundwater drawdown within the zone of interest (i.e. the Riparian zone).
- The groundwater depth contours within the alluvial aquifer were then synthesised into "depth zones", considered relevant to groundwater dependant vegetation (i.e. 0-5, 5-20 m, 20-50.m respectively). This provided a tool with which to assess key areas likely to be impacted by the proposal as a result of both abstraction and discharge, and more clearly illustrate potential impact areas. Refer to Appendix 15.

- The mapped extent of the Riparian vegetation was then overlaid over the groundwater depth zones, and the location of the proposed borefields.
- Potential drawdown impact zones were then defined by taking into account:
    - The Marillana Creekline intersection with areas of the underlying CID aquifer which will be dewatered as part of the Proposal. This is because the alluvial aquifer naturally leaks into the underlying CID. With the commencement of dewatering, leakage is likely to be accelerated in the areas where the two aquifers overlap with each other.
    - The proximity of the borefield, where the extent of drawdown will be greatest
    - The boundary where predicted drawdown was modelled to be greater than 5 m, and proximal to the intersection of the two aquifers. This boundary conservatively defines areas where the watertable could periodically be lowered below natural water table fluctuations under worst-case climate and drawdown extent scenarios.

Zone 1: Main Riparian Impact Area

This is the area where the Marillana creekline (part of the Alluvial aquifer) overlaps with the underlying CID aquifer (which is also the CID orebody). In this area, natural leakage occurs between the Marillana Creekline into the underlying CID aquifer. Drawdown impacts as a result of dewatering of the CID orebody would therefore greatly accelerate the leakage between the aquifers in this area and thus could potentially reduce the water availability for Riparian Vegetation in this zone. Due to the location of the borefield in this area, drawdown will be most significant in this zone (predicted to range from 20 to 50), as influenced by climatic variability and BHPBIO discharge volumes. Irrigation of the vegetation within this area would not be feasible as an operational contingency measure to alleviate vegetation stress, as water would immediately be recycled back into the proposed JSW pit (i.e. double handled). However, some surface water would enter the alluvial aquifer during natural rainfall and surface flow events, in addition to discharge from BHPBIO Yandi operations upstream.

Note that Zone 1 (Appendix 15) essentially coincides with the same area which was predicted to show tree stress in the original Junction Central Environmental Impact Assessment (Consultative Environmental Review) in 1995 (Hamersley Iron 1995).

Zone 2: Potential Impact area

This area represents a worst-case extent of drawdown beyond natural watertable fluctuations and where minor overlapping sections of the CID and alluvial aquifer occur. Drawdown is predicted to range from 0 to 50 m as affected by climatic variability. Significant impacts to riparian vegetation from drawdown are considered to be unlikely within this zone, with any impacts most likely to occur in the 1.6km alluvial/CID intersection (of the total 6km section length).

3.2.1.1 Description of Drawdown Impacts

Based on the methodology described above, the maximum area of riparian vegetation potentially exposed to drawdown includes a total area of 300 ha (Table 1; Appendix 15) consisting of 110 ha in the immediate vicinity of the proposed JSW pits (Zone 1) and 190 ha further upstream (Zone 2). Zone 1 is anticipated to be the primary zone of drawdown impact because the magnitude and duration of drawdown will be most pronounced in this area (as previously described).

The only DRF species recorded in the Yandicoogina locality is *Lepidium catapycnon*. *Lepidium catapycnon* is an ephemeral xerophyte (*i.e.* not groundwater dependent) commonly found growing in skeletal soils on rocky hill slopes. This species does not occur in the drawdown or discharge footprints

(as can be determined by cross referencing Figures 3-7b, 3-7d, 7.1 and 7.2 in the PER document). The will be no impact of dewatering on this species or its habitat.

Background

Riparian systems of the Pilbara bioregion are subjected to extremely seasonal and variable hydrologic regimes, in which stream flow typically occurs following cyclonic rainfall events (Ruprecht & Ivanescu 2000). Large flow events can result in the formation of isolated pools, replenish floodplain soil moisture and recharge groundwater within the riparian system.

In creeks and rivers of the Pilbara, groundwater is typically contained within shallow, unconsolidated sedimentary aquifers close (<20 m) to the surface (Landman 2001). In some instances, groundwater reaches the surface and natural springs are formed, maintaining permanent surface water pools. These shallow aquifers often support groundwater dependent ecosystems (GDE's); natural ecosystems that require access to groundwater to meet some or all of their water requirements to maintain their communities of plants and animals, and ecological processes (Sommer & Froend 2011).

GDE's support a range of species that have deep-roots, which in the absence of rainfall rely directly on groundwater but may also contain herbaceous and grass species relying on recent precipitation (Sommer & Froend 2011). Plant species which draw water from the saturated zone or capillary fringe of the water table are known as phreatophytes and the presence of GDE's is often inferred from the presence of such species (Eamus *et al.* 2006).

Variability of Phreatophytic vegetation

Not all phreatophytic vegetation displays the same degree of dependency on groundwater. Furthermore, groundwater dependency has been shown to vary both spatially and temporally for many phreatophytic species (Eamus and Froend 2006). Obligate phreatophytes are those species for which access to groundwater is critically important to their presence in the landscape. Such species can only inhabit areas where they have access to groundwater in order satisfy at least some proportion of their environmental water requirements (EWR) (Eamus *et al.* 2006). Facultative phreatophytes, on the other hand, are plant species for which access to groundwater is not essential or important to their presence in the landscape. Facultative phreatophytes may utilise groundwater to satisfy a proportion of their EWR but, where this is not available, may also satisfy their total EWR via surface derived stored soil water reserves (Eamus *et al.* 2006).

The tree species *Eucalyptus camaldulensis (River Red Gum), E*. victrix (Coolibah) and *Melaleuca argentea* (Silver Cadjeput) are three of the most common phreatophytic species within riparian systems of the Pilbara bioregion. The presence of these species is often used to infer the existence of a GDE. The three species vary in their degree of dependence on groundwater and this variation has a strong influence on their distribution and abundance within riparian systems.

Melaleuca argentea is a tree which grows to approximately 18 metres and is found along larger watercourses of the Pilbara. *M. argentea* is thought to depend on groundwater almost exclusively to meet its water requirements and is therefore considered to be an obligate phraetophyte (Lemontagne *et al.* 2005, Graham *et al.* 2003, Landman *et al.* 2003, O'Grady *et al.* 2006). Because of its dependence on groundwater, this species is typically found in parts of creeks and rivers characterised by permanently inundated pools and springs or where the water table is permanently close to surface (McLean *et al.* 2011).

Eucalyptus camaldulensis is a common and iconic species occurring along many of Australia's permanent or larger ephemeral inland riverine systems (Wen *et al.* 2009). River Red Gum is considered a facultative phreatophyte as it obtain its water for transpiration via three main sources: groundwater, river flooding (which over tops creek and river banks thereby replenishing floodplain soil moisture), and rainfall (Wen *et al.* 2009). The degree to which River Red Gum depends on groundwater and soil moisture has been found to vary both spatially and temporally (Mensforth *et al.* 1994, O'Grady *et al.* 2009, Wen *et al.* 2009, O'Grady *et al.* 2010).

Eucalyptus victrix has been shown to access groundwater in areas where the depth to water table is low (O'Grady *et al.* 2009) but in non-riparian habitats, has also been shown to exploit shallow soil water to meet is transpiration needs following wet-season rains (Grigg *et al.* 2008). Moreover, *E. victrix* has been shown to inhabit a periodically ephemeral wetland (i.e. Mount Bruce Flats, Karijiini National Park) despite the absence of a permanently saturated regolith available to its root system (Rio Tinto 2011a). Comparisons of groundwater and stem xylem water stable isotope compositions as well as pre-dawn and midday leaf water potential measurements suggest that *E. victrix* within the Mount Bruce Flats in Karijini National Park exclusively uses water drawn from the unsaturated soil profile during extended dry periods (P. Grierson unpublished data) and therefore has no groundwater dependency in this environment.

Discussion of Dewatering impacts

Dewatering, which causes localised lowering of groundwater levels, may have a significant impact on the health of *M. argentea* but lesser impacts on *E. victrix or E. camaldulensis*, provided adequate soil moisture is maintained from periodic, rainfall-generated stream flow. Experience from Rio Tinto's vegetation health monitoring program at Yandicoogina supports the contention that individual trees of *M. argentea* and *E. camaldulensis* will respond differently to drawdown, ranging from no discernible effect to severe stress or tree death in extreme cases. Levels of stress are linked to the relative amount of groundwater (versus surface derived water) used by individual trees, climatic and physiologically mediated water use demand, and the ability of trees to adjust to a modified hydrological regime. Trees have species specific mechanisms for coping with drought which are described in Section 3.6.4.1 of the PER document. The efficacy of these mechanisms is also likely to vary between individual trees and be influenced by factors such as tree age, tree position in the landscape, historical development of the tree root system, stand density and competition for moisture etc.

Consistent with the preceding discussion, it is not possible to make quantitative predictions of the different levels of stress individual trees will be subjected to using existing scientific knowledge. The majority of *E. camaldulensis* and *E. victrix* trees growing in areas exposed to drawdown would be expected to recover from stress attributable to drawdown following the cessation of dewatering provided that soil moisture is periodically replenished. The most significant environmental impact associated with dewatering is the potential loss (death) of the obligate phreatophyte *M. argentea* within the area exposed to drawdown. As such, tree loss represents an appropriate metric for evaluating drawdown impact that could be linked to management requirements (such as site rehabilitation targets). Existing management triggers specified in the Yandicoogina Environmental Management Program (PER Appendix B) relating to foliage cover changes also provide a basis for detecting and responding to drawdown impacts.

3.2.1.2 Predicted impacts

Given these uncertainties, and to support the assessment process, the area extent of riparian vegetation exposed to drawdown has been calculated (Table 1) and spatially represented (Appendix 15).

- Within **Zone 1**, the worst case scenario level of impact can be summarised as:
    - Total loss of all obligate phreatophytic trees over time (i.e. *M. argentea*). Vegetation mapping has shown that this species is already uncommon in Zone 1 (PER Appendix A1).
    - Significant decline in health of *Eucalyptus camaldulensis* and *E. victrix* (as measured by foliage cover changes) with regular breach of foliage cover triggers beyond natural fluctuations in foliage cover as reflected in regional studies on the wider creeklines and in reference creeks within the region.
    - Death of facultative phreatophytes during drought periods (i.e. after poor wet seasons) beyond natural background rates of tree death as reflected in monitoring of reference creeks within the region.
    - Loss of standing water in the existing artificially created pools and therefore loss of aquatic macrophytes and pool-fringing vegetation.
    - Longer term recovery and re-adjustment. The latter will be assisted by location and seed sources upstream from the Zone 1 area. Although individual trees may be affected, the overall structural and functional integrity of the riparian vegetation types within Zone 1 are unlikely to be significantly compromised in the longer term. Individuals of *Eucalyptus camaldulensis* and *E. victrix* have been observed to recover from total and partial defoliation in regional studies on the wider creeklines and in reference creeks within the region.

- Within **Zone 2**, the worst case scenario level of impact can be summarised as:
    - Moderate decline (for example loss of more than 50% of average foliage beyond natural fluctuations in average foliage cover) and some deaths of obligate phreatophytic trees over time leading to regular breach of existing foliage cover triggers at end of dry season.
    - Sporadic death of facultative phreatophytes beyond natural background rates of tree death as reflected in monitoring of reference creeks within the region.
    - Shorter term recovery and re-adjustment of *Eucalyptus* tree species. The latter will be assisted by location and seed sources upstream from the Zone 2 area and the lesser extent of predicted impacts.

3.2.1.3 Conservation values and context of drawdown impact locally and regionally

The conservation values of the areas subjected to drawdown impacts in a catchment and regional context have been further evaluated by Rio Tinto to support the assessment and are presented in Table 2. The key findings of this assessment are summarised as follows:

- In the drawdown impact area (Zones 1 and 2) key conservation values which may be impacted include:
    - Occasional scattered trees of varying maturity as part of eucalypt associations (including minor occurrences of *M. argentea)*.
    - A diverse stygofauna community associated with shallow aquifer, with some possible endemics
    - Heritage values.
- The area affected by drawdown as a result of the Proposal forms a small portion of equivalent riparian vegetation types in the locality. Using existing mapping within the catchment, ***the predicted drawdown impact area equates to 300 ha (~6%) of the extant riverine vegetation within the Marillana – Weeli Wolli catchment (~5,400 ha).***
- Based on Land system mapping (van Vreeswyk *et al.* 2004) calibrated with existing vegetation mapping data***, the predicted drawdown impact area equates to ~0.4% of the riverine vegetation within the Hamersley subregion (~73,000 ha).***

3.2.2 Discharge

The area extent of discharge associated with proposed mining at JSW and Oxbow was evaluated and is described in Section 7.1 (including Figure 7.2) of the PER document and is shown in Appendix 15. This area extent was estimated based on:

- Cumulative discharge footprint scenarios determined by Rio Tinto hydrologists, using maximum licensed discharge limits for all operations discharging into the Marillana – Weeli Wolli catchment (Rio Tinto Yandi, HD1 and BHPBIO Yandi) to represent a worst case scenario. These scenarios took into account the channel morphology, evaporation rates, density of riparian vegetation (evapotranspiration), leakage and the location of discharge points.
- The additional 4 km wetting extent predicted to occur from the proposed JSW and Oxbow operations (i.e. beyond the wetting extent attributable to existing mining operations).
- The boundary of the low flow channel, within which surplus discharge water would flow and create pools. This boundary defines the area within which riparian vegetation could be exposed to prolonged periods of inundation.
- The low flow channel averages ~40 m in width in the reach between the Marillana Creek confluence and Pugs Bore. This width is considered appropriate for the estimation of channel area within the reach. However due to the dynamic nature of the system, the low flow channel continually changes its pathway during flood events; as such the selection of a 40 m channel width should be considered indicative only. Note also that the additional 4 km of discharge impact predicted to occur as a result of the Proposal is based on the extent of the existing wetting front in Weeli Wolli creek at any given time. Therefore the location of the affected 4 km section (with its associated mean channel width) could occur within a larger creek section (i.e. 8 – 17 km from the Marillana confluence) and is likely to extend and recede seasonally within this larger section.

- Consistent with the above, a conservative estimate of the area subject to potential impacts from surface water discharge footprint over time was calculated as the mapped extent of the riparian vegetation 400 m x predicted extent of the wetting front 4 km.

- The size of Zone 4 was calculated using a similar methodology, based on the proposed new location of the discharge outlet, and the mapped extent of the riparian vegetation in the area extending to the Marillana creek confluence.

Based on this methodology, the maximum area of riparian vegetation potentially exposed to discharge includes a total area of 350 ha (Table 1; Appendix 15) consisting of 160 ha in the Weeli Wolli creek downstream from the Marillana Creek confluence (Zone 3) and 190 ha in the Marillana Creek downstream from JC (Zone 4). Note that Zone 4 is already subject to discharge from the existing Yandicoogina operations, however a new discharge point will be located in this area (downstream of the existing operations), which will carry the bulk of the dewatering from JSW and Oxbow operations.

Discussion of Discharge impacts

Artificial discharge of groundwater along ephemeral creeks and rivers may favour obligate phreatophytes such as *M. argentea* (resulting in increased recruitment) and macrophytes (e.g. Typha spp.) by creating a perennial hydrologic regime. Change from a steady-state ephemeral hydrologic regime to a more perennial one may however adversely impact *E. victrix* and to a lesser extent *E. camaldulensis*. Florentine (1999) found that *E. victrix* exhibits some tolerance to waterlogging (e.g. production of adventitious roots) but overall growth, transpiration rate and net photosynthesis are negatively affected under waterlogged conditions. *E. camaldulensis*, on the other hand, is considered to be one of the most tolerant eucalypt species to waterlogging (Bell 1999; van der Moezel *et al.* 1988), however to date there have been no empirical studies investigating waterlogging tolerance of varieties and subspecies of River Red Gum which inhabit the Pilbara bioregion. At the local scale the impacts of excess water will differ depending on the substrate and channel morphology and thus the relative position of individual trees to available water.

Historical monitoring undertaken by Rio Tinto supports the contention that local scale impacts of discharge will differ depending on the interplay between factors such as substrate, channel morphology, proximity of vegetation to low and high-flow channels etc. Monitoring indicates that there have been some localised stress and loss of riparian eucalypts (*E. victrix* and *E. camaldulensis*) in sections subjected to increased surface water, whilst in other areas the cover/abundance of saplings of *Melaleuca argentea* and riparian eucalypts have increased (Mattiske 2011). Monitoring also indicates the overall condition of some tree species has improved on some fringes of the creeklines subject to discharge (Mattiske Consulting 2011). To date these localised changes in tree condition in Marillana Creek, and to a greater degree in Weeli Wolli Creek, have been restricted to some selected areas downstream from discharge areas. The extent of change has been relatively minor and confined to a limited number of observed trees. The changes have not been significant when compared with regional trends in tree responses to seasonal conditions (Mattiske 2011).

Stochastic events such as episodic floods (and to a lesser extent fire) also play a major role in structuring riparian vegetation in space and time. This effect is often difficult to separate from the potentially more subtle changes arising from groundwater discharge impacts. The creeklines in Zones 3 and 4 are subjected to natural extremes in stream flow volumes and standing water levels. Extreme cyclonic (and post-cyclonic) rain events result in floods which can cause rapid and marked shifts in the understory species and sapling numbers within the valley floor of the receiving creek lines. The force and scouring affect of rapidly flowing water during these flood events appears to be the main cause of these rapid losses in vegetation. An increase in the cover/abundance of obligate and facultative phreatophyte saplings is generally accepted to be attributable to impacts of groundwater discharge; however large flood events can also be responsible for such increases. In particular their

scouring effect can great suitable habitat (e.g. pools) in areas where such habitat previously did not exist. Rio Tinto's riparian vegetation monitoring program has been designed to provide the basis for distinguishing between impacts caused by natural seasonal and cyclonic events and impacts caused by mining operations and associated anthropogenic disturbance.

Consistent with the preceding discussion, it is not possible to quantitatively predict how individual trees will respond to exposure to discharge water. The majority of trees within the creek lines would be expected to recover from any stress attributable to discharge following the cessation of dewatering. In areas subjected to prolonged waterlogging it is possible that losses could occur in a proportion of mature trees (particularly *E. victrix*). As such, tree loss represents an appropriate metric for evaluating discharge related impacts that could be linked to management requirements (such as site rehabilitation targets). Existing management triggers specified in the Yandicoogina Environmental Management Program (PER Appendix B) relating to foliage cover changes also provide a basis for detecting and responding to discharge impacts.

3.2.2.1 Predicted impacts

Given these uncertainties, and to support the assessment process, the area of extent of riparian vegetation exposed to discharge has been calculated (Table 1) and spatially represented (Appendix 15).

- Within **Zone 3,** the worst case scenario level of impact can be summarised as:
    - Increase in sapling cover/abundance of obligate and facultative phreatophytes beyond natural range of variation as reflected in monitoring of reference creeks in the region.
    - Increase in cover/abundance of some aquatic macrophytes (e.g. Typha spp.) beyond natural range of variation as reflected in monitoring of reference creeks in the region.
    - Isolated death of facultative phreatophytic trees (especially *E. victrix* which is considered the least water-logging tolerant of the three phreatophytic tree species). Tree deaths are expected to be restricted to substrates that are fully saturated for prolonged periods).
    - Short term recovery and re-adjustment following the cessation of discharge. The latter will be assisted by location and seed sources upstream from the Zone 3 area.
- Within **Zone 4**, the worst case scenario level of impact can be summarised as:
    - Increase in sapling cover/abundance of obligate and facultative phreatophytes beyond natural range of variation as reflected in monitoring of reference creeks in the region.
    - Increase in cover/abundance of some aquatic macrophytes (e.g. Typha spp.) beyond natural range of variation as reflected in monitoring of reference creeks in the region.
    - Short term recovery and re-adjustment following the cessation of discharge. The latter will be assisted by location and seed sources upstream from the Zone 4 area and the lower predicted impacts.

3.2.2.2 Conservation values and context of discharge impact locally and regionally

The conservation values of the areas subjected to discharge impacts in a regional context have been further evaluated by Rio Tinto to support the assessment and are presented in Table 1. The key findings of this assessment are summarised as follows:

- In the discharge impact area (Zones 3 and 4), key conservation values which may be impacted include:
    - Occasional scattered trees of varying maturity as part of eucalypt associations
    - A diverse stygofauna community associated with shallow aquifer
    - Heritage values.
- The area affected by drawdown as a result of the Proposal forms a small portion of equivalent riparian vegetation types in the locality. Using existing mapping within the catchment, ***the predicted discharge impact area of 350ha equates to ~7% of the extant riverine vegetation within the Marillana – Weeli Wolli catchment (~5,400 ha).***
- Based on Land system mapping (van Vreeswyk *et al.* 2004) calibrated with existing vegetation mapping data***, the predicted discharge impact area equates to ~0.5% of the riverine vegetation within the Hamersley subregion (~73,000 ha).***

Table 1 The estimated maximum area of extent of vegetation units that could potentially be exposed to the indirect impacts of dewatering and discharge (worst case)

Riparian Zone	Location	Potential Impact	Area (Ha)	Comments
Zone 1 **Marillana Creek**	JSW drawdown zone (in vicinity of put and borefield)	Drawdown	110	*Main drawdown area.* Supplemented by surface water discharge from BHPBIO operations & rainfall events.
Zone 2 **Marillana Creek**	Potential extent of drawdown, upstream of JSW	Drawdown	190	*Drawdown extent.* Supplemented by surface water discharge from BHPBIO operations & rainfall events.
Zone 3 **Weeli Wolli Creek**	Downstream of discharge extent predicted for existing operations	Discharge	160	Based on average width of main low flow channel and mapped riparian width between the Marillana Creek confluence and Pugs bore (400m) x predicted wetting front of 4km attributable to JSW & Oxbow
Zone 4 **Marillana Creek**	Downstream of Marillana discharge outlets	Discharge	190	Area currently subject to discharge flows. Area likely to experience increased flows due to the proposal
Totals			**650**	

Table 2 Ecological Attributes and Values of the Riparian zones within the Weelli Wolli creek catchment

Ecological Attribute/Value	Weeli Wolli Springs	JSW/Oxbow Sections of Marillana Creek	Downstream of Marillana Confluence	Fortescue Marsh Catchment (2b Poonda Plain)*
Melaleuca argentea woodland	Dense mature woodland, with high level of seedling recruitment	Occasional scattered trees of varying maturity as part of eucalypt associations	Occasional scattered trees of varying maturity as part of eucalypt associations	Occasional scattered trees of varying maturity as part of Eucalypt associations (riparian woodlands) along drainage tracts
Natural permanent water	Yes	None (some areas currently inundated by BHPB dewatering discharge)	None (a variable 3-5 km stretch currently inundated by Rio Tinto/HD/BHPB dewatering discharge)	None
Phreatic (spring) habitat	Yes	None	None	None
Phreatic fauna community	Diverse community associated with phreatic habitat and surface water, including endemic	Ephemeral surface water taxa only	Ephemeral surface water taxa only	Ephemeral surface water taxa only
Stygofauna habitat	Thick saturated alluvial sequence, associated with massive calcrete zone	Saturated alluvial sequence overlying CID	Relatively shallow alluvium overlying CID	Poorly characterised
Stygofauna community	Diverse community associated with shallow aquifer and spring habitat, including endemics	Diverse community associated with shallow aquifer, with some possible endemics	Relatively few species represented from sampling in locality	Relatively few species represented from sampling in locality
Priority Ecological Community	Yes - listed as P1 PEC	None	None	None (Fortescue Marsh listed as a P1 PEC)
Threatened Flora	*Stylidium weeliwolli* (P2)	None known	None known	None known within creek bed of potential impact area
Threatened Fauna	*Macroderma gigas* (Ghost Bat; P4)	None known	None known	None known from creekline impact area Northern Quoll[+], Bilby[+]
Heritage values	Yes - significant	Yes	Yes	Yes
Representative photos				

*From EPA 2011 Draft Guidance for environmental and water assessments relating to mining operations in the Fortescue Marsh Area

+ From EPA 2011 2b Poonda Plain area, however not known from Weeli Wolli creekline impact area.

3.3 Detailed Hydrology (Stormwater) study

A Detailed Hydrology Study of drainage and flood protection structures required for the proposed JSW pits was completed in January 2012 (BG&E 2012; Appendix 1). This report describes:

- Levee placement and engineering designs within fringing sections of the Marillana Creek natural 100-year ARI[6] floodplain, to protect the JSW-A and JSW-C pits from flood risk. These have been designed to protect against a 100-year ARI event with a 500 mm freeboard. Some levee sections will require rock armouring, based on modelled flood depths and velocities.
- Drainage diversion channels on the northern boundary of JSW-C, to divert catchment inflows around mining areas into Marillana Creek. The eastern diversion channel will require gabion basket energy dissipation structures due to channel steepness.
- Drainage diversion channels on the southern boundary of JSW-A, to divert catchment inflows around mining areas into Marillana Creek.
- Floodway designs for heavy vehicle crossing points near the west end of JSW-A and Phils Creek. The floodway designs include culvert structures, and have been designed to be dry (with 600 mm freeboard) for the 2-year ARI event, and wet (with 300 mm water depth) for the 5 -year ARI event.
- Phils Creek temporary diversion channel and reinstatement channel. Both channels will be designed to withstand the 100-year ARI event. The temporary diversion channel will require a 50 m base width, with some rock armouring near the Marillana Creek confluence. The reinstatement channel has been designed to have a 50 m base width, with sections of rock armouring along the toe of the banks and extending onto the east side.

The report also describes the design of a channel diversion structure at JSE to protect a proposed new wet processing plant, and a site wide culvert analysis that identifies areas requiring through drainage across the Yandicoogina operations. The proposed wet processing plant at JSE is not part of the Proposal, and will be subject to a separate approvals process.

The completed detailed engineering designs are consistent with surface water management requirements and strategies described in the PER Document (Section 7.4). In some areas the width of the Marillana Creek 100-year ARI floodplain will be reduced by the levee structures. However there will be minimal disturbance to the Marillana Creek channel proper (low flow line) and associated riparian woodland vegetation; consistent with Rio Tinto's approach of avoiding direct disturbance riparian vegetation where possible. A layout plan for the proposed structures is provided as Appendix A in BG&E (2012) (Appendix 1).

[6] Average Recurrence Interval; the long-term average number of years between the occurrences of a flood as big as the selected event

Under the proposal, water management at Yandicoogina will be integrated across the component operations (i.e. JC, JSE, JSW and Oxbow). The statement that 'approximately 30% of abstracted water is re-used on-site for operational purposes (including reinjection at Billiards South)' refers to the whole-of-operations water balance.

To provide further clarity with respect to the impact of the proposal on the Yandicoogina overall site water balance, a site water balance based on the existing JC and JSE mines approved abstraction rates has been compared to the JSW and Oxbow proposal in order to illustrate the relative change in water requirements as a result of the Proposal (Table 3). This shows that the "relative portion" of discharge from the Proposal is up to 16Gl/a of the total discharge of 43 Gl/a (i.e. approximately 37% of the total Yandicoogina operations discharge). The modelled average and worst case water balance for the overall operations have been included in Table 4.

The water balance components associated with the proposed mining at JSW and Oxbow have not previously been considered in isolation from the current operations at JC and JSE for the following reasons:

- The individual pits are not isolated from each other hydrogeologically, giving rise to complex interactions between the pits with respect to dewatering and discharge. This is a consequence of the structure and behaviour of the CID aquifer and its variable connection with the adjacent alluvial aquifer within the Marillana Creek valley. In particular, dewatering of upstream pits can act to reduce the dewatering requirement in downstream pits. Conversely, discharge can potentially contribute to an additional dewatering requirement where the discharge intercepts drawdown cones of depression.
- Figure 7 depicts the relative portion of dewatering from each of the pits over time, including the development of JSW and Oxbow in order to illustrate the integrated nature of the water management at Yandicoogina.
- As a consequence of these interactions, significant volumes of water can be recirculated within the overall groundwater system subject to dewatering activities.
- The discharge of water volumes upstream by BHPBIO further complicates the water balance. Much of this discharge water percolates into the groundwater system near JSW where a proportion of it is re-abstracted and disposed of by Rio Tinto (refer to Figures 5-1 & 5-2 of the PER).
- Figure 8 illustrates the overall water balance over time for the Yandicoogina operations, including relative portions of abstraction, re-use, reinjection, and the resultant discharge volumes.

Figure 9 depicts the modelled cumulative Mariallana and Weeli Wolli catchment impacts as a result of mine dewatering and contexts this Proposal's impacts (JSW & Oxbow).

Table 5 provides a collated summary of the clearing estimates for Proposal related disturbance to riparian vegetation by flood controls and infrastructure.

Table 3 Predicted Rio Tinto Yandicoogina water volumes (based on worst case scenario)

Scenario	Total Dewatering (GL)	Site Use (GL)	Re-injection (GL)	Volume To Discharge (GL)
Rio Tinto Proposed Yandi operations (JC, JSE, JSW, Oxbow) worst case scenario*	53	6	4	43
Rio Tinto Existing Yandi Operations (JC & JSE License limits)	35	4	4	27
Incremental increase JSW & Oxbow	18	2	0	16

Table 4 Summary of predicted Rio Tinto Yandicoogina operations water balance (JC-JSE-JSW-Oxbow), including average and worst case scenarios

Scenario	Total Dewatering (GL)	Site Use (GL)	Re-injection (GL)	Volume To Discharge (GL)
Average Case – BHP **5**GL discharge	47	6	4	37
Worst Case – BHP **15**GL discharge	53	6	4	43

* Worst Case – based on existing BHPBIO upper license limit (**15**GL discharge)

Table 5 Estimate of the maximum extent of clearing disturbance to the Riparian flood Plain in Marillana Creek for the Yandicoogina JSW and Oxbow Proposal

Infrastructure	Max Disturbance (Ha)
Flood Control (levees, floodways, Phil's Creek diversion)	26
Infrastructure (pipes, conveyors, bore fields, roads)	14
Total	**40**

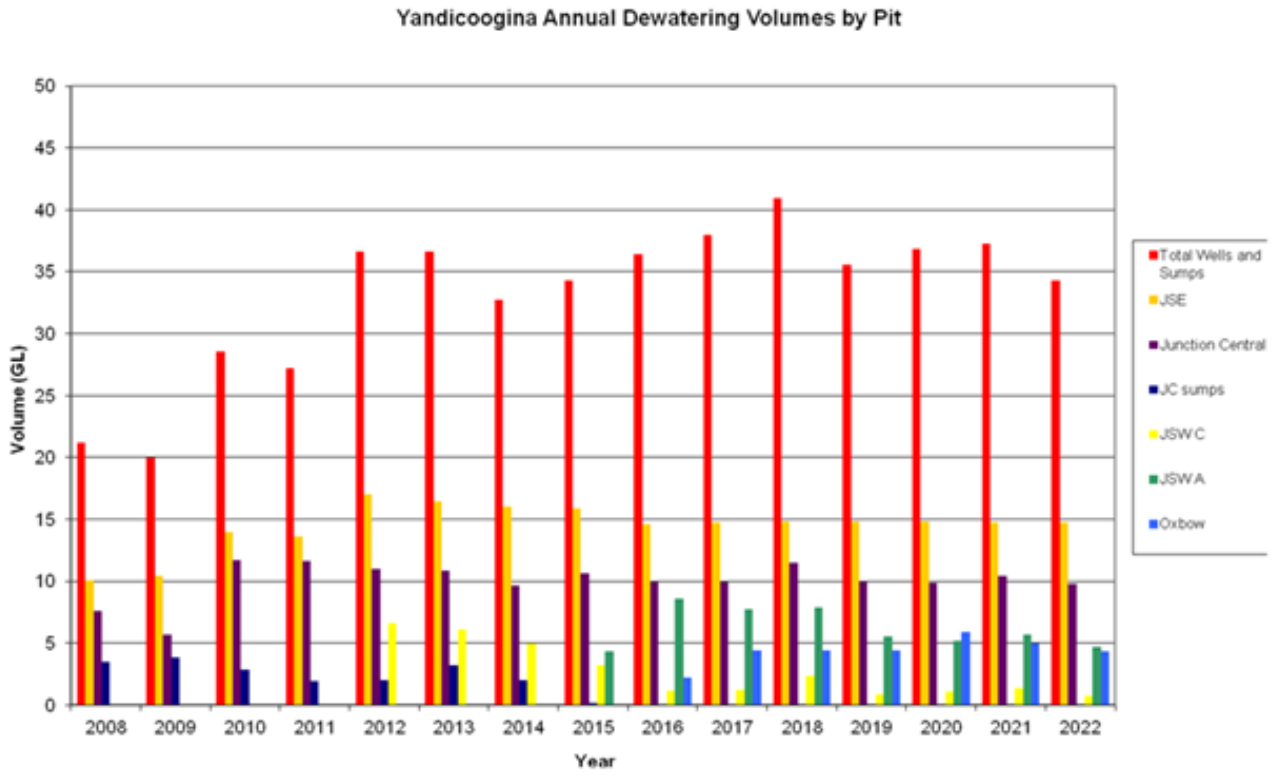

Figure 7 Yandicoogina Average Annual Dewatering Volumes by Pit

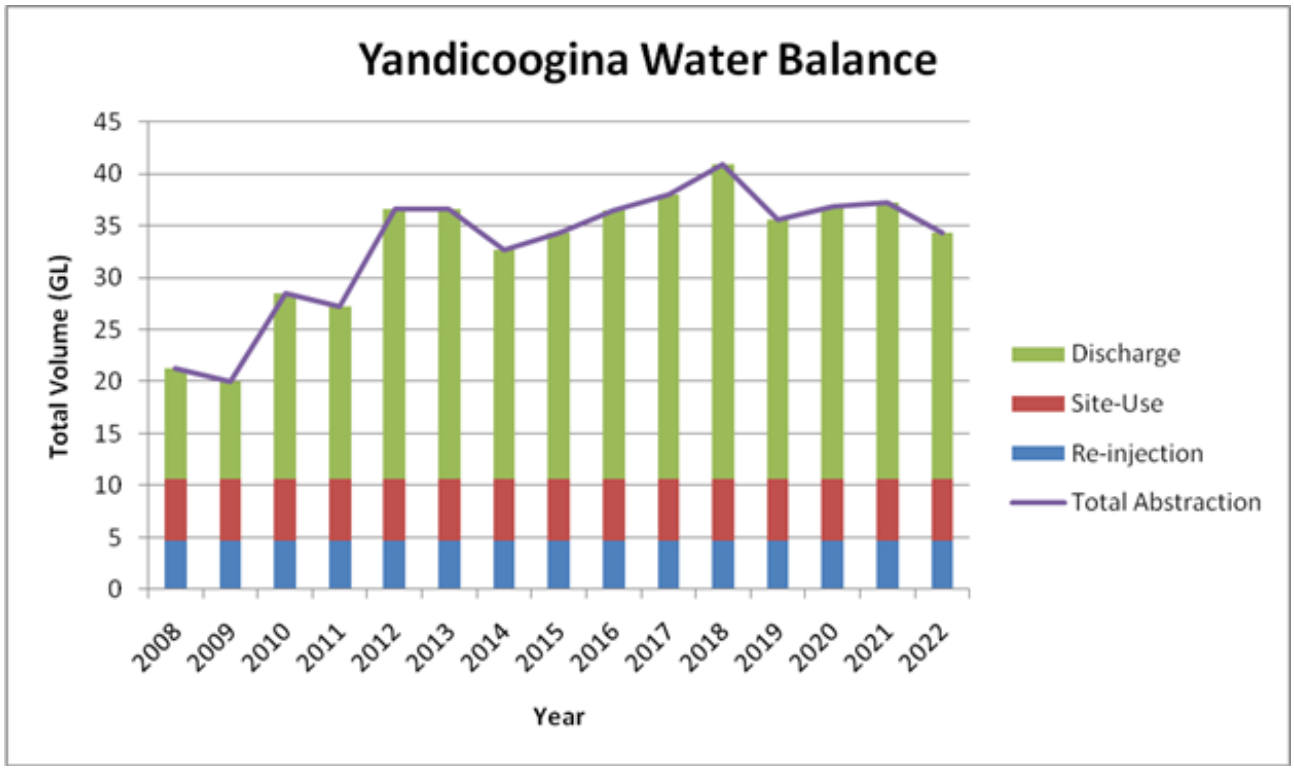

Figure 8 Yandicoogina predicted Water balance – based on 5GL/a discharge from BHPBIO Yandi.

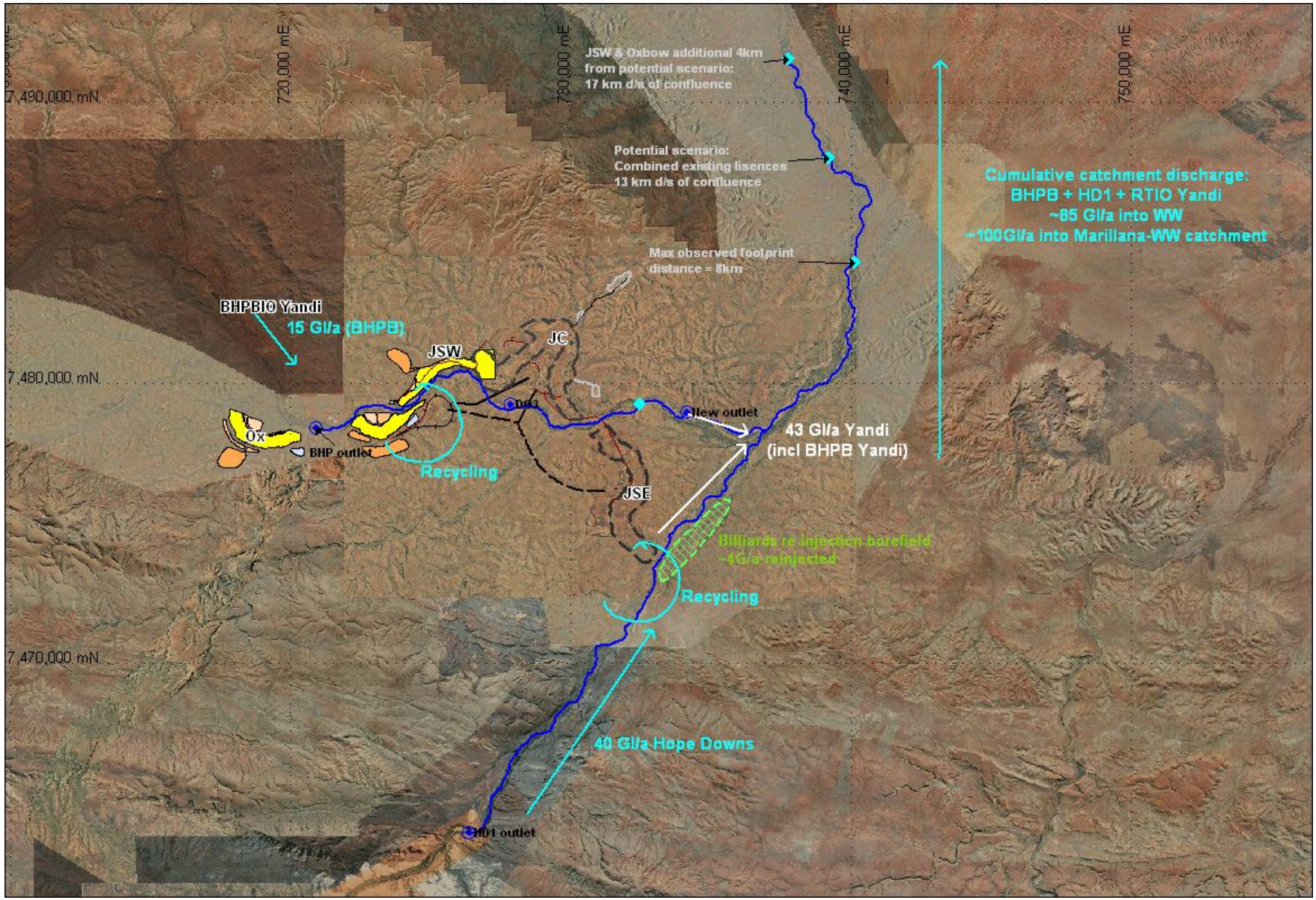

Figure 9 Marillana – Weeli Wolli catchment predicted worst case cumulative water balance* as a result of the Proposal (JSW & Oxbow)

* Assumes licence limits do not increase. BHPB Jinidi not included in the calculations as the modelled extents do not reach the HD1 discharge outlet.

3.4 Review of greenhouse gas emissions management

Rio Tinto has reviewed its approach for managing greenhouse gas emissions associated with the Proposal in light of recent national policy developments and the advancement of engineering design work associated with the Proposal. The key findings are summarised as follows.

New policy and legislative settings

The PER Document included the statement '*RTIO will monitor state and national developments for greenhouse gas emissions, and adopt a proactive approach for responding to carbon price signals or new compliance requirements that may arise*' (page 213).

Since the PER Document was originally drafted, there have been significant developments in national policy and legislation relating to industrial energy consumption and greenhouse gas emissions. The overriding development has been the passing of the Australian Government's Clean Energy Legislative Package, which received the royal assent in November 2011. This legislative package has established a carbon pricing mechanism which internalises carbon pollution costs associated with the combustion of fossil fuels. Hence it establishes a direct economic incentive for improving the efficiency of energy use and adoption of lower emissions technologies.

As part of Rio Tinto's iron ore business, the current and proposed Yandicoogina mining operations will be subject to the *Clean Energy Act 2011* (Cmth) and other relevant components of the Clean Energy Legislative Package. Compliance with the new legislative requirements forms one component of Rio Tinto's current approach for managing greenhouse gas emissions associated with the Proposal. Energy consumption and emissions associated with the Proposal will be monitored and reported annually under the National Greenhouse and Energy Reporting System (NGERS); as part of the existing reporting system in place for the integrated Yandicoogina operations.

Renewable energy and energy efficiency improvements

Rio Tinto maintains a strategic outlook across its iron ore business with respect to energy supply and demand management, efficiency of energy use and management of greenhouse gas emissions. This is driven in part by the nature of the company's power generation, transmission and distribution network; which integrates across multiple Pilbara mine sites. Supply side opportunities for improving generation efficiency and introducing renewable options are most appropriately considered in the context of the overall network. Particularly given the capital intensive and long-term investment aspects of current renewable energy solutions, any renewable generation capacity should be situated at optimum locations on the network rather than being directly associated with a particular project. Rio Tinto has being conducting wind and solar resource assessments at specific Pilbara locations since 2008, to support feasibility assessments of renewable generation options. This work remains in progress.

At the site level, energy management and emissions reductions options relate largely to demand side management and the selection of efficient energy conversion technologies. A preliminary evaluation of energy management and energy efficiency options for the Proposal has recently been completed, which has identified a number of potential design options that are currently subject to detailed engineering assessment. These options are further described in Appendix 2; and will complement energy management and energy efficiency initiatives at the existing Yandicoogina operations outlined in the PER Document. A detailed energy efficiency review will be undertaken during Q1 2012 as part of the feasibility study detailed engineering design review.

Stakeholder consultation

Rio Tinto will consult with the DEC and other relevant stakeholders early in 2012 to discuss the company's energy strategy and approach to managing energy consumption and greenhouse gas emissions. This will include discussion of measures in place to deliver continuous improvement in energy management, assessment of renewable energy options/opportunities, and how Rio Tinto's Pilbara wide strategy interfaces with activities at individual mine sites.

3.5 Mineral waste characterisation

3.5.1 Geochemical characterisation

Rio Tinto has recently completed geochemical characterisation work on samples obtained from the JSW drilling programme completed in June 2011, and grab samples obtained in 2009 and 2011 from JC and JSE lithologies (Rio Tinto 2012a, Appendix 3). A total of 274 samples were tested for elemental enrichments and 188 underwent short term leach testing, consistent with the methodologies described in Green & Borden (2011). The following strand-tag groups were collected for analysis:

- Alluvials (ALL);
- Basal clay conglomerate (BCC);
- Eastern clay conglomerate (ECC);
- Goethite vitreous lower (GVL);
- Goethite vitreous upper (GVU);
- Limonitic goethite CID (LGC);
- Weathered CID (WCH); and
- Weeli Wolli Formation (WW).

Total sulfur was analysed using the LECO method and gave results ranging from below the detection limit of 0.01% through to the maximum of 0.1%. All tested samples were categorised as non-acid forming (NAF).

All strand-tag units were either enriched or elevated in Fe, As and Sn. Elevated Ba, Sb, Se and V also occurred in a limited number of samples. Negligible leaching of any elements of potential environmental concern was detected in short term leach tests.

The results indicate that there is a low risk of acidic and/or metalliferous drainage associated with the Yandicoogina lithologies. Note that Rio Tinto is also undertaking long-term kinetic testing of waste materials from Yandicoogina, which will further inform ongoing geochemical characterisation and risk assessment.

3.5.2 Assessment of selenium leaching risks

Selenium is an element of high eco-toxicological interest, due to its somewhat unusual chemical attributes and biological modes of action. Selenium can exist in multiple oxidation states (2-, 0, 4+, and 6+) which influence its environmental mobility. Although an essential element at low concentrations, selenium can cause a variety of toxic effects in plants and animals at higher concentrations; in particular high trophic level organisms such as fish and waterbirds (Lemly 2002). Global experience has shown the selenium can be especially problematic in aquatic/wetland environments, under conditions where abiotic forms of the element are efficiently scavenged and bio-accumulated by algae and micro-organisms. Subsequent transmission through food chains is the principle mechanism by which higher level fauna are exposed to toxic concentrations.

Rio Tinto has reviewed the chemistry and likely behaviour of selenium in the Hamersley Group stratigraphic sequences typically encountered during iron ore mining (Rio Tinto 2012b, Appendix 4). Selenium occurs below sulfur in the Periodic Table and, as such, has similar chemical properties. For this reason selenium is generally associated with sulphur containing minerals such as pyrite, alunite, jarosite or gypsum.

Liquid extract tests performed by Rio Tinto across a range of lithologies (n=658) indicate that selenium leaching is most likely to be associated with pyrite containing materials; such as shale, lignite and siderite. Although selenium can also occur in sulphate minerals (such as alunite), it appears to be much less mobile in these mineral forms.

Selenium has a strong affinity for iron. It can adsorb strongly to iron oxides and may naturally be present in Pilbara ore. However, due to its incorporation into the iron oxide structure of these materials, selenium is unlikely to be released unless the iron oxide dissolves. The mineral wastes at Yandicoogina are not anticipated to be exposed to chemical conditions that would enable this to occur. Rio Tinto is also undertaking kinetic testing of waste materials from Yandicoogina, as part of a precautionary approach to mineral waste management.

3.6 Closure options assessment

Closure planning is an evolutionary process and becomes progressively more detailed and specific over the operational life of a mine site. Rio Tinto has acknowledged that closure planning for JSW and Oxbow remains in progress, which is a result of the entire Yandicoogina operations Life of Mine (LoM) closure plan being revised; development of a closure plan incorporating only JSW and Oxbow operations is not considered appropriate nor in line with the EPA Closure objectives and 2011 DMP Mine Closure guidelines. Previous commitments and objectives approved for Yandicoogina operations are now no longer considered appropriate or environmentally viable when applied to a LoM closure plan.

Closure planning studies have continued during the public review process in order to support more detailed evaluation of the closure options proposed within the Yandicoogina Life of Mine (LoM) Closure Plan (PER Document Appendix A15). This work has included detailed mine planning and scheduling, together with subsequent hydrological and hydrogeological modelling for each of the closure options presented (Appendix 5). Note that the LoM Closure Plan is a holistic planning document that addresses the existing JC and JSE mines, and undeveloped deposits at Billiard South, in addition to the JSW-A & C and Oxbow deposits that are the subject of the Proposal. A holistic approach is appropriate given the integrated nature of the final closure landform that will be associated with the various Yandicoogina mines.

The hydrological and hydrogeological modelling studies contribute to understanding the technical feasibility of meeting water quantity and quality objectives post-mining under the different closure scenarios. The overarching objectives for water management at closure include:

- Maintain surface water and groundwater through-flow (albeit with no pre-determined water table elevation);
- Maintain surface water and groundwater quality to within acceptable limits for the agreed post closure land uses; and
- Maintain stable land forms.

The GoldSim model[7] was used to assess the long term water and salt balance which would occur at the Yandi mine site post-closure under different final landform scenarios (BG&E 2012). Within the model, each pit is treated as a "bucket" which receives inflow from surface water runoff, direct rainfall, seepage from nearby river flows and groundwater. Outflows include evaporation, groundwater outflow and surface water outflow (overtopping). Salt loads in the various inflows and outflows determine indicative salt loads in the pit lakes, which tend to equilibrate over time based on simplified mixing and dispersion assumptions.

Four scenarios were considered in detail. These were:

i. The mining of individual pits to create open pit voids (No Backfill Option)

ii. The mining of a continuous channel as an open void, effectively linking the various mine pits (Continuous Channel Option)

iii. The combination of mining the Oxbow, JSW A and JSW C pits to create open pit voids and backfilling of the JC, JSE and Billiard South[8] pits to specified levels (Selected Pit Voids Option), and

iv. Backfilling to 2 meters above the pre-mining ground water level in all pits (Complete Backfill Option).

These scenarios are further described in Appendix 5. A summary of the modelling results is presented as follows.

3.6.1 Scenario 1 – No Backfill

As a result of the high evaporative losses, water levels within the in JSE and Billiard South pits are maintained at a much lower level than the natural groundwater levels. Consequently, these pits act as a groundwater sinks. Since water cannot leave these pits, salt concentrations build over time until the pits become hypersaline (>20,000 mg/L).

A different outcome occurs in the upstream pits, including Oxbow and JSW-A/JSW-C. Groundwater levels in these pits are maintained well above the downstream pits, facilitating groundwater throughflow and the flushing of salts. Hence these pits remain fresh (salinity <1,000 mg/L)

3.6.2 Scenario 2 – Continuous Channel – Creek at Base of Channel

The continuous pit model assumes that a creek system is established at the base of the mined out pits (*i.e.* the original CID palaeochannel is re-instated). This would result in a single mine void extending from Oxbow - JSW - JC - JSE through to Billiard South. At a broad conceptual level, the channel would form a drainage structure connecting all of the pits. Side walls would be profiled using backfill to create a safe and stable landform and to reduce surface expression of any standing water to reduce evaporation. Design criteria would seek to provide a safe and stable landform, erosion management features, and measures to maintain suitable pit lake water quality and maintenance of flows.

Additional engineering studies and further stakeholder consultation is necessary for more specific design criteria for the channel to be finalised. The design will need to be consistent with the final closure objectives to be agreed with regulatory agencies.

[7] GoldSim has been used extensively in the mining industry worldwide to evaluate mine water management issues.

[8] Note that mining at Billiard South is not currently proposed but is part of the current life of mine plan

Water from Marillana, Weeli Wolli Creek and minor creeks would drop into this system via a series of engineered structures and flow along the base of the CID. At the downstream end of this system (along the downstream end of JC), a single wedge profiled pit lake would form. At the downstream end of the lake, water would flow into the existing Weeli Wolli Creek channel.

The volumes of water flowing through Marillana and Weeli Wolli Creek are large compared to the volume of evaporation which would occur from the lake. Average annual flow rates are approximately double the evaporation rate, and consequently the water in the pits remain fresh (pit salinity levels of around 130 mg/L are reached).

3.6.3 Scenario 3A – Selective Pit Voids (Background Groundwater Salinity)

This scenario recognises that there is limited material available for backfilling and attempts to target the use of the available material to maximum benefit. The option involves partial backfilling of Billiard South, JSE and JC pits. Oxbow and JSW-A/JSW-C pits would be left open. The water levels in the partially backfilled pits tends to match the backfill level.

The selective backfill serves two purposes. The first is to raise groundwater levels in the selected pits such the pits do not act as sinks and groundwater through flow is maintained. The second is to reduce the area from which evaporation can occur, which results in an overall reduction in salinity.

This scenario results in groundwater through-flow being maintained. Salinity increases moving downstream due to the progressive effect of evaporative salt concentration. The highest water salinity concentrations occur at Billiard South and JSE resulting in brackish water; however average salinities are still below 5,000 mg/L. The average salinities in Oxbow and JSW-A/JSW-C pits are fresh at around 1,000 mg/L.

3.6.4 Scenario 3B – Selective Pit Voids (BHPB Post Closure Salinity)

A model run has been performed which includes the projected groundwater salinities post-closure of the BHP Billiton Iron Ore (BHPBIO) Yandi mine, upstream from Oxbow. The publically released Marillana Creek (Yandi) mine Decommissioning and Final Rehabilitation Plan (January 2004) states that expected groundwater salinities at the downstream boundary of the BHPBIO operations area will be 1,100 mg/L. This value was then input into the model, replacing the 500 mg/L used in all other model runs. The modelled steady state salinity is around 7,000 mg/L in JSE and Billiard South pits. The salinity in the upstream pits remains fresh with Oxbow and JSW-A ranging from 1,000 to 2,000 mg/L and JSW-C averaging around 1,000 mg/L.

3.6.5 Scenario 3C – Selective Pit Voids (Surface Water Augmentation)

This Scenario uses the backfilled pits and water quality as described in Scenario 3A and diverts water from Marillana Creek and Weeli Wolli Creek into the pits. The Marillana Creek flow path is located some distance from the Oxbow pit and then flows adjacent to JSW-A and JSW-C pits. It has been assumed that any diversion of Marillana Creek flow would occur evenly between these pits.

A scenario was run in which all of Marillana Creek flow was diverted into JSW-A/JSW-C. This results in water levels in these pits being higher than in Oxbow. Consequently, groundwater through flow is not achieved and Oxbow would become a groundwater sink, becoming saline with time. This is not considered an acceptable outcome.

Scenarios were then run in which 10% and 20% of Marillana Creek flow was diverted into JSW-A/JSW-C. In these scenarios water quality in Oxbow and JSW-A/JSW-C remains fresh (<1,000 mg/L).

3.6.6 Scenario 4 – Complete Backfill

This scenario includes all pits backfilled to 2 m above pre-mining water level. This option requires more material than will be available for backfill. If all available waste were to be used for backfill and an area known as 'Backfill Hill' near JSE were to be mined specifically for backfill, there still would not be adequate material to backfill to this level and additional fill material would need to be sourced.

In this scenario, in pit water levels are similar to pre-mining water levels and groundwater through flow is achieved. After major rainfall/streamflow events, water ponds on top of the backfill which results in some evaporation and salinity increases. Water quality is generally fresh with the exception of Billiard South which is brackish at around 3,800 mg/L. Modelled water quality in Oxbow and JSW-A/JSW-C is very fresh (<500 mg/L).

3.6.7 JSW and Oxbow Water and Salt Balance Summary

A summary of predicted water quality in each pit under all scenarios is provided in Table 6. Under nearly all of the modelled closure scenarios (involving pit lakes), pit lakes at Oxbow and JSW-A/JSW-C remain fresh over the long term. This is due to their position upstream within the pit sequence, which predisposes these pits to groundwater throughflow thereby reducing the opportunity for evaporative concentration of salts. The only scenario under which these pits go saline is if 100% of Marillana Creek flows were diverted into JSW-A/JSW-C, which results in Oxbow becoming a groundwater sink. This is not considered to be an acceptable closure option.

Table 6 Summary of Predicted Water Quality

Scenario	Oxbow	JSW-A	JSW-C	JC	JSE	Billiards
No Backfill	<1,000	<1,000	<1,000	<1,000	>20,000	>20,000
Channel	Dry	130	130	130	130	130
Selective Backfill (base case)	800	1,000	500	2,500	4,800	4,800
Selective Backfill (+BHPBIO)	1,600	1,700	800	4,000	7,500	7,000
Selective Backfill (+diversions)	900	800	500	2,400	5,500	4,000
Complete backfill to AWT	250	150	100	100	800	3,800

3.6.8 Overall findings

Based on the water quality modelling results, three conceptual closure options appear to be technically viable. These are:

1. formation of a continuous channel at the base of the mined pits with Marillana Creek and Weeli Wolli Creek diverted into this channel;
2. selective use of backfill in downstream pits; and
3. backfilling of all pits to above the pre-mining water table.

Each of the options can potentially satisfy the key objectives of maintaining water quality and through-flow. However Option 3 would require excavation of all the surrounding hills within the project area, with associated large scale landscape modification and environmental impacts. For this reason, Option 3 is considered to be a least preferred option.

The final closure option will be determined based on further stakeholder consultation and technical studies to deliver a technically feasible and environmentally acceptable scenario. The geotechnical evaluation and subsequent modelling to support this work will be ongoing over the next 2 years as part of the closure planning process.

The key criteria for the closure plan is to maintain groundwater and surface water flows, maintain water quality, and return the area to landforms that are safe, stable and compatible with the surrounding environment, and as such, the final closure design will be developed to meet these criteria.

In addition to the information provided in Appendix 5 (Yandicoogina Closure options), further information regarding closure design considerations for spill out structures and bunds, to help meet closure water management objectives is provided below. The additional information contexts scenarios and key considerations for large magnitude (>1:100 ARI) flood events.

3.6.8.1 Bunding/levees

Post commissioning, bunds will be built to protect sections of the pits from creekline flows during flood events. The bunds are required at several locations where minor tributaries currently enter Marillana Creek, (including the retained channel area “aqueduct” if the partial backfill option is chosen). These bunds will include features such as:

- shallow gradients
- rock armouring
- filter layers between rock protection and the bulk earthworks
- down-face drainage controls
- will be located outside of the main Marillana creek flow paths, such they are not subjected to impinging flow
- to ensure long term stability, the bunds will have a factor of safety that complies with best practice engineering design.

The bunds will be designed to withstand major flood events (i.e. well in excess of the 1:100 ARI event – subject to further modeling work to establish the most appropriate flood scenario), however the ultimate size of major events (to design for) will be limited by the flood management works proposed by the upstream BHPB Yandicoogina operations. The BHPB Yandi Decommissioning and Final Rehabilitation provides a 100 year flood estimate of 1,860 m^3/s for Marillana Creek at Flat Rocks (Catchment area 1,370 km^2), with a Probable Maximum Flood of 28,600 m^3/s. The 100 year ARI peak

flow rate in Marillana Creek within the Yandicoogina mine site has been estimated by Rio Tinto Iron Ore (RTIO 2008). This report used RORB (run-off and streamflow routing program) hydrological modelling and ARR rainfall to produce flood estimates of between 2,500 m^3/s and 2,600 m^3/s for the creek section between Oxbow and Marillana Creek outlet (Catchment area 2,230 km^2). The flood estimates contained within the BHPB report are consistent with the Rio Tinto study once catchment areas are considered.

3.6.8.2 Large flood events greater than 1:100 year ARI

During events greater than 100 year ARI, spill out structures will be utilised by BHPB to divert an increasing proportion of the flow above a 100 year event into mine voids. During the Probable Maximum Flood (PMF) 80% of the estimated 28,600 m^3/s flow in Marillana Creek at Flat Rocks (BHPB Yandi Decommissioning and Final Rehabilitation) will be diverted into BHPB pits via several spill out structures. This is advantageous for the closure of the Rio Tinto Yandicoogina mine site, as the Rio Tinto mine area will be shielded from much of the larger Marillana Creek flow events.

Additional flow which reaches Marillana Creek downstream of the BHPB site will require consideration, for example spill out structures into Oxbow and JSWA/JSWC may be incorporated into the design to ensure that the bunds are not being overtopped during flood events. These spill out structures would contain a number of minor drop structures linked by flat or reverse gradient sections to limit velocities and shear stresses during major flow events. The spill out structures would be heavily rock armoured and include features such as launching aprons, baffles and weirs to improve stability. Dependent on the details of design, it is possible that the lower retained mesa sections could be modified to act as the spill out structures.

It is expected that the proposed system would be stable over the long term,(i.e. thousands of years).

3.6.8.3 Consequences if the proposed closure plan fails

The system is not expected to fail, but if it did, a proportion of the flood events would flow into the pits. Due to the relative widths of Marillana Creek, and the tributaries requiring bunding, the majority of flow would continue in Marillana Creek. Spill over water entering the pits would be unlikely to result in the pit overtopping. If 20% of the total Marillana Creek flow entered the JSW-A/JSW-C pits, the water levels in these pits would not rise enough to block groundwater flow; hence groundwater through flow would be maintained. Again, the flow events would be modified by the upstream BHPB operations.

For the partial backfill scenario, the retained creekline section (previously referred to as the “aqueduct” section), is considered unlikely to fail since it consists of a typically 300 m wide section of unblasted CID material and would therefore be considered stable (subject to normal erosion). Geotechnical investigations will be undertaken to confirm this assumption. In the event of failure, there would likely be a large sediment load washed into downstream pits, which would ultimately impact groundwater through flow, and would divert a portion of larger ARI events into the pits (as described above). If the geotechnical investigations were to indicate that this retained section would be likely to fail, then the contingency would be to partially backfill each of the pits against the retained section of the creekline (“aqueduct”). Engineering designs would also be implemented to manage these flood risks (larger flood events) as described above.

In the event of a bund failure low flows are maintained in Marillana Creek. During significant flood events a proportion of flow would be lost into the pits, however the pits would be unlikely to over top and the reduction of flow to the downstream environment would be mitigated by the inflows from Yandicoogina Creek (catchment area 206 km^2, junction with Marillana Creek 5 km downstream of JSW) and Weeli Wolli Creek (catchment area 1,567 km^2, junction with Marillana Creek 12 km downstream of JSW).

To mitigate against bund failure and the reduction in downstream flow during flood events, the system will be built with a number of factors of safety/levels of conservatism such that failure is highly unlikely.

- The system will be designed to be suitable for a long term event, ie substantially greater than the 100 year ARI event (i.e. designs would be based on a major flood events)
- The system comprises two components: the Spill out structure and the Bund

3.6.8.4 Spill Out Structures

These structures are required to limit flow past the bunds

- Generally these spill out structures would contain a number of minor drop structures linked by flat or reverse gradient sections to limit velocities and shear stresses during major flow events.
- The spill out structures would be heavily rock armoured and include features such as launching aprons, baffles and weirs to improve stability.
- It is expected that a section of the remaining Mesa could be modified to form the invert of the structure. This would improve the stability.
- The spill out structure would be used for only a period of days every 100 years and only receive significant flows in major events, i.e. every several hundred years.

3.6.8.5 Bunds

To ensure long term stability, the bunds would be designed with a large factor of safety. These bunds will include features such as:

- Shallow gradients to limit velocity of down face runoff and improve stability
- Rock armouring to provide protection from erosion due to down face and Marillana Creek flow
- Filter layers between rock protection and the bulk earthworks to prevent removal of fines layer beneath the rock armouring
- Down face drainage controls such as limiting the length of down face flow paths through the use of benches
- The bunds would be located outside of main flow paths in Marillana Creek such they are not subjected to impinging flow.
- Dependent on topography and final designs, construction would be to a level greater than the remaining Mesa sections such that any overtopping occurs away from the bund.

3.6.9 Closure Summary

Key aspects of the closure planning process to date are reiterated as follows:

- Rio Tinto has developed broad closure objectives that will be reviewed and refined in subsequent revisions of the closure plan.
- Rio Tinto has developed indicative completion criteria to support the development of final completion criteria in consultation with regulatory agencies and other stakeholders.
- The key closure supporting information documents provided so far include:
    - Appendix A15 – Yandicoogina Closure Study report (The Yandicoogina JSW and Oxbow PER)
    - Yandicoogina Closure Options: Preliminary Water Modelling Results (this work comprises the additional research to support the closure study report) (Appendix 5).

- Rio Tinto contends that the studies and assessments completed to date are sufficient to demonstrate that there will be a technically viable closure option available for the site. However it is acknowledged that further studies are required to enable Rio Tinto to commit to the channel option, or an alternative option, as a definitive closure strategy.
- A range of additional studies (*e.g.* hydrogeology, hydrology, environment, heritage and social) are required to enable a preferred final landform to be selected. These studies are scheduled to commence within the next 12 months, or are already in various stages of implementation. Additional detail on these proposed studies is provided on pages 68/69 of the PER Document Appendix A15. These studies will underpin a detailed final landform design to be completed at least 5 years prior to mine closure, in accordance with the Rio Tinto Mine Closure Standard.
- An updated Yandicoogina Closure Plan is scheduled to be completed within 3 years of approval. This plan will be structured to address the requirements of the DMP Mine Closure Guidelines 2011.

In relation to JSW and Oxbow specifically (The Project):

- The modelling completed to date and discussed in the previously submitted Response to Submissions document predicts that water quality and flows upstream of JC (i.e. JSW and Oxbow) would largely be un-impacted, irrespective of the closure scenario adopted. Refer to Table 6.

3.7 Future studies and investigations

Additional studies will be undertaken during the implementation of the Proposal in order to protect and maintain the environmental values, and are presented in Table 7.

Table 7 Additional studies to support environmental protection and management at Yandicoogina

Environmental Aspect	Planned Studies	Rationale	Implementation 2012 - 2013	Implementation Post-2013
Closure	Geotechnical investigations	To support engineering assessment and design of final closure landforms.	✓	
	Additional mine planning work	To support the optimal integration of mine scheduling and mineral waste management with closure implementation.	✓	
	Additional hydrological and hydrogeological modelling	More detailed modelling studies are required to support the selection and design of final closure landforms. Ongoing data collection during the operational phase of mining provides the basis for progressive model refinement and validation.	✓	✓

Environmental Aspect	Planned Studies	Rationale	Implementation 2012 - 2013	Implementation Post-2013
	Ecological assessment of mine closure options	More detailed ecological impact assessments are necessary for the proposed closure scenarios, taking into account changes to the pre-disturbance hydrological regime and ecological water requirements of the Marillana and Weeli Wolli creek systems.	✓	
Surface water (discharge management)	Seasonal storage and discharge study	If technically viable, the use of the JC pit void to enable storage and controlled release of surplus water volumes would enable the discharge regime to more closely mimic the natural ephemeral flow regime.	✓	
	Project water sharing opportunities	Rio Tinto is investigating opportunities for connecting surplus water generation with off-site demand. In the longer term, new opportunities created by future mining projects may also emerge.	✓	✓
	Aquatic fauna monitoring Fish tissue sampling	Aquatic fauna sampling will continue as part of the Yandicoogina Monitoring Program. Rio Tinto has also commenced the collection of baseline information on body tissue concentrations of elements of eco-toxicological interest (*e.g.* selenium) in fish species.	✓	✓
	Surface water quality monitoring	Surface water quality monitoring will continue as part of the Yandicoogina Monitoring Program. Mercury and selenium will be included in the standard monitoring analyte suite.	✓	✓

Environmental Aspect	Planned Studies	Rationale	Implementation 2012 - 2013	Implementation Post-2013
Groundwater	Groundwater quality monitoring	Groundwater quality monitoring will continue as part of the Yandicoogina Monitoring Program. Mercury and selenium will be included in the standard monitoring analyte suite. Rio Tinto is also implementing isotopic tracer tests in creek lines as part of a PhD project in collaboration with Flinders University and the National Centre for Groundwater Research and Training. This study will provide additional insights into the behaviour of the groundwater system, and contribute to refining existing groundwater modelling.	✓	
Stygofauna		Stygofauna monitoring will continue as part of the Yandicoogina Monitoring Program.	✓	✓
Riparian vegetation health monitoring	Riparian vegetation health monitoring	DCP, DSMI imagery and vegetation transect monitoring will continue as part of the Yandicoogina Monitoring Program.	✓	✓
	Water use dynamics of riparian trees.	This project examines the 'Dynamics of water and tree populations in riparian woodlands' and is part of an ARC Linkage funded project (Ref. LP0776626) involving UWA, RTIO, BHPBIO and DEC. The aims of the study are to: (i) establish the relationships among climatic extremes and episodic events (floods and droughts) with population dynamics of the major riparian species (ii) quantify the impacts of changes in population structures for local and regional hydrology, and	✓	

Environmental Aspect	Planned Studies	Rationale	Implementation 2012 - 2013	Implementation Post-2013
		(iii) assess the interaction of changes in groundwater and surface water flows with other soil properties and their impacts on tree health. This project will also establish how tree age influences tree water use, and access and dependency on groundwater.		
Fortescue Marsh	Fortescue Marsh climate and hydrodynamics study	This project is examining the hydrologic history and function of the Fortescue Marsh through the installation of monitoring bores, examination of sediment records and growth records in vegetation (tree rings). The project will assess the scale and extent of marsh hydrological processes through time, over thousands of years to more recent changes (*i.e*. hundreds of years to recent decades). Collectively this information will be invaluable for informing the ongoing protection and management of the Marsh. The University of Western Australia (UWA) is a project partner, and the project has received a Commonwealth funding contribution through the Australian Research Council (ARC) Linkage Program (Ref. LP120100310).	✓	✓

4 Ongoing stakeholder consultation

In addition to the Stakeholder Consultation which was undertaken during the development of the PER Document, further stakeholder consultation was conducted during and post the public review period (Table 8).

Table 8 Stakeholder consultation conducted during and post the PER public review period

Date	Stakeholder	Purpose	Items discussed	Key outcomes
14/11/11	DMP	Discussion of Yandicoogina Closure Plan and updates to the Yandicoogina hydrogeological Modelling	Prior closure commitments (relating to approved mines) Hydrogeological modelling Geotechnical study requirements	Consensus that old closure commitments relating to the JC and JSE mines are no longer applicable/appropriate in a life-of-mine scenario for the integrated Yandicoogina operations. New closure approaches, as put forward in the PER Document, were discussed. Updated hydrogeological modelling pertaining to the various closure options was presented, including reference to the most current mine planning and using a LoM scenario for the integrated Yandicoogina operations. Geotechnical studies are yet to be undertaken, but will be completed to support the closure option selected A workshop with stakeholders to determine an agreed optimal closure outcome is proposed to be held in early 2012.
8/12/11	OEPA, DEC, DoW, DMP, Chem Centre	Mineral waste workshop Discussion of current issues and latest research information	AMD Neutral Mine Drainage	Rio Tinto presented current research information on acid and neutral mine drainage characterisation and management in its Pilbara iron ore business. Consensus that significant AMD testing had been undertaken for Pilbara geological formations, and that where risks exist, these can be identified and managed. Kinetic testing not considered obligatory for all projects based on static test work and risk profiling. Broad waste characterisation should be provided at the time of seeking approvals for new projects, in accordance with a risk based management approach.

Date	Stakeholder	Purpose	Items discussed	Key outcomes
13/12/11	DoW	Discussion of Closure Plan and updates to the hydrogeological Modelling	Prior closure commitments (relating to approved mines) Hydrogeological modelling	Consensus that old closure commitments relating to the JC and JSE mines are no longer applicable/appropriate in a life-of-mine scenario for the integrated Yandicoogina operations. New closure approaches, as put forward in the PER Document, were discussed. Updated hydrogeological modelling pertaining to the various closure options was presented, including reference to the most current mine planning and using a LoM scenario for the integrated Yandicoogina operations. Hydrogeological modelling of closure scenarios considered to be adequate. Geotechnical studies are yet to be undertaken, but will be completed to support the closure option selected A workshop with stakeholders to determine an agreed optimal closure outcome is proposed to be held in early 2012.

Ongoing consultation activities will occur throughout the remainder of the environmental impact assessment (EIA) process: including meetings with stakeholders, workshops and informal information sessions. Table 9 outlines the proposed Yandicoogina consultation program in 2012.

Table 9 Stakeholder consultation conducted during and post the PER public review period

Stakeholder	Purpose
DMP	Closure Plan workshop and updates.
DoW	Closure Plan workshop and updates. Hydrogeological Modelling updates and dewatering.
DEC	Location of new ecological monitoring sites in Weeli Wolli Creek downstream from the Marillana Creek confluence. Closure Plan workshop and updates. Presentation and discussion of Rio Tinto's energy management strategy for its iron ore business.
OEPA	Closure Plan workshop and updates.
Gumula	Closure Plan workshop and updates. General project updates & proposed further surveys.
BHPBIO	Closure Plan Updates. Pastoral final land use requirements.

5 Submissions received and Rio Tinto responses

5.1 Lack of detail within document

Submitter	Submission and/or issue	Rio Tinto response
1 public submission addressed this factor	The submitter contends that there are no maps within the PER at an appropriate scale to see what is actually proposed. These need to be provided.	Rio Tinto contends that Figure 2-1 in the PER Document provides adequate detail of the key elements if the Proposal. Interpretation of Figure 2-1 is supported by the detailed Proposal description contained in the text of Section 2 of the PER Document. This is supported by comments and feedback on the PER Document received from government agencies and other stakeholders during the public environmental review process. In overall terms the figures included in the PER Document are provided at a suitable scale to demonstrate the core elements of the Proposal, and their context within the overall Yandicoogina operations and surrounding environment. The level of detail is consistent with EIA documents from numerous other mining proposals subject to completed public review processes under the EP Act.
1 public submission addressed this factor	[The submitter contends the] PER should provide: • SMART (specific, measurable, achievable, realistic and timely) objectives and goals • Accurate figures or ranges to support all statements • Firm commitments • Details of what management processes will actually be used and what they realistically can expect to attain • Incorporate all findings of supplementary reports and answer questions raised in them.	The management objectives for each environmental factor described in Section 7 of the PER Document align with stated EPA environmental protection objectives. The proposed environmental management measures described in Section 7 of the PER Document are based on established site Management Plans and practices for the existing Yandicoogina mine site. These were largely developed in conjunction with, and approved by, various regulatory agencies (DEC[9], DoW[10] and the OEPA) to satisfy conditions under Statements 417, 523 and 695; and are reported on annually to the OEPA as part of the site Annual Environmental Review process. Regular updates of the site Management Plans are required, and these are subject to DEC/DoW and OEPA approval.

[9] Department of Environment and Conservation

[10] Department of Water

Submitter	Submission and/or issue	Rio Tinto response
	• Provide clear consideration of environmental trade offs • Effects, benefits and management processes of alternative options should be clearly delineated throughout the report • Maps at appropriate scale, to clearly see and understand actions that are proposed. • Be a document the proponent is prepared to use as a top level working document for the project. All of these points are [considered by the submitter to be] significantly lacking in this document.	The effectiveness of the environmental management practices in place at the Yandicoogina operations is demonstrated by over 16 years of effective mine site operation, without significant breaches of project implementation conditions. In support of this point, a summary of the audit history of the Yandicoogina operations is provided in Appendix 6. As indicated in the PER Document, the site environmental management plans were updated and adapted to include the proposed JSW and Oxbow mines. This is appropriate since Yandicoogina effectively operates as a single mining operation incorporating multiple pits. The updated management plans have been collated into the Yandicoogina Environmental Management Program provided as Appendix B to the PER Document. These plans provide the framework for operational environmental management at the site. All findings of studies and investigations supporting the PER document were considered in the updates made to the Yandicoogina Environmental Management Program.
1 public submission addressed this factor	The PER is lacking in detail and so does not provide for the praxis of environmental management. [The submitter contends that there is] a lack of detail on the preferred option and key design considerations [in the surface water management plan]. The surface water management plan is considered to be unrealistic. The PER document frequently refers to other documents which are not included in the list of documentation provided on the Rio Tinto website page. Page xvii states the 2003 Decommissioning and Rehabilitation Plan is no longer achievable and *' A*	The praxis of environmental management at the Yandicoogina mine site (currently and as applicable to the Proposal) is demonstrated by the successful implementation of the Yandicoogina Environmental Management Program (EMP) over the life of the JC and JSE mines. In this time there have been no significant breaches of project implementation conditions. The EMP was thoroughly reviewed and updated to ensure its suitability for application to the Proposal, and was included as Appendix B to the PER Document. With respect to specific points raised by the submitter: **1) Surface Water Management Plan** The assertion that the Surface Water Management Plan is “unrealistic” is not substantiated. The core elements of this plan include: • Identification of environmental aspects to be managed

Submitter	Submission and/or issue	Rio Tinto response
	new set of closure objectives has been developed and included in the current Decommissioning and Rehabilitation Plan'. There is no document with this name on the Rio Tinto website with the PER documents. Without this information there can be no proper assessment. Various studies have been presented without updating from different projects. Amongst the list of studies in the 'Yandicoogina closure study report' (p67-8) that are required the submitter contends that these have not been conducted. Perusal of the main document indicates little evidence that these reports have been done. Without an idea as to issues such as pit water quality, diversion water quality and hydrology there is not only no plan for closure, but no assessment of risks. The submitter considers that the 'Yandicoogina closure study report' (PER Appendix 15) provides no plan for closure, presents inadequate closure objectives and provides no assessment of closure risks. The closure objectives are so general and without specific criteria as to be almost meaningless. *Page 135: 'ecological objectives and targets for the rehabilitation of water-dependent values at the end of the life of the development need to be set in advance.* Why isn't it done and reported here?	• Environmental performance objectives • Implementation strategy and management actions • Monitoring and reporting requirements • Contingency actions to be initiated in the event that surface water environmental targets are not being achieved. Consistent with this plan, a qualitative evaluation of alternative options for managing surplus water volumes generated by mine pit dewatering was undertaken and presented in Sections 5.3 & 5.4 of the PER Document; taking into account multiple environmental assessment criteria. The evaluation clearly demonstrated that the existing strategy of discharge to the creek systems is preferable to the alternative options currently available. Rio Tinto considers that transfer of surplus water to meet an off-site demand would be a desirable alternative if a demand sink becomes available at a future time, and continues to explore this potential. Rio Tinto is also continuing more detailed investigations into the feasibility of using the JC pit void to enable seasonal storage and release of water. With respect to creek line modifications, the Proposal will maintain the low flow line in Marillana Creek such that during rainfall events surface water flows will continue to be maintained in Marillana creek, along a pre-existing pathway. Minimal disturbance to the main channel will occur at vehicle crossing points. There will be some encroachment of flood protection structures into the 100-year ARI floodplain at JSW, however this will not significantly affect the functional integrity of the main channel. The flood protection structures are being designed to ensure minimal changes to the existing flow regime and hence provision of flows to downstream ecosystems. The terminus of a smaller tributary, Phil's creek, will be diverted for a period of time to enable mining of the western portion of JSW-C. The flow regime delivered into Marillana Creek will be maintained by the diversion structure. Post-mining in this area the flow line will be reinstated and designed to have similar functional characteristics to the existing channel.

Submitter	Submission and/or issue	Rio Tinto response
	The submitter contends that Page 219 includes inappropriate landform construction which may affect the rehabilitated areas ability to support native vegetation and meet revegetation completion criteria. Not enough detail has been provided. The submitter considers that there is inadequate planning for rehabilitation. The submitter contends that planning for Decommissioning and Rehabilitation appears to be way behind. [With respect to items discussed on] *Page 222 – 223: 7.8.4.4. Rehabilitation measures:* • how these things are going to done? • have any been done already: • what type of landscape will Rio Tinto be able to recreate? Will bear any resemblance to the existing landscape? • Where are the closure targets? The submitter contends that this PER fails to provide an accurate account of the environmental management of the rehabilitation stage of this project.	**2) References to other documents** All the documents cited in the PER included reference details. Key documents were listed in Table 4-2 and provided as Appendices. It is impractical to include all references as appendices; therefore only supporting studies with specific relevance to the key environmental factors associated with the Proposal were included as Appendices. Many of the references not included in Table 4-2 constitute supporting documents to previous Yandicoogina operational approvals and can be found on either the EPA website or Rio Tinto website (as part of documentation relating to the JC and JSE approvals). Note that historical closure plans for Yandicoogina operations were referred to as Decommissioning and Rehabilitation Plans consistent with Ministerial Statements for the JC and JSE projects. The new Yandicoogina Closure Plan (PER Document Appendix 15) constitutes the latest iteration of the Decommissioning and Rehabilitation Plan. The proposed additional final landform studies described on pages 68/69 of the PER Document Appendix A15 will contribute to the detailed final landform design to be completed at least 5 years prior to mine closure. Closure planning is an evolutionary process that begins at a conceptual level and becomes progressively more detailed and specific over the operational life of a mine site. Some elements of the proposed studies described in Appendix A15 of the PER document have been addressed in the studies completed to date (*e.g.* in relation to pit water lake quality scenarios and surface water engineering aspects) as discussed in the PER documentation. A set of feasible conceptual final landform options have been identified, which provide the basis for fulfilling closure objectives which have been developed in consultation with regulatory agencies (see below for further discussion). **3) Adequacy of Yandicoogina Closure Study Report** As a component of developing the Proposal, Rio Tinto reviewed and updated the closure strategy for the Yandicoogina operations. A realistic Life of Mine closure strategy has been proposed based on the current knowledge base underpinning site closure planning. This is described further in Section 3.6. As previously stated, closure planning is an evolutionary process that begins at a conceptual level and becomes progressively more detailed and specific over the operational life of a mine site. Rio Tinto acknowledges that closure planning for

Submitter	Submission and/or issue	Rio Tinto response
		Yandicoogina is at a conceptual stage, concordant with the current mine plan and the anticipated life span of the overall Yandicoogina operations. Realistic closure objectives and options have been identified and discussed with relevant regulatory agencies, and are presented in the PER document in Table 7-10 on page 218. The need for a range of additional studies (*e.g.* hydrogeology, hydrology, environment, heritage and social) to enable a preferred final landform to be selected has been identified, and these studies are scheduled or in various stages of implementation. The closure plan provided with the Proposal will be progressively updated, to reflect new knowledge and the outcomes from stakeholder consultation processes. Studies supporting closure planning will continue throughout 2012, and an updated closure plan is scheduled to be completed in 2013. Closure completion criteria will be developed as the site approaches closure. These will be specific, and will be agreed with stakeholders. Rio Tinto does not consider it is appropriate to develop such criteria at this early stage of a project because there are likely to be significant changes, both internal and external between now and closure such as: • Understanding and appreciation of environmental and social values; • Industry closure and rehabilitation standards; • Stakeholder expectations; • The operational mine plan; and • Surrounding land uses. Therefore, Rio Tinto has developed broader closure objectives that will be reviewed and refined in subsequent revisions of the closure plan; and documented indicative completion criteria to support the development of final completion criteria in consultation with stakeholders. Since the PER Document was submitted, mine planning and hydrological modelling studies which address gaps identified in the closure study report have been completed; the results of which are provided in this document (Section 3.6 & Appendix 5). These studies have provided an improved level of understanding of such issues as pit lake water quality and impacts to flow regimes for various closure scenarios. At least two

Submitter	Submission and/or issue	Rio Tinto response
		closure scenarios have been identified that are predicted to result in acceptable hydrological outcomes, and the channel option described in the closure study report is predicted to provide the basis for a pit lake of very good water quality. Further studies are required to enable Rio Tinto to commit to the channel option, or an alternative option, as a definitive closure strategy. However; research undertaken to date is sufficient to demonstrate that there will be a viable closure option available for the site. With respect to mine site rehabilitation, Rio Tinto has developed standard practices which apply across its Pilbara iron ore business. These standards have been developed form the accumulated knowledge of multiple mining projects implemented over several decades. Core elements include: • Soil resource Management; • Rehabilitation Planning and Implementation (Waste dumps, Tailings Storage Facilities, Borrow Pits, Exploration); • Mineral Waste, Sulfidic and Hazardous Materials Management • Records and Data Management; • Revegetation; and • Monitoring & Reporting. An outline of the standard Rio Tinto soil management process is provided in Appendix 9. As part of a continuous improvement approach, the standards are regularly reviewed and updated to reflect new knowledge, methods and technologies. Rio Tinto anticipates that the specific methods currently employed across it's iron ore business are likely to have further evolved by the time significant rehabilitation works commence at Yandicoogina. However the current standards provide a guiding framework under which specific rehabilitation prescriptions for the Yandicoogina site will be developed prior to on-ground works.

5.2 Dewater discharge

Submitter(s)	Submission and/or issue	Rio Tinto response
DOW DEC 1 Public Submission addressed this factor	The submitter contends that *Minimise discharge* actually means 100% of dewatering volume into the creek system because Rio Tinto haven't started to perform the studies required to use the old pits as storage. Components of the Yandicoogina Environmental Management Plan (EMP) (page 141 of the main document) gives the key objectives of the Surface Water Management Plan as: *Minimise discharge into the creek systems to minimise impacts to Weeli Wolli, Marillana and Yandicoogina Creeks.* *Maintain flow paths and flow regimes in the creeks.* *Maintain water quality in the creeks.* *Evaluate alternative discharge locations and methodologies.* However, page 21 (PER) Table 5-1 clearly shows that 100% of dewatering volume from Junction South West and Oxbow would go as surface water discharge. Table 4.3 of the PER is misleading and the submitter contents that the document fails to meet OEPA guidelines.	Note that dewatering does not equate to discharge; there is a component of both abstraction and discharge. Approximately 30% of the abstracted water is re-used on site for operational purposes (such as ore processing and dust control). In order to minimise discharge, dewatering volumes are minimised (sufficient to enable mining) and operational water use is maximised. Re-injection bores will also continue to be used to dispose of some surplus water during the dewatering and mining of the JSW and Oxbow deposits. The discharge calculations (Appendix 11) were independently reviewed by SKM, and this review was provided as Appendix A10 to the PER Document. Table 5-1 of the PER Document and Tables 3 & 4 of this document outline the key site water balance values for different operational scenarios, taking into account variable BHPBIO discharge scenarios (ranging between 0 and 15 GL/yr). These scenarios provide an understanding of the implications of BHPBIO changing its historical discharge regime. The values in Table 5-1 are consistent with Figure 33 in the PER Document Appendix A12. The projected discharge of up to 16 GL/yr, with an annual mean of about 10 GL/yr over the project life, is based on the Whole Mine Dewatering prediction described in PER Document Appendix A12 (and graphically illustrated in Figure 34 of Appendix A12, and Figures 7 & 8 of this document). This prediction assumes that BHPBIO's discharge to Marillana Creek remains at a constant rate of 5 GL/yr and is discharged evenly throughout the year. Rio Tinto considers this to be a reasonable assumption given that : • BHPBIO's mean annual discharge in the period 2002-2010[11] was 5.1 GL/yr (range 2.5 to 7.9 GL/yr); and • BHPBIO has provided no information to suggest its discharge rates will need to be increased in the foreseeable future.

[11] BHBPIO discharge data for 2011 was not able to be obtained at the time of document preparation.

Submitter(s)	Submission and/or issue	Rio Tinto response
	Figures used in the executive summary (page xiv) are somewhat different: *Discharge volumes from the JSW and Oxbow mine pit developments are predicted to contribute additional volumes of up to 16 GL/yr, with an annual mean of about 10 GL/yr over the project life.* Please explain the difference. It appears that Rio Tinto have underestimated discharge calculations. The 16 GL figure is extensively used throughout the document, despite the fact that it is inconsistent with the report detail and incorrect by a factor of 30%. The submitter contends that flow regimes cannot be maintained in creeks when there is no storage for the volumes of water being talked about and studies have still not been commenced for possible storage locations, consequently the only current option is that all dewatering will be discharged to the surface. Neither can flow paths be maintained when creeks are being mined. The impacts of BHP Billiton's Yandicoogina discharge is included in the model, as a factor in the calculation of discharge volumes, however BHP operations may be subject to change, and this may impact on the management regime at Oxbow and JSW. Hope Downs discharge is also included in the calculated discharge volumes, and the discharge will effectively result in the Weeli Wolli Creek being saturated for the life of Hope Downs mine – from the discharge outlet to below Gray's Crossing. The PER states that mining at	As described in Sections 5.3 and 5.4 of the PER Document, discharge of surplus water to the creek systems has been evaluated to be preferable in comparison to other options on environmental grounds. As a working mine pit, and repository for waste fines from ore processing, the JC pit void is not suitable for water storage at the present time. Rio Tinto recognises that it could potentially be used to store surplus water volumes following the cessation of mining. Investigations into the engineering feasibility of this option are in progress. Maintaining the flow regimes refers to maintaining the functional structure of current creek system flow lines and the passage of natural flow volumes arriving from upstream. The intent of this approach is to minimise disruptions to downstream water influxes in the creek systems. This strategy is intended to provide for ecological water requirements in sections of Marillana Creek and Weeli Wolli Creek outside the mining development areas. Note that no portions of the Marillana Creek (as defined by the 100-year ARI floodplain) will be mined under the Proposal; however the terminus of Phil's Creek will be mined and the flow line reinstated post mining. Rio Tinto acknowledges that discharge of surplus water from mine pit dewatering constitutes an additional input of water into downstream creekline areas (over and above maintained natural flows), which is anticipated to have impacts on riparian ecosystems as identified and discussed in the PER Document, and further described in section 3.2.2 of this document. The PER Document has considered discharge from the Hope Downs 1 mine as part of a cumulative impact assessment approach (refer to Appendix 11). The Proposal does not include mining at the Billiards deposit, however Rio Tinto acknowledges that should this area be nominated for mining at a future time additional studies addressing site water balance implications would be required. With respect to Table 4-3 in the PER Document, this table provides a summary of the key components of the Yandicoogina Environmental Management Program, including the key objectives and procedural components. Copies of all Management Plans in the EMP are included in Appendix B of the PER Document. The Management Plans are adapted from those approved in accordance with Ministerial Statements for the existing Yandicoogina operations, which are currently used operationally.

Submitter(s)	Submission and/or issue	Rio Tinto response
	the Billiards deposit is not a possibility while Weeli Wolli Creek remains saturated, so no impact of mining at Billiards is included in the hydraulic modelling. The proponent should monitor the hydrology, ecology and biomass accumulation of both the Marillana and Weeli Wolli creeks, specifically within the area of influence of the additional proposed surface water discharge from this operation. This monitoring program should include provision, within the implementation framework of the proposal, for remediating these systems as necessary to ensure that the identified environmental and conservation values associated with these ecosystems and any downstream ecosystems, including Fortescue Marsh, identified as a Priority 1 ecological community, are maintained. The proponent has indicated that the dewatering and associated surface water discharge footprint from this proposal would extend the current discharge disturbance *"4 km past the current peak maximum footprint, to approximately 17 km beyond the confluence of Marillana and Weeli Wolli Creeks"* (p. xxiv). Continuous surface water discharge of surplus mine water into these creek systems has significant potential to alter or disrupt the 'normal' ecology, surface and groundwater hydrology and biomass of Marillana and Weeli Wolli creeks and ultimately the Fortescue Marsh. The long-term implications are not clearly understood. The proponent should include the elements of mercury and selenium in the monitoring plan for discharge water	The key environmental factors for the JSW and Oxbow pits are the same as those previously identified for the existing Yandicoogina operations, and thus the management actions are similar. Yandicoogina will function as a single operation and as such the management actions need to be overarching for the entire site rather than new management actions for the same factors being managed. BHPBIO operations may seek to make changes to their current dewatering regime. This would be subject to additional licensing and approvals by regulatory authorities, who would need to consider cumulative impacts of the changes being authorised. With respect to environmental monitoring (described in detail in Section 3.1 and Appendices 12 & 14): • Digital Cover Photography monitoring below the confluence of Marillana and Weeli Wolli Creeks currently includes one site immediately below the confluence and a second site at Pugs Bore approximately 17 km downstream of the confluence. Rio Tinto plans to establish a further six sites between the existing Y13 and PB01 sites in order to increase coverage within the proposed new discharge footprint. • DMSI imagery is currently captured seasonally along the Marillana and Weeli Wolli systems including from the confluence of the two systems through to Fortescue Marsh. Capture of this imagery and qualitative interpretation of tree health based on derived plant health indices will continue and provides adequate coverage for the proposed extended discharge footprint. • Riparian vegetation monitoring is currently undertaken at 26 locations along the Weeli Wolli creek system and a further seven sites along selected reference creeks (Mindi Mindi and Coondiner Creek). Seven monitoring transects are located below the confluence of Marillana and Weeli Wolli Creeks; four sites within the current discharge footprint and a further three sites beyond the current discharge footprint but within the anticipated new discharge footprint. The northern most vegetation monitoring point is located approximately 1.6 km upstream of the anticipated wetting front at maximum discharge volumes.

Submitter(s)	Submission and/or issue	Rio Tinto response
	from the mine site.	A PhD study: *Estimation of infiltration rate from Marillana Creek to the surrounding aquifers* has been established between Rio Tinto and Flinders University in order to assess the leakage rate of water between Marillana creek and its surrounding aquifers and how this interacts with existing and proposed mining operations at Yandi, and thus inform potential ecological impacts. This is described further in Section 5.4 (Groundwater). The ongoing water quality monitoring program at Yandicoogina will include selenium and mercury in the elemental test suite for completeness; however these elements have not been identified as a risk based on geochemical characterisation of the rock types at Yandicoogina and historical water sampling (Refer to Appendices 3 & 4).Note that monitoring of these elements is currently not a licensing requirement.

5.3 Water quality

Submitter	Submission and/or issue	Rio Tinto response

DEC
 	
1 Public Submission addressed this factor
	Given that algal growth in the above groundwater is noted in the aquatic management report (PER Document Appendix A7), water quality must also be called into question if nitrogen levels rise. The proponent should explain management for excess nitrogen levels and maintaining water quality.
	
	[The submitter contends that there is a lack of assessment of risk] is frequent: 'The Yandicoogina JSW & Oxbow mine development Aquatic Management final report states' (p27-8): '*Elevated total nitrogen and total phosphorus levels have been recorded from mine process water which is discharged from the levee bank discharge point upstream of Marillana Reach Two (Table 1). The authors are unaware of whether any baseline data exist for total nitrogen levels in the groundwater, but it could be that groundwater is naturally elevated in nutrients. Naturally high levels of nitrate have been reported from arid zone groundwaters in Australia (Barnes et. al. 1992). If baseline data do exist for water quality of the groundwater in the vicinity of the discharge point on the level bank it would assist is discriminating between natural conditions and possible mine effects. This highlights the importance of obtaining adequate baseline data prior to development.*'
	
	However, in the main report 'section 3.11.3. Groundwater quality', of the main report does not mention nitrogen. This of concern as 'The Yandicoogina JSW & Oxbow mine development Aquatic Management
		Elevated nitrogen levels and algal growth have been detected in the surface pools of the creek systems downstream from the Yandicoogina operations. Appendix A7 to the PER Document identifies that the cause of elevated total nitrogen levels in the lower reaches of the Marillana Creek is unknown, but may be coming from any number of potential sources including:
		
		• current pastoral activities and cattle stocking, including attraction of cattle to permanent water bodies
		• historical cattle use and leaching from soils,
		• some influence from Yandi operations such as:
		  ○ elevated total nitrogen in groundwater discharge water,
		  ○ contamination of groundwater from ammonium nitrate storage or septic systems associated with offices and accommodation,
		  ○ elevated total nitrogen in mine process water discharged into the creek
		
		PER Document Appendix A7 also identifies that eutrophic conditions and algal growth are linked to a lack of wet season flushing flows. A decline in mean nutrient concentrations over time has been monitored in the Weeli Wolli Creek, which may partially be attributable to flushing by dewatering discharge.
		
		The ecological monitoring program in place at Yandicoogina (Section 3.1) provides the basis for detecting potential impacts relating to nutrient loads in the Marillana and Weeli Wolli Creek systems. The analyte suite and monitoring schedule is established in accordance with DEC approved discharge licensing as follows:
		
		1. monthly: for cumulative volume discharged (m^3)
		2. quarterly: for pH, EC, TDS, TSS
		3. bi-annually: for pH, EC,TDS, TSS, Al, Ca, Mg, Na, K, SO_4, Pb, Cu, Fe, Mn, Mo, Zn, As, Cd, Cr, NO_3, Total Phosphorus

Submitter	Submission and/or issue	Rio Tinto response
	final report states' (p27): *Significantly higher total nitrogen levels have been recorded by the authors downstream of RTIO's Yandi discharge, compared with upstream on Marillana Creek (WRM 2010a*) [The submitter contends that]: • Yearly monitoring of water quality in bores is inadequate and should be at least monthly. (PER page 102). • It should be easy to automate at least more aspects of monitoring of discharge water quality, aquifer water quality and depth so that monitoring can be on a continuous or at least several times daily.	In addition, control sites at Flatrocks, Upstream of M1, Downstream of M6 are measured quarterly for pH, ED, TDS, TSS, Major Ions, heavy metals, nutrients, TRH, COD and MBAS. Plant, waste water treatment plants, and sumps are measured monthly for pH, TDS, EC, TSS, TRH and flow rates. The Yandicoogina Surface Water Quality Management Plan includes provisions for: • investigating cause of water quality changes • removing the cause if the change is due to mining activities. Nitrogen in the form of nitrate (NO_3) is included in the Yandicoogina groundwater monitoring program (as indicated in Table 3-7 of the PER Document). The analyte suite and monitoring schedule is established in accordance with DoW issued groundwater licence requirements (outlined in the site groundwater operating strategy): 1. Monthly: for pH, EC, temp, Run Hours, cumulative flow, instantaneous rate flow, water level elevation 2. Annually: for pH, EC, TDS calculated, Na, K, Ca, Mg, Cl, CO_3, HCO_3, SO_4, NO_3. With respect to daily monitoring, this is not required under existing licensing conditions, and the additional data collected would not enhance management responses or outcomes. The proposed monitoring schedule represents standard practice for iron ore mining projects.

5.4 Groundwater

Submitter	Submission and/or issue	Rio Tinto response
One public submitter addressed this factor	The submitter contends [that the following] risk is not assessed: *For hyporheic ecotones, both downwelling (where surface water enters the stream bed) and upwelling (where water exits the bed) areas are required proper ecological functioning, such as the maintenance of bed filtration and fish nurseries (Hancock 2002). However, pumping from bores located near rivers can create unidirectional flow of river water into the stream bed (Hancock et al. 2009, Buss et al. 2009). This would alter exchange patterns to downwelling only, resulting in reduced filtration effect of water passing through the hyporheic zone (Mauclaire and Gibert 1998).* (p26, The Yandicoogina JSW & Oxbow mine development Aquatic Management final report'). This issue has the potential to affect ground water as well as having a significant impact on the ecological functioning of Weeli Wolli Creek, Marillana Creek and potential to adversely affect Fortescue Marsh.	A PhD study: *Estimation of infiltration rate from Marillana Creek to the surrounding aquifers* has been established between Rio Tinto and Flinders University in order to assess the leakage rate of water between Marillana creek and its surrounding aquifers and how this interacts with existing and proposed mining operations at Yandicoogina. In particular, the below water table mining of the CID deposit. The permanent flow from continuous discharge into Marillana and Weeli Wolli Creeks has resulted in an increased potential for down gradient leakage into the underlying aquifers. The quantification of the leakage rate between the creek and surrounding aquifers is therefore essential in updating the groundwater balance, taking into account the updated hydrogeological setting and the groundwater - surface water interaction that has been impacted by mining operations; this will also enable an understanding of subsequent ecological impacts as a result of the mine water discharge. This project will estimate stream infiltration rates using multiple methods, with each method capturing different spatial and temporal scales. A mass balance approach will be used to understand reach - scale processes. This approach will utilise ion and isotope concentrations of water samples collected from the surface flows within the creeks, and also from the shallow sediments adjacent to, and underneath the creek (the hyporheic zone). This would allow an informed assessment of the potential risk from surface water discharge to aquatic ecosystems. Existing Rio Tinto and BHPBIO Yandicoogina operations have been discharging into Marillana Creek since 1994. The JSW and Oxbow projects will utilise the existing discharge infrastructure currently in place for Yandicoogina, thus avoiding adding additional discharge points into Marillana creek. Aquatic monitoring is currently being undertaken on a biannual basis at Yandicoogina, which would also provide monitoring data prior to the implementation of the JSW and Oxbow Proposal. In addition, the later scheduled Oxbow deposit would result in lower discharge volumes (~8 GL/a) than the existing Junction Central operations, which it will ultimately replace.

5.5 Surface water

Submitter	Submission and/or issue	Rio Tinto response
	The key procedural components for the surface water EMP are (PER page 114): *Maintain the flow paths, quantity and quality of water within Marillana, Yandicoogina and Weeli Wolli Creeks to protect ecosystems and maintain ecological water requirements;* *Regulate discharge to creek systems and evaluate alternative discharge locations and methodologies (e.g. to achieve ecological mimicry)*; *Minimise the volume of runoff from operational areas and treat runoff to remove contaminants;* *Prevent erosion.* The submitter contends that surface discharge and mining of creeks renders the first component unrealistic and unachievable. Regulation of discharge is unlikely and not the preferred option, the preferred option (currently and in the foreseeable future) being continuing discharge. A competent environmental review document would track the differences between the proposed options, but this has not been done. The submitter contends that *'maintain the flow* paths' means : • *Modifying the Marillana Creek floodplain and low flow channel* (p xiii) and • *The diversion of Phil's Creek will involve relocating the last 800 m of this creek* (p xiv).	Issues relating to discharge management, and the maintenance of flow paths and the flow regime in the Proposal area creek systems, are discussed in Section 5.2. The Proposal does not include mining of the Marillana and Weeli Wolli creek lines. The JSW deposit is a single, continuous deposit. Under the Proposal it will be segregated into two mining areas (JSW-A and JSW-C) separated by the 100-year ARI floodplain of the Marillana Creek, which will not be mined but subject to some disturbance associated with the development of flood protection structures and vehicle crossings (Table 5). This is depicted in Figure 2-1 of the PER Document. The proposed flood protection levees are designed such that whilst the creek line will be narrowed in the flood plain section separating JSW-A & C, the existing low flow line (or storm water flow line) will be maintained in Marillana creek and not diverted from its current path. This will enable the flow paths to be maintained, including the quality and quantity of water in order to protect ecosystems and maintain ecological water requirements. Only the terminus of a tributary into Marillana Creek (Phil's creek) will be temporarily diverted to allow for mining. This tributary will still maintain natural flows into Marillana creek during the period in which it is temporarily diverted. The surface water discharge also serves to maintain some of the environmental water requirements by reducing the localised impact of the groundwater drawdown on riparian systems in the vicinity of JSW. With respect to the surplus water management strategy of disposal to the Marillana Creek, a detailed review of all water surplus management options is provided in Section 5 of the PER Document, including an analysis of the options and the resultant environmental impacts of each of the options.

Submitter	Submission and/or issue	Rio Tinto response
	Appendix 7 Yandi – Aquatic Management (p 35) states: *As part of pit development, it will be necessary to re-align sections of Marillana Creek, particularly around the JSW deposit. This will likely require substantial excavation to develop a channel of adequate size, dimensions and elevation to act as a 'natural' creekline to join back into Marillana Creek. This engineered channel will likely remain in perpetuity and become the 'natural' creekline, so careful consideration to channel design and form must be given.* The fauna management strategy calls for the management process: *maintain a riparian vegetation buffer of not less than 200 metres around Marillana, Yandicoogina and Weeli Wolli Creeks to protect the riparian habitat of fauna associated with the creeks (excluding intrusion into this buffer associated with flood protection levees and a heavy vehicle road crossing at JSW).* (Page 177) Clearly this is unrealistic and unachievable. Page 13 Yandi operations PDF of riparian vegetation also describe management actions to *'Avoid construction of diversion structures in creeklines.'* How can this avoidance take place when the PER refers to the diversion of Phil's creek and the modification of the Marillana Creek floodplain? The surface water management plan key components lack detail on the preferred option and the key design considerations. The maintenance of creek flow paths only refers to areas outside the project area, however the documentation as a whole is overly focused within the project area and [generally] neglects off site environmental considerations. Averaged out over a year 16 GL equates to just under 2 million litres per hour, or 2000 cubic metres at the upper flow given in the figure above (21.3 GL) it is approximately 2.5 million litres or 2,500 cubic metres per hour. However as aquifer input is	With respect to creek line modifications, the Proposal will maintain the low flow line in Marillana Creek such that during rainfall events surface water flows will continue to be maintained in Marillana creek, along a pre-existing pathway. Minimal disturbance to the main channel will occur at vehicle crossing points. There will be some encroachment of flood protection structures into the 100-year ARI floodplain at JSW, however this will not significantly affect the functional integrity of the main channel. The flood protection structures are being designed to ensure minimal changes to the existing flow regime and hence provision of flows to downstream ecosystems. Maintaining a riparian buffer of 200 m along Marillana Creek formed part of the conditions of approval for the existing Yandicoogina JSE project. Because Yandi JSW will form an extension to the existing Yandicoogina operations, the same site management principles will in general apply, as they protect the same environmental values. However, the proximity and orientation of the JSW deposits to Marillana Creek means that this requirement is not able to be fully applied at JSW. Where feasible, a riparian buffer will be maintained, and the existing site Riparian Vegetation Management Plan has been updated to reflect this. Some requirements for roads cannot be avoided; however, infrastructure crossing points/encroachment requirements have been restricted to critical operational requirements only and designed to avoid significant impacts. For this reason the objective of the fauna management strategy to maintain a riparian buffer, excluding intrusion into this buffer associated with flood protection levees and a heavy vehicle road crossing at JSW is achievable. Figure 2-2 in the PER Document illustrates the key riparian buffer/avoidance zone and any infrastructure encroachments into this zone.

Submitter	Submission and/or issue	Rio Tinto response
	seasonal, peak flow would be considerably higher, so how are flow paths downstream of the development to be maintained? There is also at least a 12% chance of a 1 in 100 year rainfall event in the area in the life span of the mine, so how would that impact? How will [discharge volumes and flow rates] affect creek structure, and how will [discharge] outlets be designed to prevent erosion? [The submitter contends that the] long term ecological effects have not been adequately modelled and assessed. Appendix A9 [states] ' *Further work is therefore required to identify creek sections that are potentially "at risk" or sensitive to flood regime change for future preservation or rehabilitation*' (page 35) however this is not addressed in the PER document.	The Yandicoogina Surface Water Management Plan is an extension of the existing Ministerial requirements for current Yandicoogina operations and has been applied to this Proposal. The key design considerations are outlined in the objectives, and further work has recently been completed to inform the design of surface water management structures (Refer to Appendix 1). The maintenance of creek flow paths refers directly to the development of the proposed JSW and Oxbow mines, specifically where levees are designed to be built in the section between JSW-A & C, which would narrow the creek bed in this area. As previously discussed this would be designed to maintain the existing low-flow path within this zone. Additional work on erosion control structures has been completed and is described in BG&E (2012) (Appendix 1). Rio Tinto does not agree that off-site considerations have not been addressed. In fact, the difficulty of scale of the diagrams is a result of providing the public with adequate local context in relation to the Yandicoogina operations as a whole, and also to capture downstream impact predictions. Off site considerations are captured in Figures 2-1, 2-2, 3-1, 3-7b, 3-8, 3-12, 3-16, 3-20 of the PER Document; and with explicit respect to the predicted extent of surface water discharge in Figure 7-2 of the PER Document. Rio Tinto contends that that long term ecological effects of discharge have been adequately considered, within the constraints of current scientific knowledge. Baseline monitoring of the creek systems has been undertaken and a program for ongoing monitoring is presented in the PER Document and the updated Yandicoogina EMP and further described in Sections 3.1 & 3.2 (Appendices 12 & 14). The overall approach constitutes an adaptive management framework for detecting impacts to the creek systems protecting riparian ecological values.

Submitter	Submission and/or issue	Rio Tinto response
1 public submitter addressed this issue DEC	The proponent should monitor the hydrology, ecology and biomass accumulation of both Marillana and Weeli Wolli creeks, specifically within the area of influence of the additional proposed surface water discharge from this operation. The monitoring program should include provision, within the implementation framework of the proposal, for remediating these systems as necessary to ensure that the identified environmental and conservation values associated with these ecosystems and any downstream ecosystems, including the Fortescue Marsh, identified as a Priority 1 ecological community, are maintained. Water discharge associated with this proposal has been identified by the proponent as significantly adding to water discharged by other mining operations in the greater Weeli Wolli catchment including Hamersley Iron Pty Ltd's Yandicoogina Junction South-East, Rio Tinto's Hope Downs 1 and BHP Billiton's Yandicoogina Mines. The additional discharge would bring the system nearer to the possibility of long-term ecological damage. The current year round surface water expression in riparian system that is adapted to a highly seasonal surface water regime is potentially having detrimental impacts on the ecology of the Marillana and Weeli Wolli creek systems without the additional discharge of this operation. The proponent has indicated that the dewatering and associated surface water discharge footprint from this proposal will extend the current discharge disturbance *"4 km past the current peak maximum footprint, to approximately 17 km beyond the confluence of Marillana and Weeli Wolli Creeks"* (p xxiv). This will be as a result of the maximum combined and predicted total surface water disposal activities from mining operations in the	The potential impacts to the hydrology and ecology (including biomass accumulation) of Marillana and Weeli Wolli Creeks as a result of the proposed additional surface water discharge from the Proposal are described in Sections 7.1.3.3 (Flora and Vegetation), Section 7.2.3 (Terrestrial Fauna) and Section 7.4.3 (Surface Water) of the PER Document. The Yandicoogina Riparian Vegetation Management Plan, Weed Management Plan, Ground Water Management Plan and Surface Water Management Plan have been updated such that monitoring requirements stipulated in these plans also apply to the riparian systems directly affected by the extended discharge footprint. Where necessary, the current monitoring programs as described in the Management Plans will be extended to ensure adequate coverage of the proposed increase to the discharge footprint. Monitoring will include: • Remote sensing of riparian vegetation using DMSI • Riparian vegetation cover/abundance and composition • Digital Cover Photography (Tree Health) • Aquatic Fauna • Surface Water Quantity and Quality To date, biomass accumulation has been monitored indirectly through Riparian Vegetation Transect Monitoring. This monitoring technique employs a standard belt-transects design of 10 quadrats, (each 100 m^2 in area). Within each 100 m^2 quadrat the cover/abundance and condition of all vascular plant taxa are recorded. It is Rio Tinto's view that this monitoring regime based on cover/abundance of riparian plant species provides appropriate data on changes in biomass accumulation in the Marillana and Weeli Wolli systems. Specific calculations of standing plant biomass are not deemed necessary in light of the existing data currently captured in the monitoring program.

Submitter	Submission and/or issue	Rio Tinto response
	greater Weeli Wolli catchment. The continuous surface water discharge of surplus mine water into these creek systems has significant potential to alter or disrupt the 'normal' ecology, surface and groundwater hydrology and biomass of Marillana and Weeli Wolli creeks and ultimately the Fortescue Marsh.	Specific management measures to avoid, minimise and remediate adverse impacts to riparian ecosystems within and downstream of the proposed additional surface water discharge are described in Section 7.1.5 (Riparian Flora and Vegetation), Section 7.2.4 (Terrestrial & Aquatic Fauna), Section 7.4.4 (Surface Water) of the PER. The management measures are also embedded within the various management plans listed above such that they form key components of the projects implementation and operating environmental management framework. Further descriptions of the predicted impacts are provided in Section 3.2. Should monitoring indicate that extension to the wetting front within Weeli Wolli Creek is causing an adverse impact on riparian ecosystems, Rio Tinto, in consultation with the DEC would consider taking the following remediation actions: • Weed control measures in areas where monitoring has identified higher cover/abundance of weed species relative to reference sites. • Thinning treatments, targeting artificially induced recruitment of samplings in areas where tree density significantly increases because of discharge water. • Rehabilitate affected riparian vegetation using plant material of suitable provenance • Manage the timing of discharge to more closely emulate the natural flow regime (episodic). This includes staged reductions in discharge volumes so that trees can adapt to the reinstated natural wetting regime. .

5.6 Vegetation and flora

Submitter	Submission and/or issue	Rio Tinto response
1 Public Submission addressed this factor	Monitoring sites for riparian vegetation should be established prior to commencement of all works and definitely before commencement of dewatering and not three months after as stated in the Riparian Vegetation Management Plan. Commencement should be at least a year in advance to provide seasonal comparison. Changes in vegetation and environment between the site and Fortescue Marsh require monitoring and documentation on a minimum of 6-monthly basis. All targets must be measurable and have associated monitoring program with regular reporting. Actual dynamic volumes of discharge to creeks may impact on riverine vegetation.	Rio Tinto has undertaken regular monitoring of riparian vegetation along Marillana Creek and Weeli Wolli Creek since 2005, in association with the existing Yandicoogina operations and also the Hope Downs 1 mine. This includes quarterly measurements of foliage cover since 2007. Refer to Figures 2 – 5. Under the Proposal this monitoring will be continued, and additional monitoring points will be added, spanning the extended surface water footprint predicted in the downstream reaches of Weeli Wolli Creek. Monitoring at these new points will occur prior to the commencement of dewatering the JSW and Oxbow ore bodies. The monitoring schedule and tree health management triggers are provided in the Yandicoogina Riparian Vegetation monitoring plan (Table 31 in PER Document Appendix B). Reporting on monitoring activities is provided annually as part of the Yandicoogina Annual Environmental Review.

5.7 Heritage

Submitter	Submission and/or issue	Rio Tinto response
1 Public submitter addressed this issue	The comments do not indicate if any of the sites are in the project area and of what significance they are. Page 209 [states] that: '*direct disturbance of some archaeological sites will be undertaken, mostly of low archaeological significance*.' So what about the ones that aren't of low significance? How many is some? And if this is the case why does page 207 say: *Aboriginal heritage sites could potentially be disturbed by proposed activities*? If some sites will be disturbed and some sites may only be potentially disturbed why aren't these distinguished? In fact why haven't they been clearly mapped and defined already? The submitter contends that Figure 3.24 is non-informative, as significant sites have not been shown. While the main report says, '*some'* elsewhere this is categorised as *'Numerous heritage sensitive areas were identified following archaeological and ethnographic surveys in close proximity to the mine area and adjacent to creek lines.* (page 5 Appendix A9),	Heritage surveys have been undertaken across the Proposal area as per the requirements of the *Aboriginal Heritage Act 1972*, the Rio Tinto Cultural Heritage Management standard, and the current Indigenous Land Use Agreement (ILUA) with the Gumula Aboriginal Corporation. The spatial extent of Aboriginal heritage surveys undertaken to support the Proposal is clearly depicted in Figure 3-24 of the PER Document. The purpose of this Figure is to demonstrate locations within the Proposal area that have been included in archaeological and/or ethnographic surveys. These areas include the entirety of the proposed disturbance footprint. Due to the highly sensitive nature of the heritage information to the Traditional Owners, specific details relating to identified heritage sites cannot be provided in a public document or specifically depicted on a map. Note that confidentiality of these sites is an explicit requirement in accordance with agreements in place between Rio Tinto and the Traditional Owners. This is a common requirement for public documents prepared under the Western Australian EIA process. It is reiterated that the EPA applies the following management objective for protecting Aboriginal heritage: '*To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation'*. Any disturbance to Aboriginal heritage sites associated with the Proposal will be subject to the provisions of the *Aboriginal Heritage Act 1972* and consultation with the Traditional Owners.

Submitter	Submission and/or issue	Rio Tinto response
	Despite '*Extensive archaeological and ethnographic surveys have been undertaken within the Yandicoogina locality (eg Quartermaine 1993, 1995, 1996; Hammond 1997; Archae-Aus 2001, 2003a & b; 2005, 2010a and b; O ‟Conner and Brunton 1995; MacDonald 2003; Day 2004; Ethnosciences 2010; MacDonald and Coldrick 2010)* (p207) The proposed management still requires: *Surveying of heritage sites prior to construction* and *Establish and maintain a register of sites of Aboriginal significance within the site, including spatial records of site locations* (page 210). This again implies the ethnographic surveys haven't been read or properly assessed.	Rio Tinto has maintained effective working relationships with the Traditional Owners since mining commenced at Yandicoogina in 1996. As part of ongoing consultation with Traditional Owners associated with the existing mining operations, Rio Tinto has already identified multiple heritage avoidance areas and also identified lower priority areas that may be acceptable to disturb in accordance with legislative procedures. Note that the heritage avoidance zone currently demarcated around Weeli Wolli Creek, Marillana Creek and Phil‟s Creek (excluding existing infrastructure crossing points) was identified in the context of the JC and JSE mining operations. As identified in the PER Document, the Proposal involves modifying this exclusion zone to permit encroachment into the Marillana Creek 100-year floodplain at JSW to permit the construction of flood protection levees and new vehicle crossing points. Rio Tinto acknowledges that additional heritage surveys may be required where infrastructure or infrastructure tie-ins need to be moved to avoid other environmentally sensitive or heritage sites delineated in completed surveys. This includes the need for more intensive surveys at specific locations which may have been subject to broader scale surveys.

5.8 Closure and rehabilitation

Submitter	Submission and/or issue	Rio Tinto response
1 public submitter addressed this issue	With respect to the preferred closure option, the submitter contends that] there needs to be firm commitments about natural channel design and form. The submitter contends that inadequate detail on channel design features has been provided to achieve an acceptable result. Appendix A9 notes that the redesigned water ways will require rock lining to prevent erosion, how is this going to be incorporated? How will such a design feature incorporate any sort of ecological mimicry? These channels are intended to be left in perpetuity, turning them into rock lined gutters has to be totally unacceptable. Please provide the design features that ensure that there is an acceptable result.	A detailed Hydrology Study of drainage and flood protection structures required for the proposed JSW pits was completed in January 2012 (BG&E 2012; Appendix 1). The key findings of this study are presented in Section 3.3. Sections of engineered channels requiring rock lining have been evaluated in this study. Rock armouring is a proven methodology for providing long term stability to engineered earth and rock structures. With appropriate design, rock armouring can be integrated with other rehabilitation aspects such as revegetation and riparian habitat reinstatement. Rio Tinto considers that rock armouring will be an essential feature of final landform designs at Yandicoogina to help meet the ecological water requirements of the downstream creek systems.
1 public submitter addressed this issue	The submitter contends that the issue of topsoil deficit identified in Appendix 15 is not adequately addressed. The submitter contends that native seed procurement for rehabilitation is not adequately addressed, due to a lack of a stated plan for this activity. This is a long term project – why is there no plan to collect local seeds and employ local aboriginal people who know the bush? The use of local seed should be a firm commitment.	Rio Tinto has standard practices for managing topsoil across its Pilbara iron ore business. A potential shortage of topsoil has been identified due to the following factors specific to the Proposal: • the nature of the soil types and terrain in the Proposal area, including generally shallow soils; and • inherent limitations to progressive rehabilitation due to the temporary nature of waste dumps. This will necessitate some topsoil storage for relatively long periods. Options for addressing this issue are stated in the PER Document Appendix A15 (pg 74) and include collecting additional soil volumes, prioritising placement and reducing thickness of application.

Submitter	Submission and/or issue	Rio Tinto response
		Rio Tinto Iron Ore has developed site specific seed lists for each of its operations. These lists are based on reference sites in proximity to project sites, to ensure species returned to rehabilitation are similar to that of the surrounding area and landscape feature. This is consistent with best practice approaches to seed collection which advocate the use 'local provenance' seed or eco-geographic approaches for matching for seed collection and rehabilitation sites based on environmental, edaphic and climatic variables. All seed procured by Rio Tinto's iron ore business is sourced from the local areas in accordance with strict collection requirements. Rio Tinto is supportive of local indigenous people being involved the company's rehabilitation activities. Seed collectors generally have existing relationships with local indigenous people who supply seed through our seed collectors. In recognition of the need to ensure high quality seed is used in future rehabilitation activities, Rio Tinto commenced a seed provenance research project in conjunction with the Science Division from the DEC in 2009. This ongoing project is using genetic indicators to help define species provenance boundaries. These boundaries will provide the basis for optimising seed collection strategies and ensuring that seed used in mine site rehabilitation is genetically similar to the pre-mining vegetation. Rio Tinto is committed to continuous improvement in rehabilitation practices, and maintains a rehabilitation research and development program spanning its Pilbara iron ore operations. Research in progress directed at the topsoil deficit issue includes an assessment of using materials such as waste rock types or fines from tailings facilities as soil bulking agents. A set of field trials is being developed as part of this project.
1 public submitter DMP	The submitter contends that Appendix 15 provides inadequate detail about the risks of closure and their amelioration The submitter contends that Rio Tinto has not adhered to the 2003 Rehabilitation scheme, and that they now want to leave a 20 kilometre lake presumably 60 metres deep, This would appear to imply a significant lack of planning.	Closure completion criteria will be developed as the site approaches closure. These will be specific, and will be agreed with stakeholders. Rio Tinto does not consider it appropriate to develop such criteria at this early stage of a project because there are likely to be significant changes, both internal and external between now and closure such as: • Understanding and appreciation of environmental and social values; • Industry closure and rehabilitation standards; • Stakeholder expectations; • The operational mine plan; and • Surrounding land uses.

Submitter	Submission and/or issue	Rio Tinto response
	With an 'acceptable' water salinity of just under 15,000 mg/l? (p17 closure study report). This is significantly higher than the current 1290 mg/l in alluvial aquifer and up to 600 mg/l in the CID at Yandicoogina. So while natural ecosystems may develop in them they will be significantly different to the existing natural ecosystems. [The Yandicoogina Closure study report states] *Impacts to Fortescue Marsh are likely to be restricted to the impacts of seasonal flushing of channel water downstream during heavy periods of rainfall.* This is substantially different from the table on (PER) page xxxi which states '*no potential for the Fortescue Marsh to be affected as a result of dewatering'.* Aquifer reinjection sites (PER) p 131 of the main report states: *deep water table - the Weeli Wolli alluvial plain, creek proper and the associated ecosystem occupies a broad area with a relatively deep water table (~30 m below surface). The depth to water table and relatively high porosity of the alluvium means that the system is able to absorb large, infrequent flood flow events that occur in the Weeli Wolli catchment. Water reinjection in this area would reduce the buffering capacity of the unsaturated alluvium, potentially increasing the size and frequency of surface water flows discharging directly into the environmentally sensitive Fortescue Marsh further downstream. This type of hydrologic modification could result in undesirable ecosystem changes in the Marsh.*	Therefore, Rio Tinto has developed broader closure objectives that will be reviewed and refined in subsequent revisions of the closure plan, and has documented indicative completion criteria in order for stakeholders to get an indication of the types of issues that are expected to be addressed. Since the PER Document was submitted, mine planning and hydrological modelling studies which address gaps identified in the closure study report have been completed; the results of which are provided in this document (Refer to Section 3.6 and Appendix 5). These studies have provided an improved level of understanding of such issues as pit lake water quality and impacts to flow regimes for various closure scenarios. At least two closure scenarios have been identified that are predicted to result in acceptable hydrological outcomes, and the channel scenario described in the closure study report is predicted to lead to a pit lake of very good water quality. Refer to Table 6. Further studies are required to enable Rio Tinto to commit to the channel scenario, or an alternative scenario, as a definitive closure strategy. However; research undertaken to date indicates that there will be a viable closure option available for the site. Studies supporting closure planning will continue throughout 2012, and an updated closure plan is scheduled to be completed in 2013. The Fortescue Marsh is not predicted to be affected by mine dewatering during the operational phase of the project, based on the predicted extent of the discharge footprint. This is a separate issue to the behaviour of the final closure landform, which will not affect the Fortescue Marsh if salinisation of pit lakes is prevented. The use of the Weeli Wolli alluvial plain as an injection area would create areas of artificially mounded groundwater in the vicinity of the injection bores. This modified groundwater regime would be different to that caused by water derived from creekline flows that naturally percolate into the groundwater system beneath the alluvial plain (*i.e.* locally concentrated versus more dispersed water influxes to the groundwater system). Depending on the location of the injection infrastructure, there is a risk that groundwater mounding could act to propagate surface flows closer to the Fortescue Marsh. The extent of this risk has not been evaluated further, as it would require hydrogeological characterisation of the Weeli Wolli alluvial plain (*i.e.* an investigative drilling and bore installation program).

Submitter	Submission and/or issue	Rio Tinto response
	However, '*The majority of the groundwater extracted for mine pit dewatering purposes will ultimately be returned to the aquifer downstream of mining operations, through the action of surface water percolating beneath the Marillana and Weeli Wolli Creek beds' (*page xv main report) the difference between the 10 – 20 gL of surface run off going into this aquifer by injection or percolation from the surface is difficult to see (though the figure given elsewhere suggest maybe a 9% difference due to evaporation when total water is discharge either one of the 2 methods), especially as recharge due to flood events is by percolation. This would make the statement above from the PER incorrect. It is noted that RTIO have completed the Yandicoogina Closure Study Report (Appendix A15) to determine three conceptual closure options. These options are: 1) retaining JC and Oxbow open pits; 2) creating a 'channel' landform utilising the CID orebody zone, or 3) backfilling to ground level involving quarrying of surrounding hills. Option 2 ('channel') is considered the preferred option by RTIO. It is concerning that a feasible and environmentally acceptable closure option has not been determined at this stage. It is imperative that a feasible closure option is determined prior to mine commencement as this needs to be integrated into the mine planning and scheduling for the project. If this integration does not occur, the viability of certain closure options may be compromised, resulting in an unsatisfactory closure outcome.	

Submitter	Submission and/or issue	Rio Tinto response
1 public submitter addressed this issue	Salinity from the pit water after rehabilitation and its impacts on Fortescue Marsh is not mentioned within the main PER document. When the agreed minimum rehabilitation criteria in the 2003 rehabilitation plan is 15,000 mg /l in the pit (p17 closure study) and the pit is to become a permanent lake/channel which, from figure 31 of the closure report, looks as if it is contained in a water course then it has a significant environmental impact which requires investigation. Creating a saline lake which drains into Fortescue Marsh appears to be breach those Rio Tinto closure objectives If the pit lake can have a salinity levels up to 250 times greater than the ground water (600 mg/L to 15,000 mg/L) this also has to have an effect on the ground water quality as they are interconnected. All of the decommissioning land form options appear to have significant unpalatable environmental consequences, however these appear not to have been analysed or compared adequately, this requires doing before assessment of the project can be made. Post mining the total water flow at Oxbow is set to decrease by 26% and peak flows by 50% (page 45, Appendix A9 Marillana creek regional flow balance), as far as I could tell no mention of this is made in the main document nor its ecological effects on Fortescue Marsh or the long term effects on riparian vegetation or which oft	The Yandicoogina Closure Study (PER Document Appendix A15) includes the following objectives of specific relevance to the protection of the Fortescue Marsh: • Objective 8: The water in any pit voids should be able to support natural ecosystems • Objective 9: Environmental values of Fortescue Marsh should not be compromised These objectives are stated in Table 7-10 of the PER Document, along with nine other closure objectives. Consistent with these objectives, the final landform strategy includes measures for preventing the development of salinity in surface and groundwater systems at Yandicoogina. With respect to historical salinity targets, the water salinity level of 15,000 mg/L was an objective previously agreed with Government in 1998 soon after the JC mine commenced operation, and Rio Tinto does not consider that it reflects current environmental standards. It should be noted that recently completed modelling for various closure options indicates that significantly better pit lake water quality is likely to be achievable under the current closure scenarios (refer to Section 3.6). Each of the conceptual final landform design options has advantages, disadvantages and associated environmental impacts. As part of the mine closure process, Rio Tinto will work with regulatory agencies and other relevant stakeholders to select a final closure option which optimally delivers against the closure objectives. More detailed analysis of the environmental consequences of each option will occur in parallel with more detailed design and engineering studies addressing each option. Seasonal flushing of fresh water from the Marillana and Weeli Wolli Creek catchments into the higher salinity Fortescue Marsh is a natural phenomenon that is independent of mining activity. The volumes of water delivered to the Marsh in cyclonic flood events are orders of magnitude greater than discharge volumes associated with mining at Yandicoogina. Based on modelling and monitoring data collected since the mid-1990's, Rio Tinto does not consider there to be any significant risk to Fortescue Marsh as a result of mining and discharge at Yandicoogina.

Submitter	Submission and/or issue	Rio Tinto response
	times requires floods for regeneration or other vegetation. This may also be of concern for Fortescue Marsh as in the warning about changed hydrologic conditions. Page xiv of the main report claims '*The project is not predicted to have any lasting detrimental effects on surface water values'* .This statement requires justification in view of the continual discharge of 10 – 21.3 GL of water per year. Effects of mine discharge water are inadequately dealt with in the main document. The change in hydrologic conditions due to dewatering and then another sudden change 12 years later at the cessation of mining with a saline pit channel can have significant affects on the ecology. Insufficient study has been done of downstream effects. The proposed monitoring program outlined in the PER is inadequate and lacks detail.	Appendix A9 of the PER Document included a theoretical modelling activity with the purpose of providing a better understanding of the influence of truncating tributary flow and catchment runoff on the flood behaviour in Marillana Creek at selected locations (*i.e.* immediately downstream of the BHPBIO Yandicoogina operations prior to the Rio Tinto Yandicoogina Oxbow deposit and at the catchment outlet terminus of Marillana Creek at the Weeli Wolli confluence). This theoretical modelling exercise was not designed to accurately represent the closure conditions for all of the deposits adjacent to Marillana Creek, and cannot be interpreted as being representative of the Marillana Creek flow conditions post mining. Relevant critical assumptions made in the modelling assessment included: • Creek systems originally flowing over the mapped CID terminate into (future) pit voids; and • Insufficient materials are available for backfill pits to create a free draining surface, thus all pits act as infinite capacity voids. The modelling provided insights into how closure landforms could affect the flow regime in Marillana Creek, and is one of multiple inputs considered in the development of the currently proposed closure options. Discussion of mine discharge water and its potential downstream effects is provided in previous responses addressing surface water, water quality and ecological monitoring. Rio Tinto considers that the proposed monitoring program is adequate and constitutes an extension to existing (DEC, DoW & OEPA) approved management plans for existing Yandicoogina operations. Further discussion is provided in previous responses addressing surface water, water quality and ecological monitoring.

Submitter	Submission and/or issue	Rio Tinto response
DMP	Rio Tinto should be aware of the DMP/OEPA 2011 Mine Closure Guidelines when finalising their detailed mine closure studies.	Rio Tinto is aware of the new DMP/OEPA 2011 Mine Closure Guidelines, which are listed as one of several applicable mine closure guidelines in the PER Document (pg 215). The Yandicoogina Closure Study Report (Appendix A15 to the PER Document) is structured to reflect the DMP/OEPA 2011 guidelines and includes a checklist addressing the key guideline elements. Rio Tinto is aligning the final Yandicoogina Closure plan to meet the requirements outlined within these guidelines. It should be noted that the Proposal referral; the Environmental Scoping Document approval (by the OEPA); and the draft PER submission were all completed prior to the release of the new Mine Closure Guidelines.

5.9 Levees

Submitter	Submission and/or issue	Rio Tinto response
DoW One public submitter for this factor	As a major portion of the proposed project area is located in flood-prone areas, a levee system is proposed as the main form of flood protection. There is potential for levees to be breached/overtopped during extreme flood events.	A detailed Hydrology Study of drainage and flood protection structures required for the proposal was completed in January 2012 (Appendix 1: BG&E 2012). This report details the hydraulic analysis for the Yandi Sustaining Project. The resulting outputs from this study provided: • Marillana Creek levee height requirements. • Floodway design and culvert configuration of the Marillana Creek and Phil's Creek floodways. • JSW-C drainage diversion channel designs including energy dissipation structures. • Phil's Creek temporary diversion and realignment design. • JSW-A drainage diversion channel designs including energy dissipation structures. • JSE drainage diversion channel designs including energy dissipation structures. • Site-wide culvert design. This report recommends appropriate drainage design for the proposed levees which will provide adequate site drainage for a 100 year ARI flood event via diversion channels and levees. Floodways will be dry for a 2 year ARI event and wet (300 mm flood depth) for a 5 year ARI event.

5.10 Waste characterisation

Submitter	Submission and/or issue	Rio Tinto response
DEC DMP One public submitter for this factor	The submitter contends the PER states that physical waste characterisation has not been completed to date. Physical waste characterisation must be completed prior to project approval. The proponent should undertake geochemical testing to determine whether backfilling pits with waste rock would adversely affect groundwater quality in local aquifers. No information has been provided in the document on the characteristics of waste rock material that may be used to backfill mine voids created by the project. Previous research on rocks associated with Channel Iron Deposits in the region (Gardiner, 2003) has indicated that the rocks may be enriched in metalloids and metals such as antimony, arsenic and molybdenum that form stable oxyanions in solution. Depending of the mineralogy of the rocks, these elements may be released under circum-neutral and oxidising conditions when rocks are removed from below the water table. Under some circumstances, metals release can take place from these materials even in the absence of significant levels of sulphide materials. It is recommended that additional testing work of waste rock materials takes place to determine whether there is a potential leaching hazard associated with the use of these materials as backfill. The proponent should undertake geochemical testing to determine the extent to which metals and metalloids are desorbed and leached from iron ore materials that are stockpiled onsite and are subject to oxidation.	**Erodibility** Rio Tinto has standard Landform Design Guidelines which apply across its Pilbara iron ore business. The guidelines classify waste rock according to erodability parameters, and specify parameters such as maximum slope lengths, slope gradients and lift heights for each class of waste. The guidelines also provide design specifications for ensuring effective drainage to reduce erosion, cover treatments that may be required, and construction standards for concave slopes. A review of the Landform Design Guidelines was undertaken in 2011, following a comprehensive literature review and a materials testing and erosion modelling program. Representative waste from Yandicoogina was included in this program. The revised document is scheduled for completion in 2012. **Potential for AMD** Static testing has been completed on 95 samples spanning most lithologies at Yandi. The tests undertaken include paste pH & EC, S, SO_4-S, ANC, NAG tests, kinetic NAG, solid and liquid extract assays and acid base characterisation curves. Preliminary results from the static test work (Appendix 3) indicate a low risk of metal/metalloid mobility and this can mostly be attributed to the low sulfur content found in the Yandicoogina lithologies. For precautionary purposes complementary long-term leach testing is currently being undertaken during 2012 to further evaluate the metal/metalloid mobility risk. It is anticipated that a number of different leach tests methodologies will be trialled to determine the most appropriate method going forward for this type of analysis.

Submitter	Submission and/or issue	Rio Tinto response
	Iron oxides can absorb a variety of cationic and anionic chemical species; buy the absorption behaviour is very sensitive to changes in pH and redox potential. Most problematic is the anionic adsorption of metals and metalloids of environmental concern which for stable oxyanions in solution, as these species may be desorbed and leached at neutral pH conditions when iron ores from below the water table are excavated, stockpiled and allowed to oxidise. Of particular concern is the potential for selenium leaching from oxidising iron ore. Iron ores may not have been subject to geochemical testing as proponents may have assumed that they are geochemically "inert" due to their low sulfur content. However, runoff, from these materials can cause significant environmental harm if it contains elevated concentrations of selenium, mercury, molybdenum or other constituents of environmental concern. The proponent should include the elements mercury and selenium in the monitoring plan for discharge water from the mine site.	Rio Tinto has undertaken an investigation into the risk of selenium mobility at Rio Tinto Pilbara mine sites. This work identified a low risk for selenium mobility in ground or surface waters from mined material with low sulfur content. The AMD risk assessment for Yandi has indicated that waste has a low sulfur content and therefore the risk of selenium mobility has been assessed to be low (Rio Tinto 2012b; Appendix 4). In waste materials from Pilbara operations, selenium, when it occurs, is likely to be associated with stratigraphic units that contain sulfur, such as McRae Shale, lignite and siderite. This material, whilst not found at Yandicoogina, is generally managed by Rio Tinto in accordance with the SCARD management plan. In summary, if selenium was originally adsorbed to iron oxides, over the millennia since the formation of the iron oxides it would have been incorporated into the iron oxide structure and would only be released if the iron oxide dissolves *i.e.* requires a change in chemical conditions. The ongoing water quality monitoring program at Yandicoogina will include selenium and mercury in the elemental test suite; however these elements have not been identified as a risk based on geochemical characterisation of the rock types at Yandicoogina and historical water sampling. Note that monitoring of these elements is currently not a licensing requirement.

5.11 Climate change

Submitter	Submission and/or issue	Rio Tinto response
DEC	The proponent should demonstrate that consideration has been given to the use of renewable energy sources for the proposal (*e.g.* wind and solar) as alternative power sources. The proponent notes in the PER that electricity will be sourced from existing power stations at Paraburdoo and Dampier, with backup from an existing onsite 10 MW diesel generator. A recent study by Evans and Peck commissioned by the Commonwealth Government's Australian Centre for Renewable Energy (ACRE) has revealed the extent to which wind and solar can compete with traditional fuels (i.e. gas and diesel) in the isolated grids of the Pilbara and Midwest. It is recommended that the proponent demonstrates that renewable energy sources have been considered for this project. The proponent should benchmark the emission intensity of the project against other comparable iron ore mining projects. The proponent notes the emission intensity is between 3 to 5 kg CO_2-e per tonne of product (*i.e.* to 2024) despite the fact that, even without a carbon price, emission intensity (CO_2-e per $) for iron ore mining in Australia is expected to drop by around 25% between 2010 and 2050.	**Evaluation of renewable energy options:** Rio Tinto is investigating opportunities for building renewable energy into its Pilbara iron ore business. Note that the existing generation capacity is based primarily on gas turbines located in proximity to coastal gas supply sources. With respect to electricity supply it is appropriate to evaluate renewable energy options at a regional scale, rather than a site scale, due to the integrated nature of Rio Tinto's power generation, transmission and distribution infrastructure. Particularly given the capital intensive and long-term investment aspects of current renewable energy solutions, any renewable generation capacity should be situated at optimum locations on the network rather than being directly associated with a particular project. The report by Evans & Peck (2011) identified that although the solar and wind resource in the Pilbara is abundant in regional terms, it has been poorly characterised at local scales relevant for the development of renewable generation capacity. Long term resource characterisation (*i.e.* over several years) is necessary to support detailed engineering assessments of large scale renewable technologies. Rio Tinto has been conducting solar PV and wind energy resource evaluations since 2008, in order to indentify optimum locations for renewables to augment conventional generation capacity supplying the network. The data generated by these evaluations is being used to support ongoing renewables feasibility assessments. **New National Policy and Legislative Settings** Since the PER Document was originally drafted, there have been significant developments in national policy and legislation relating to energy consumption and greenhouse gas emissions. The overriding development has been the passing of the Australian Government's Clean Energy Legislative Package, which received the royal assent in November 2011. This legislative package has established a carbon pricing mechanism which internalises carbon pollution costs associated with the combustion of fossil fuels.

Submitter	Submission and/or issue	Rio Tinto response
	The proponent has identified greenhouse gas emissions as a 'key potential environmental impact' of the project. Despite this, the proponent fails to identify any specific management strategies to minimise emissions. The EPA's *Guidelines for preparing a Public Environmental Review* state that proponents are required to: • Outline potential impacts on factors of the environment; • Identify proposed management strategies to ensure those environmental factors are appropriately protected: and • Demonstrate that proposals should be judged by the EPA to be environmentally acceptable. In relation to greenhouse gas emissions, the proponent should demonstrate compliance with *Guidance No. 12 on Minimising Greenhouse Gas Emissions*, which notes that proponents should 'clearly indicate in their review documentation': • Greenhouse gas emissions inventory and benchmarking; • Measurers to minimise greenhouse gas emissions; and • Carbon sequestration to further reduce emissions.	The Proponent will comply with all relevant statutory requirements and legislation relating to greenhouse gas emissions including the *Clean Energy Act 2011* (Cmth) and other relevant components of the Clean Energy Legislative Package. The Clean Energy Legislative Package has changed the settings under which renewable energy projects are evaluated by Rio Tinto. As such, renewable energy opportunities available to Rio Tinto are in the process of being evaluated in this context. At the global scale, rapid advances in renewable energy technologies are occurring which also need to be taken into account. **Demand side measures** Rio Tinto has identified a number of demand side measures for reducing energy consumption and improving emission intensity at the site level, which will be implemented under the Proposal. These include: • conducting regular energy efficiency audits (Q1 2012); • preventing unnecessary clearing of vegetation through clearing procedures; • connecting to existing power generation and rail infrastructure that currently service the Yandicoogina operations, thereby reducing the need for additional infrastructure; • increasing the efficiency of the operation through scheduling, pit optimisation and minimisation of re-handling; • increasing the efficiency of waste and ore haulage; • regularly maintaining and servicing equipment; and • evaluating and adopting appropriate technology during the detailed design phase to improve greenhouse efficiency. Specific opportunities identified for detailed engineering assessment are further described in Appendix 2. **Benchmarking** Energy efficiency benchmarking is inherently difficult for iron ore mining projects, given the variable nature of key factors affecting energy use such as heterogeneity within ore deposits, inconsistent stripping ratios, regular mine plan amendments, mine expansions and upgrades. Rio Tinto adopts other continuous improvement approaches, which are proposed for discussion with regulatory agencies in early 2012 (Section 4).

Submitter	Submission and/or issue	Rio Tinto response
	The proponent has outlined general areas of operations which may be the focus of further consideration or analysis (Section 7.7.4). This offers no assurance that energy efficiency opportunities use of renewable energy or offsetting activities have been appropriately considered, or the extent to which they have been implemented to minimise emissions. There is insufficient information to evaluate whether the EPA's objectives for this factor are likely to be met. It is recommended that the proponent be required to provide additional information to facilitate consideration of the proposal by the EPA. The proponent should identify the following: • Efficiency measures which are cost effective or are likely to become cost effective (for instance, following application of a carbon price); • Efficiency opportunities which will be implemented, the abatement associated with these measurers and an indication of the implementation timeline; • Use of renewable energy for the proposed project; and measures to offset emissions (in total or per tonne of product).	The Proponent is subject to the *Energy Efficiency Opportunities Act 2006* (Cmth) (EEO Act), administered by the Department of Resources, Energy and Tourism (DRET). As part of the Clean Energy Legislative Package, the Federal Government is expanding the Energy Efficiency Opportunities (EEO) program to include major Greenfield and expansion projects. Such an expansion would mean that Rio Tinto would be required to undertake energy efficiency assessments, in line with EEO requirements, at the design stage of major Greenfield and expansion projects. The DRET has initiated consultation sessions regarding this proposed expansion of the EEO program. The primary aim of these sessions is to identify the key challenges and issues that corporations like Rio Tinto will face when undertaking assessments at the design stage of major Greenfield or expansion projects. Feedback emanating from these sessions will inform the development of an Issues Paper and subsequent Regulatory Impact Statement, to be used for further consultation. One-on-one consultations commenced in January 2012. Rio Tinto Iron Ore is committed to actively participate in this consultation process. The organisation will develop processes and systems ensuring compliance with this expansion of the legislation, and beyond, via an effective and rigorous set of standards applying to the Expansion Project and Study teams. In accordance with the provisions of the EEO Act, an energy efficiency audit of the Proposal will be undertaken in accordance with the amended legislation. **Greenhouse gas emissions reporting** In accordance with the requirements under the *National Greenhouse and Energy Reporting Act 2007*, the Proponent will report annually on: • production of energy • consumption of energy • Scope 1 (direct) emissions • Scope 2 (indirect) emissions. The implementation of greenhouse gas and energy conservation measures will enable the company to minimise emissions and provide a mechanism for continuous improvement in greenhouse gas emissions resulting from the Proposal.

Submitter	Submission and/or issue	Rio Tinto response
	The proponent should demonstrate how projected climate change impacts (including temperature change, rainfall change, and extreme weather events) will be incorporated into the project's design in order to reduce risks to the natural environment. Climate change impacts in the north-west are likely to include more intense extreme weather events such as cyclones and storms which will present an increased risk of inundation and flooding in the region. This could lead to infrastructure deterioration/damage and potentially contamination of the environment (for example, as a result of spills, stockpiles and surface water management infrastructure being compromised. It is proposed that the proponent should demonstrate how projected climate change impacts will be incorporated into the project's design in order to reduce risks to the environment during the construction, operational life of the project and post closure.	**Projected climate change impacts** Rio Tinto takes climate change projections into consideration across all of its Pilbara operations. A study by CSIRO Marine and Atmospheric Research used a number of models to make climate change projections for the whole of Australia (Suppiah *et al.* 2007). Modelling was undertaken for various greenhouse gas scenarios, and the findings below are based on mid-range global warming scenarios. With respect to the Pilbara, the study found: • An average temperature increase of between 1°C and 1.5°C between 1990 and 2030; • An average temperature increase of between 3°C and 4°C between 1990 and 2070; • A reduction of up to 5 per cent in rainfall during the months of December to February, • A reduction of up to 5 per cent in annual rainfall, by 2030 (relative to 1990); • A reduction of up to 5 per cent in rainfall during the months of December to February; and • A reduction of up to 10 per cent in annual rainfall, by 2070 (relative to 1990). There is a high degree of uncertainty regarding predictive climate modelling for north-western Australia, and research is currently being undertaken by the Indian Ocean Climate Institute (IOCI) to verify and validate modelling assumptions. Opinion on rainfall projections for the Pilbara currently range from significant annual rainfall decreases of 30 to 40 per cent and a reduction in the number of cyclonic events (but increasing event intensity) to significant rainfall increases and an increase in cyclonic events. Given these uncertainties, Rio Tinto adopts a conservative approach to engineering design, allowing for a wide range of plausible future climate scenarios.

6 Comments by the Office of the EPA

The following tables summarise the Proponent's responses to comments raised by the Office of the Environmental Protection Authority (OEPA), which were provided to the Proponent in December 2011.

6.1 Vegetation and flora

OEPA comment	Rio Tinto response
The Executive Summary of the document has conflicting statements in regards to flora of conservation significance and is not definitive in regards to potential impacts to known Rare Flora within the project area: Vegetation and Flora section (p. ix) states "JSW and Oxbow disturbance areas do not contain significant populations of species with special conservation status"; Conclusion section states that "There are a few flora of elevated conservation significance in the project disturbance area and where individual plants are identified they will be avoided, wherever possible." (p.xvi); Table 1 Vegetation and Flora section states that "no significant populations of rare, threatened or otherwise significant plant species were recorded." It then goes on to list rare and priority species that are found in the area. If they are within the project boundary of this project area *i.e.* JSW and Oxbow then they should be included. If they are outside of the project boundary they should not be included here, or explain why they are being discussed; and	Rio Tinto holds the view that there is no conflict between statements made in the Executive Summary and the body of the PER document with respect to rare flora. All statements are consistent with the findings from botanical surveys of the Proposal area, which identified that no "significant populations" of plant species of conservation significance occur within the disturbance footprint of the Proposal. The issue appears to be centred around the definition of what comprises a "significant population" of a significant species. EPA Guidance 51 does not define "significant population"; flora significance is regarded as a case specific concept which should be considered at various scales (local, regional and national) and takes into account species' ecological and conservation values. Rio Tinto questions the interpretation that <u>any</u> rare flora record is significant (as suggested in this submission); particularly in instances where very few or single plants constitute the "population". The significance of the occurrence of rare flora in the Proposal area, and the extent of potential impacts on these taxa associated with the Proposal, is further discussed as follows: ***Lepidium catapycnon*** Only one previously unknown individual of the DRF species *Lepidium catapycnon* was recorded in recent surveys of the Proposal area; on a recently burnt hilltop southeast of the proposed Oxbow disturbance area. Several other individuals were previously recorded in earlier surveys conducted for the approved JC and JSE mines. All known populations at Yandicoogina are shown in Figure 3-7b in the PER Document. The PER Document identifies that one historically recorded *Lepidium catapycnon* population, consisting of three plants near the rail loop, is in the proposed disturbance footprint. Note that this population is currently fenced off and will not be cleared, but may be impacted by secondary effects from mining such as dust. This population has previously had an approved "Licence to Take" authorised by the DEC during construction of the existing JC operations; which was never exercised. No additional individuals of *Lepidium catapycnon* will be impacted by the Proposal. *Lepidium catapycnon* is known from multiple populations across the central Pilbara region, generally in association with rocky hilltops. The Yandicoogina records are within the natural range of this species (*i.e.* not outliers). The Proposal will not affect the persistence of this taxon at a local or regional scale, given the limited disturbance to recorded individuals and its preferred habitat. Therefore the Proposal is expected to have no significant impact on the conservation of this species.

OEPA comment	Rio Tinto response
Table 3 uses the same misleading "significant populations of rare species" statement, which requires revision. All populations of threatened/rare or priority flora are significant; Currently the statements relating to significant flora within the Executive Summary are inconsistent and require addressing.	***Rostellularia adscendens* var. *latifolia*** *Rostellularia adscendens* var. *latifolia* was recorded in historical surveys at Yandicoogina, near the southern margin of the proposed JSW-C pit. This area is in the proposed clearing footprint. *Rostellularia adscendens* var. *latifolia* is a Priority 3 taxon known from scattered collections through the Hamersley Ranges, as well as from the far eastern Pilbara bioregion. Note that from the contextual data provided in the PER Document (page 57) and supporting Appendices, it is clear that the Yandicoogina records of *Rostellularia adscendens* var. *latifolia* are part of a much broader taxon distribution. This species has been recorded 53 times from 10 other locations across the central Pilbara, including Brockman 4, Hamersley Station, Caves Creek and the Fortescue Valley (Biota internal database), in addition to the Yandicoogina record. Its occurrence has been recorded in clay soils, along drainage lines, creeks, and occasionally on rocky hills (page 23 of Appendix 1 of the Yandi JSW/Oxbow PER). There is nothing exceptional about these habitats at Yandicoogina and these landscape features are also very widespread in the region. Therefore the Proposal is expected to have no significant impact on the conservation of this species. ***Goodenia nuda*** The Priority 4 species *Goodenia nuda* has been recorded adjacent to the proposed JSW pit area and north-east of the JC pit. These areas are outside the proposed disturbance footprint and hence the Proposal is expected to have no significant impact on the conservation of this species. Under the DEC priority flora classification system, Priority 4 species are those that have been adequately surveyed and are considered to be rare but not currently threatened. From the contextual data provided in the PER Document (page 57) and supporting Appendices, it is clear that the Yandicoogina records of *Goodenia nuda* are part of a much broader species distribution. Therefore the Proposal is expected to have no significant impact on the conservation of this species.
Additionally, the proponent's use of the term 'significant' is not consistent. If threatened (rare) or priority species are located and/or impacted then the proponent must demonstrate why the impact is not significant, not just state that it is not. It should also be noted that 'significant flora' is defined in EPA Guidance 51 and it should be noted that the use of the term is not limited to conservation listed flora.	The information addressing the previous submission point discusses Rio Tinto's conclusion that the identified potential impacts to the rare flora taxa *Lepidium catapycnon, Rostellularia adscendens* var. *latifolia* and *Goodenia nuda* are not significant. The interpretation of the term 'significant flora' in the PER Document and supporting Appendices is consistent with EPA Guidance 51 with respect to flora that are not conservation listed. Note that page 58, paragraph 1 of the PER Document discusses flora species that are not conservation listed flora but may be of interest.

OEPA comment	Rio Tinto response
In the text of the PER (Section 3.6 Vegetation and Flora, p. 59) it is clearly stated that rare and priority flora will be impacted by the proposal. This needs to be included within the Executive Summary, to ensure consistency. It is noted that the RTIO letter (ref: RTIO-HSE-0122899) attached to the redrafted PER states that Hamersley Iron Pty Ltd has an approved "Permit to take rare flora" for impacts to *Lepidium catapycnon* DRF. Advice from DEC's Species and Communities Branch states that the 2005 issued permit is for 'incidental take' related to early mine exploration and development and therefore is not consistent with on-going mining and/or deliberate 'take'. This information should also be included in the PER and furthermore it is likely that an application to take be made for RTIO's current mining operations.	Rio Tinto acknowledges the request for the specifics of impacts on rare and priority flora to be included in the Executive Summary. Given Rio Tinto's assessment that the conservation status of rare and priority flora will not be affected by the Proposal, due to no significant populations being affected, the level of detail contained in the Executive Summary is considered to be adequate. The population of *Lepidium catapycnon* within the proposed disturbance footprint (adjacent to the existing rail loop) is currently fenced off and will remain so during operations and new mine development. Populations will not be deliberately removed, but are likely to be impacted by dust from the proposed constructions and operation from the ROM pad nearby. RTIO intends to apply for a permit to take for this particular stand, to address any secondary impacts as a result of construction activities or mining operations. With respect to this population, note that the PER Document makes the statement (page 158) '*This population has previously had an approved "Licence to Take " authorised by the DEC during construction of the existing JC operations*'; and a statement to the same effect is made on page 57. The PER Document does not state that Hamersley Iron Pty Ltd has an approved "Permit to take rare flora" for impacts to *Lepidium catapycnon* DRF.
The vegetation section of the PER has been revised and is greatly improved from previous drafts. Previous comments in relation to the number of quadrats still remains unresolved in that 17 quadrats mapped within the JSW boundary for 7 vegetation types (an area of approximately 1460 hectares); and 11 quadrats for Oxbow with 16 vegetation types (approximately 724 hectares), comprising up to 2200 hectares of vegetation proposed for clearing for the two proposal areas combined. Although the proponent has commented that replication of plots within vegetation types has been met, this is not evidenced from the information presented in the PER (Figure 3.7 c-d). Replication means at least two quadrats in each and every vegetation unit defined.	It is acknowledged that some of the vegetation types within the Oxbow part of the disturbance area were sampled with a single quadrat only. However, this was largely a function of field access at the time, dissection of some vegetation types by tracks and condition of the site following recent fires (meaning that some areas could not be effectively sampled with quadrats). The area extent of some of the vegetation types is also relevant: four of the units are so small that it is unlikely that there will be sufficient intact vegetation area to locate replicate quadrats. However, to address this issue, Rio Tinto has conducted a supplementary field exercise in Q1 2012 to complete additional quadrats at Oxbow. This work was intended to provide replication to the extent achievable within the constraints identified above. The overall findings from existing survey data, and preliminary results of the mapping exercise, support that this does not alter the overall findings in regards to flora and vegetation conservation significance as they currently stand, and the work is being collated for completeness only.

OEPA comment	Rio Tinto response
Whilst the PER defines the amount of clearing in hectares that the proposal involves, it is not clear how much vegetation (in hectares) would be indirectly impacted by the proposal.	Indirect impacts to vegetation could potentially include exposure to dust loads caused by mining activities, the introduction and/or spread of weeds, groundwater drawdown and surface water discharge. These are discussed in Section 7.1.3 of the PER Document, and further described in Section 3.2. There are currently few empirical data demonstrating that dust deposition has any significant impacts on vegetation in the Pilbara (for example Biota 2009c, Butler 2010). The dust control practices used by Rio Tinto at Yandicoogina (and other iron ore mines operated by the company) have been found to be effective in preventing significant impacts to vegetation, and a similar outcome is anticipated in the Proposal area. Weed infestations are not severe at Yandicoogina; however, several invasive species - notably, Ruby Dock, Mexican Poppy and Buffel Grass - have been detected in vegetation surveys. The existing Yandicoogina Iron Ore Mine Operation Weed Management Plan was updated to include the proposed JSW and Oxbow operations, and included in the PER Document Appendix B. This plan describes a range of measures for preventing the introduction and spread of weed species, mapping and monitoring weed populations, and controlling weed populations. Implementation of this plan will prevent any significant impacts to vegetation from weeds. Groundwater drawdown caused by mine pit dewatering will not impact on the majority of the vegetation units within the Proposal area, which are dominated by xerophytic flora that subsist on soil water derived from surface inputs only. Riparian vegetation units within the predicted drawdown footprint can include phreatophytic species (notably *Eucalyptus camaldulensis* and *Melaleuca argentea*) that could be affected by modified watertables – please refer to the next comment (and Section 3.2) for additional discussion. The potential impacts of surface water discharge on riparian vegetation are described in Section 7.1.3.3 of the PER Document – please refer to the next comment for additional discussion. Table 1 and Appendix 15 provide further detail of the extent of the predicted impacts.
Page 162 of the PER describes decline in tree health from flooding and drying cycles as remaining poorly understood. Further explanation of dewatering impacts to Riverine vegetation is required.	The response of riparian trees (principally *Eucalyptus camaldulensis*, *E. victrix* and *Melaleuca argentea* at Yandicoogina) to flooding and drying cycles is affected by a complex array of factors such as tree age and condition, root system plasticity, soil type and stratigraphy, hydrology and groundwater dynamics, and geomorphic processes such as erosion. The broad types of impacts on these riparian species caused by modified eco-hydrological regimes are discussed in Section 3.6.4 of the PER Document.

OEPA comment	Rio Tinto response
	In most instances the available science is not sufficient to predict more specific, site level responses in the ephemeral creek systems of the Pilbara. Individual trees, even where in close proximity, may display different responses as affected by their life histories, root system architecture and root system plasticity. Accordingly the PER Document identifies that '*individual trees are likely to exhibit different responses, ranging from no significant change in health to tree death in extreme cases*'. A particularly challenging aspect relates to the separation of naturally occurring processes and cycles from human inducted changes. Eco-hydrology and the groundwater dependence of ecosystems is an active area of research nationally; and a number of research institutions are involved in relevant Pilbara based projects. Rio Tinto is an active contributor to this research (Appendix 8). Whilst recognising the limits of available knowledge, Rio Tinto considers that impacts on riparian vegetation associated with dewatering and discharge activities are unlikely to cause significant irreversible changes to riparian vegetation communities or significantly detract from the ecological values of these communities. This conclusion is supported by operational experience gained at Yandicoogina since mining commenced in 1996 (Appendix 12 & 14), and industry experience more widely in the Pilbara region. Further discussion is included in Section 3.1 & 3.2. The limits of knowledge have been recognised in the formulation of the Yandicoogina tree health monitoring program, implemented since 2003 in association with the existing JC and JSE mines (as described in Section 3.6.4 of the PER Document). This program has been designed to address the range of potential vegetation responses that could be expected. Results from the program to date have informed the environmental impact assessment process for the Proposal (as described in Section 3.1). The monitoring program is regularly reviewed and updated to incorporate the most currently available scientific knowledge and methods.
Page 171 of the PER describes Riparian Vegetation as having local conservation significance. Further explanation of this comment as well as management to protect the vegetation from impacts of the proposal is required.	This vegetation type was considered to have local conservation significance because it occurs in the major surface drainage features for the area: seasonal ephemeral creek habitats, which are also listed as "ecosystems at risk" by Kendrick (2001). The principal management approach adopted under the Proposal is the avoidance of direct disturbance (*i.e.* clearing) to riparian vegetation, by stipulating minimal encroachment into the Marillana Creek 100-year ARI floodplain. As such, the majority of the extant riparian vegetation in the Proposal area will be preserved. Details of the direct clearing impacts are outlined in Table 5. The detection and management of these impacts is set out in the Yandicoogina Riparian Vegetation Management Plan, Groundwater Management Plan and Surface Water Management Plan; which collectively comprise an adaptive management framework for protecting riparian vegetation values.

6.2 Fauna and habitat

OEPA comment	Rio Tinto response
The fauna sections of the PER have been amended to take into account some of the OEPA's comments on an earlier draft. However these changes do not adequately resolve the OEPA's concerns which are outlined below: This proposal relies on a series of previous studies in the region providing regional data sets to underpin conclusions in the PER rather than undertaking detailed surveys of the actual project area. To assess impacts of the proposal it is necessary to use the data in these regional studies. This has not been done and the PER does not present information on the likely faunal assemblage of different habitats or their regional characteristics.	The summary of previous studies was included in the PER Document to demonstrate the extent of previous systematic fauna sampling that has been conducted both actually along Marillana Creek catchment, and in the wider Yandicoogina locality. The purpose of this was primarily to establish that the terrestrial fauna assemblage of this part of the Pilbara bioregion is relatively well known. The broader dataset also demonstrates other findings: notably that there are very few records of fauna species of conservation significance in the Proposal area despite the extensive sampling effort over many years. Rio Tinto does not agree with the statement: "*This proposal relies on a series of previous studies in the region providing regional data sets to underpin conclusions in the PER rather than undertaking detailed surveys of the actual project area*." Two systematic fauna surveys were conducted for both the JSW and Oxbow components of the disturbance footprint for this proposal (Biota 2009 and Biota 2010). These comprised trapping and non-systematic sampling at a combined total of 18 trap sites. The fauna assemblages recorded from this survey work at JSW/Oxbow have been revised and compiled against the broader data set from the Yandicoogina locality (Appendix 7a). This demonstrates that all species recorded from the proposed disturbance area have previously been recorded in the locality and that the assemblage is a subset of that of the broader area (as stated in the PER Document). There are limitations on completing this assemblage analysis at the finer scale habitat level – much of the contextual data (notably DEC's Pilbara Biological Survey and the Nature Map database) do not provide the habitat level breakdowns necessary to support such an analysis.
The PER states (page 79) that a range of fauna surveys have been undertaken in the Yandicoogina locality and that "*these surveys provide a comprehensive overview of the fauna assemblage present in the wider Yandicoogina locality, a subset of which would be expected to utilise the habitats of the overall project area*". A list of the vertebrate species recorded from all surveys is provided as an addendum to Appendix A3. However, there is no tabulation on the species recorded on	While this comment has been listed separately, Rio Tinto's response is covered in the response to the previous comment.

OEPA comment	Rio Tinto response
particular surveys, nor is there any information on which habitats the various species have been recorded in. This is required to assess both the regional assemblage and to adequately assess likely impacts on the fauna of the project area. Until the information collected in previous studies is used to explain and justify the conclusions reached in the PER it is not possible to adequately assess the likely impacts of the project on the terrestrial fauna of the area.	
Some statements in section 3.9.1 dealing with subterranean fauna surveys are ambiguous and need to be reworded. For example, what does the statement that "*Of the 52 taxa recorded, 32 were collected at multiple locations and 20 were collected at four or more sampling locations*" mean? It is not clear what "*This is likely to be an artefact of the artificially lowered water table from the adjacent Phil's Creek borefield, as this area was largely below the standing water table prior to mine dewatering activities associated with the existing mines*" actually means. Is it being suggested that the troglofauna moved into the area after the water table was lowered, or is it being suggested that the fauna increased in abundance from the small areas of original habitat that was above the water table?	Rio Tinto does not consider that the cited sentence from Section 3.9.1 of the PER Document is ambiguous: it communicates that of the 52 taxa recorded 20 were recorded at one sampling location only, 32 species were collected at more than one site, and 20 of those were collected from four or more sites. <u>The majority of the sampled taxa were previously known from outside the Yandicoogina survey area</u>. However, 15 new (undescribed) taxa were recorded. These are currently known only from the Yandicoogina area. Based on patterns of distribution for stygofauna in the Pilbara more generally, this finding is likely to be an artefact of the boundaries of the sampling program rather than true reflection of the geographic distribution of these taxa (Biota 2010e; Appendix A8 of the PER). The 2010 sampling program also supports this finding, with both *Gomphodella* sp. „yandi‟ and *Recifella* sp.1 taxa, previously thought to be significant [*i.e.* to have conservation significance] due to their restricted distribution within the Marillana Creek system, now also sampled within Weeli Wolli Creek'. Rio Tinto Iron Ore has adapted a habitat assessment and management approach to protect and maintain stygofauna habitat, which it has undertaken during the last 16 years of operation at Yandicoogina. "Based on geological drilling information [and geophysical data], the Marillana and Weeli Wolli Creek systems are believed to provide contiguous habitat for stygofauna" (Biota 2010, Appendix 8 of the PER). This approach is also reflected in the OEPA discussion paper: "A Review of Subterranean Fauna Assessment in Western Australia (February 2012)" which seeks public feedback to support a habitat risk-based approach. In summary, nearly 50% of the species were sampled at four disparate sampling points which suggests that the fauna is locally widespread, with ~75% of the impact area assemblage confirmed as occurring more widely in the region. (Data derived from Appendix 3 within Biota 2010).

OEPA comment	Rio Tinto response
	The mechanisms for troglofauna occurrence in the JSW area are yet to be elucidated. The lowering of the watertable in the JSW area due to dewatering from JC operations has artificially created additional above watertable habitat available for troglofauna colonisation. Prior to dewatering, less than 10 m of habitat depth would have been available for troglofauna colonisation. The geological substrate available as potential habitat prior to dewatering would have comprised Quaternary stream bed alluvials, subject to significant flows and inundation during storm and cyclonic events. The CID materials below the alluvials were located below watertable prior to dewatering. This latter type of environment setting is not suitable for troglobitic species. Rio Tinto is carrying out ongoing regional research into the distribution and habitat preferences of troglofauna in the Pilbara region, to contribute to a regional knowledge-base on this fauna.
The types of animals that will be covered by the statement "all animal strikes by vehicles will be recorded and documented" in Table 7-5 needs to be defined. It is unrealistic to assume that many smaller birds, reptiles and even mammals will be sighted or even able to be identified. The benefits of compiling a list need to be stated.	Recording of animal strikes would be limited to larger body-size species where they are relevant to ongoing site environmental management. This would primarily be focused on feral predators (foxes and cats), but larger vertebrate species of conservation significance (*e.g.* the Pilbara Olive Python and the Northern Quoll) would also be recorded. Collection of these data over time would provide an additional input to ongoing site management as a qualitative indicator of relative abundance of these species in the operations area.
Please provide a table clearly stating what percentage of fauna habitats surveyed would be impacted by implementation of the proposal.	Rio Tinto contends that the fauna survey boundary is an entirely arbitrary way of providing context for percentage habitat loss. To provide an illustrative example: EIA fauna surveys often address the expected disturbance area for a proposal – this means that the percentage loss of the habitats within that area could be up 100%, but this is only a function of the limited boundaries used. Rio Tinto suggests that it is more informative to take a broader locality or sub-regional assessment context, based on data sets such as land system mapping, if this type of proportional habitat loss analysis is required. This can only be meaningfully done by considering other broader studies which assessed habitats in the Hamersley subregion such as Kendrick (2001) and van Vreeswyk et al. (2004). Appendix 7b provides a breakdown of habitats at JSW/Oxbow based on land systems within the Hamersley sub-region: this demonstrates that the habitats present occur more widely and are well represented in the sub-region and the proportional habitat loss arising from the Proposal is small. This is consistent with the above finding that the individual species and overall assemblage recorded at JSW/Oxbow are broadly represented in the wider locality (based on other surveys and data sources from the locality).

6.3 Water Quality

OEPA comment	Rio Tinto response
Appendix 6 page 19 refers to values of nitrogen and phosphorus concentrations in mine process water recorded from the level bank discharge point at RTIO's Yandi. Shading indicates the value exceeds ANZECC/ARMCANZ (2000) guidelines. Please describe management for exceedences. Within the aquatic management final report significantly higher levels of nitrogen have been recorded downstream of Rio Tinto's Yandicoogina discharge, compared with upstream on Marillana Creek. Hamersley has stated in its response that the proposed monitoring schedule represents standard practice for iron ore mines. The OEPA questions why best practice is not being applied.	The levee bank discharge is process water and predominantly discharges to land and subsequently evaporates due to the low volumes of water. The DEC operating licence does not specify limits for this discharge and as such the Rio Tinto internal guidelines are applied. Exceedances of licence limits are recorded as an incident and reported to the DEC. Where license limits are not set, exceedances of the Rio Tinto guidelines are reported internally and management actions are established to address the specific exceedances. One of the actions from the elevated levels measures at the levee bank was to reduce detergents into the system, based on the outcomes of study into detergent loads. Rio Tinto recognises that the EPA encourages proponents to achieve best practice. Under the Western Australian EIA process, Rio Tinto understands that proposals assessed and recommended for approval by the EPA are generally expected to embrace best practice, meets appropriate standards and EPA objectives. The EPA stance on best practice is articulated in Guidance Statement 55 '*Implementing Best Practice in proposals submitted to the Environmental Impact Assessment process*'. This Guidance has been in place since December 2003. The proposed monitoring schedule is consistent with practices in place for numerous Pilbara iron ore mines (including those operated by Rio Tinto and other companies) which have been subject to the Western Australian EIA process and approved under the *Environmental Protection Act 1986*. By implication these approved mines would be expected to operate in accordance with best practice environmental management standards. The statement '*the proposed monitoring schedule represents standard practice for iron ore mining projects*' implicitly recognises this, and should be interpreted as indicating that the proposed monitoring schedule is consistent with an industry wide best practice approach. Note that the proposed monitoring schedule builds on the schedule already in place at Yandicoogina established for the JC Mine (originally approved in May 1996 in accordance with Statement 417; and supplemented by Statement 523 in October 1999) and JSE mine (approved in October 2005 in accordance with Statement 695). The schedule is regularly reviewed in accordance with operating licence requirements.

	Note that although elevated nitrogen levels and algal growth have been detected in the surface pools of the creek systems downstream from the Yandicoogina operations, the cause of elevated total nitrogen levels in the lower reaches may be coming from any number of potential sources including: • current pastoral activities and cattle stocking, including attraction of cattle to permanent water bodies • historical cattle use and leaching from soils, • some influence from Yandi operations is possible such as: o elevated total nitrogen in groundwater discharge water, o contamination of groundwater from ammonium nitrate storage or septic systems associated with offices and accommodation, o elevated total nitrogen in mine process water discharged into the creek Also note that the Nitrogen levels referred to in WRM's report also relate to the levee discharge, which is as described previously is process water, not subject to DEC licensing, however Rio Tinto monitors the water quality in this area in accordance with the existing DEC licence guidelines. The proposed monitoring schedule is considered consistent with best practice for iron ore mining projects in the Pilbara region.

6.4 Cumulative impacts

OEPA comment	Rio Tinto response
Cumulative impacts – dewatering from the BHPBIO Jinidi proposed iron ore mine and cumulative impacts to Weeli Wolli Creek does not appear to have been taken into consideration in hydrological study calculations.	The Jinidi Project was referred to the OEPA in August 2011 and received an API level of assessment in September 2011. The publically available project referral information contains the following statements relating to groundwater abstraction and discharge of any dewatering surplus: 1. *Mine dewatering could potentially be approximately 7 gigalitres per year (GL/year). Mine-derived water would be used for construction and operational purposes, with surplus water discharged to the surface, injected into aquifers and/or shared with*

OEPA comment	Rio Tinto response
	mines elsewhere. Potable water and, if required, alterative Project water supplies, would be preferentially sourced from mines elsewhere or from adjoining aquifer systems. BHP Billiton Iron Ore intends to investigate the feasibility of re-injecting surplus water into surrounding aquifers and water sharing arrangements. 2. *The proposed Project could potentially discharge the maximum mine dewatering volume of approximately 7 GL/year to one or more nominated creek locations during discrete periods. However, a large volume (i.e. approximately 6 GL/year) of this mine-derived water would be needed during operations for ore conditioning and dust management. BHP Billiton Iron Ore would optimise its mine plan and water balance, and investigate aquifer reinjection and water-sharing agreements, in order to minimise surface discharge.* 3. *BHP Billiton Iron Ore is seeking approval to discharge mine-derived groundwater at one or more nominated creek locations during discrete periods. Typically, groundwater quality measured in the proposed Project area is 'fresh'. Additional information on water quality will be documented in the proposed Project EIA document.* 4. *Project water demands (approximately 6 GL/annum) are likely to be met by pit dewatering (up to 7 GL/annum). Should dewatering exceed operational demand, surplus groundwater would be discharged into local watercourses during discrete periods. Potential impacts would be localised and temporary.* ***5.*** *The indicative water balance suggests that the operational water demand (approximately 6 GL/annum) is likely to be met by pit dewatering (up to 7 ML/day). Should dewatering volumes exceed operational demand, surplus groundwater would be discharged into local watercourses during discrete periods. The potential discharge would temporarily alter local hydrological characteristics by increasing stream flow and/or creating unseasonal flow. Following a preliminary options analysis, the preferred location for disposal of excess groundwater is to the south of the OB 41 deposit, as shown on Figure 16a. Depending on the frequency and volumes of excess water disposal, one or more local creeks in this area could be affected for a distance of up to several kilometres downstream of the discharge point(s) through localised increases in surface water availability*

OEPA comment	Rio Tinto response
	and mounding of the water table. The localised disposal of excess groundwater into watercourses to the south of the proposed Project ***is not expected to directly impact Weeli Wolli Spring and the calcrete outcrops in its vicinity.***
	6. *During the operational phase of the proposed Project,* ***regionally significant impacts on the Weeli Wolli Creek Catchment and Fortescue Marsh appear to be unlikely.*** *Following closure, potential catchment area losses associated with the residual OB 13 and OB 41 mine voids are predicted to account for less than 3% of the total Weeli Wolli Spring Catchment, and as a result, the potential impacts on regional surface water flows are likely to be commensurate (noting that the spring is a groundwater discharge feature).*
	Rio Tinto has made an assessment of the publically available information relating to the Jinidi iron ore project proposal, and notes that: • Surplus mine pit dewatering volumes are undefined, but likely to be in the order of 1 GL/year (based on dewatering of 7 GL/year and operational use of 6 GL/year). However a final disposal method for surplus volumes is not specified (with the stated potential options including re-injecting surplus water into surrounding aquifers, water sharing with other users and/or surface discharge to local creeks). • In BHPBIO's assessment *'one or more local creeks in this area could be affected for a distance of up to several kilometres downstream of the discharge point(s) through localised increases in surface water availability and mounding of the water table. The localised disposal of excess groundwater into watercourses to the south of the proposed Project is not expected to directly impact Weeli Wolli Spring and the calcrete outcrops in its vicinity'.* An additional high level hydrological review completed by Rio Tinto (RTIO 2012, Appendix 11), based on the publically available information also indicates that the surplus discharge from BHPBIO, even under a worst case scenario, is unlikely reach Weeli Wolli Spring. Therefore, based on the information available, there does not appear to be an interrelationship between the impacts of the Yandicoogina project and the Jinidi project. Ie. The Jinidi project does not appear to extend the downstream wetting footprint extent beyond the predictions described within the Yandicoogina JSW & Oxbow PER. Cumulatively,

OEPA comment	Rio Tinto response
	BHPBIO's Jinidi project could extend the *upstream* wetting footprint, and therefore the total wetting footprint of Weeli Wolli Creek by several kilometres if all 7Gl/a of their proposed surplus water were discharged into Weeli Wolli Creek. The finding by RTIO is consistent with BHPBIO's statement within their referral document: #4 BHPBIO states that: *Potential impacts would be localised and temporary.* In the absence of additional information, and based on a high level hydrological assessment, Rio Tinto provisionally accepts that this BHPBIO assessment is valid subject to ongoing OEPA assessment under the EIA process.

6.5 Waste

OEPA comment	Rio Tinto response
Is waste from the proposal to be located within existing facilities and if so, do these facilities have the capacity to accept the waste from this proposal prior to it being placed back into the pit?	Waste handling and disposal associated with the Proposal is described in the PER Document and reiterated as follows. Mineral waste from the proposal is proposed to be placed in new, temporary out-of-pit waste dumps (before ultimately being used to backfill the pits). Indicative locations for the proposed waste dumps at JSW and Oxbow are shown in Figure 2-1 of the PER Document. The sequencing and backfilling strategy is tied in with the closure strategy, which is currently being revised for a Life of Mine scenario for the integrated Yandicoogina operations. Crushed ore from JSW and Oxbow will be transported to the existing dry plant at JC for further crushing screening. Some of this ore will feed into the wet processing stream, with associated wet fines waste disposed into the storage cells already established for this purpose in the JC pit. If required, any plant expansion requirements at JC (over and above current licence limits) will be subject to the provisions of Part V of the EP Act. Asbestiform minerals are not known from the CID orebody, but can occur in surrounding lithologies. Any fibrous waste encountered during construction or mining of the JSW and Oxbow areas will be disposed of at the existing on-site facilities, in accordance with the current Yandicoogina Fibrous Mineral protocols and procedures. With respect to non-mineral waste, the existing waste disposal systems servicing the JC and JSE operations will be used to collect and recycle waste streams associated with the Proposal including: hydrocarbon wastes (oil, drums, rags, filters *etc*), tyres, batteries, scrap metal, printer cartridges, paper and cardboard, conveyor belting and computing equipment. The licensed landfill facility servicing the JC and JSE operations will be used to dispose of putrescibles and inert materials, such as household waste, cardboard, furniture, fill, and demolition material associated with the Proposal. It is not anticipated that the existing landfill facility will need to be expanded beyond current licence limits; however any future expansion requirement will be subject to the provisions of Part V of the EP Act.

OEPA comment	Rio Tinto response
	Hazardous wastes will be collected and sent off-site for treatment by licensed contractors. An existing land farm bioremediation facility used to treat hydrocarbon contaminated soils, will continue to be operated over the project life. It is not anticipated that the existing land farm bioremediation facility will need to be expanded beyond current licence limits; however any future expansion requirement will be subject to the provisions of Part V of the EP Act. Existing wastewater treatment facilities servicing the JC and JSE operations will also service wastewater generated in association with the Proposal. It is anticipated that the current facilities will need to be expanded to accommodate the Proposal, which will be undertaken in accordance with the provisions of Part V of the EP Act.

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Appendix 1

Yandi Sustaining Project – Detailed Hydrology (Stormwater) Study

Appendix 2

RTIOEP - Energy Efficiency Opportunities Register

Appendix 3

Preliminary Results of Geochemical Characterisation of Yandicoogina Samples

Appendix 4

Selenium in Waste Materials at Pilbara Operations

Appendix 5

Yandicoogina Closure Options:

Preliminary Water Modelling Results

Appendix 6

Yandicoogina Operations Audit Register

Appendix 7a

Yandicoogina Fauna Species List

Appendix 7b

Yandicoogina JSW & Oxbow Fauna Assemblages by Habitat

Appendix 8

Rio Tinto Iron Ore sponsored ARC Linkage Grants (Past, present and future)

Appendix 9

Rio Tinto Iron Ore

Soil Management Process

Appendix 10

Yandicoogina Closure Options - Summary of water and salt balance modelling

Appendix 11

Update report – baseline hydrology assessment for Yandi discharge

Appendix 12

Synthesis of discharge impacts on Marillana and Weeli Wolli Creeks

Appendix 13

Marandoo Phase II

Coolibah Soil Moisture Investigation

(RTIO 2011a)

Appendix 14

Review of flora and vegetation along Weeli Wolli, Mindy Mindy and Coondiner creeklines (Mattiske 2011)

Appendix 15

Drawdown and discharge impact figures