Pilbara Iron

A member of the Rio Tinto Group

Yandicoogina Junction South East Project

Environmental Protection Statement

Prepared for
Hamersley Iron Pty Ltd
by Strategen

strategen

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Yandicoogina Junction South East Project

Environmental Protection Statement

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Report	Version	Prepared by	Reviewed by	Submitted to Client	
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EXECUTIVE SUMMARY

INTRODUCTION

Hamersley Iron Pty Limited (Hamersley), the proponent for this proposal, owns and operates the existing Hamersley Yandicoogina mine. The Yandicoogina mine was commissioned in December 1998 and is a conventional open cut iron ore mine in a Channel Iron Deposit (CID). The current mining area is referred to as Yandicoogina Junction Central (Yandi JC). Processed ore is transported by the Central Pilbara Railway to the Hamersley ship loading facilities at Dampier Port and Cape Lambert, 300 km north-west of Yandicoogina on the Pilbara coast.

Hamersley considers there is sufficient world demand for iron ore to warrant placing additional Yandi tonnage into the market. In response to this demand, Hamersley proposes to increase production capacity at Yandicoogina from 36 Mtpa to 52 Mtpa by commencing mining operations in a new pit (Junction South East) adjacent to the currently approved mining area, referred to as Yandi JSE and is the subject of this EPS. Ore from Yandi JSE will be conveyed to the existing Yandicoogina rail loadout infrastructure where it will undergo minor additional processing (tertiary crushing and screening) before passing onto the Pilbara Rail system.

LOCATION

Hamersley's Yandicoogina Iron Ore Mine is located 90 km north-west of Newman and 300 km south-east of Dampier in the Central Pilbara. The Yandicoogina Mine Operation is covered by ML274SA established under the *Iron Ore (Yandicoogina) Agreement Act 1996*. The Yandi Village is located within a Special Lease application covering Windell Location 157.

ASSESSMENT PROCESS AND EPA ADVICE

This document presents an Environmental Protection Statement (EPS) prepared in accordance with Administrative Procedures for environmental assessment prescribed under the *Environmental Protection Act 1986*. The EPA will report on its assessment of this proposal to the Minister for the Environment pursuant to section 44 of the Act.

The EPS contains a sufficient level of detail on management measures to assess the likelihood of any critical aspects that may prevent the proposal from progressing.

The expedited procedure required considerable upfront investigation and stakeholder consultation to resolve issues before the release of the EPS. Hamersley has consulted extensively with Government agencies and other key non-government organisations as part of the EPS process.

DESCRIPTION OF THE YANDI JSE PROJECT

The principal activity of the Yandi JSE project will be mining, crushing and screening of iron ore obtained from an open cut mine in the CID. The key components of the Yandi JSE proposal are summarised below:

- New mine pit along the CID with attendant waste rock (or low grade) dumps, flood protection levees and diversion drains.

- New access roads and internal mine roads, upgrade and extension of communications systems and extension of the existing High Voltage electricity network.
- Lube and fuelling facility adjacent to the new mine pit connected to the Junction Central fuel facility by an above ground pipeline.
- Two new cluster well fields and a sacrificial bore in the initial mining area to dewater the CID ahead of mining – then various dewatering well fields along the JSE CID during mining with a supply pipeline to Yandi JC and discharge or recharge infrastructure for excess water. Potable water for the new offices and plant at Yandi JSE will be sourced from dewatering or by a new well.
- Dry primary/secondary crushing plant with ROM pad, plus administration buildings, plant workshop and carpark.
- Overland conveyor to convey crushed ore from new crushing plant to transfer station on existing overland conveyor system.
- Ford style crossing of Yandicoogina Creek to Yandi JC for heavy vehicles, with minor realignment of the existing unsealed road to Newman, plus an emergency light vehicle crossing of Yandicoogina Creek to the west of the orebody alongside the piled bridges for conveyor crossings.

The key characteristics of the proposal are shown in Table S1.

STAKEHOLDER CONSULTATION

There has been substantial stakeholder consultation and public review of the existing Yandi JC operation as part of previous environmental approval processes.

Key agencies have been actively consulted during the preparation of this EPS, including the:

- Environmental Protection Authority Services Unit (EPASU)
- Department of Environment (DoE) – Northwest Regional Office and water specialists based in Perth
- Department of Conservation and Land Management (CALM) – Pilbara Regional and Science Offices.

Non-government organisations considered key stakeholders and consulted during the preparation of the EPS, were:

- Conservation Council of Western Australia
- Wildflower Society
- Gumala Aboriginal Corporation (Gumala).

Discussions were also held with representatives of companies who operate or have proposed mines which may interact with Yandi JSE. Companies consulted were:

- BHP Billiton Iron Ore
- Hope Downs Management Services.

KEY ISSUES RAISED

The main issues raised by stakeholders related to water and closure management, cumulative hydrological impacts from other mining activities in the area, vegetation disturbance and disturbance of Aboriginal heritage values.

Table S1 Key characteristics of the Yandi Junction South East Project

Characteristic	Proposal
Land clearing	
Infrastructure (ROM pad, plant, conveyor, roads & miscellaneous)	54 ha
Waste dump	60 ha
Pit (including drains and roads)	395 ha
Backfill Hill (mine void backfill source)	160 ha
Total land clearing	669 ha
Mining	
Length of CID to be mined	5.8 km
Area of CID to be mined	370 ha
Mining rate	To a maximum of 16 Mtpa (total Yandi: JC & JSE = 52 Mtpa)
Ore reserve to be mined	280 Mt
Estimated mine life	16 years (current estimate)
Mine pit profile	About 65 m deep; 40 m below pre-mine watertable
Waste dumps	Waste rock dumps and low grade dumps to be constructed within a 60 ha paddock dump formation
Dewatering requirements	Initial: 27-30 ML/d Maintenance: 15-20 ML/d Sump dewatering (approx. 1ML/d)
Volume of dewater used (Yandi JC and JSE)	Approximately 18 ML/d: ▪ 3 ML/d Yandi JSE (dust suppression and potable use) ▪ 15 ML/d Yandi JC (wet processing plant, dust suppression, potable use)
Number of dewatering wellfields	Initially two clusters of wells and a sacrificial well As mining progresses, three additional cluster wellfields, plus sumps
Closure strategy	Use out of pit waste dumps and ROM pad, plus additional mined fill to backfill the final pit void to at least 490mRL. Rehabilitation of backfilled material to commence once final landforms are constructed and stable.
Proportion of overburden and waste material backfilled (versus out-of-pit)	100% (excluding material for drainage embankments remaining)
Proportion of mine void to be filled with overburden	About 55%
Processing	
Dry primary and secondary crusher capacity	24 Mtpa
Railed ore	up to 16 Mtpa
Infrastructure	
Overland conveyor	Single horizontally curved unit approximately 4 800 m long to convey crushed ore from Yandi JSE crusher facility to the transfer station on the existing overland conveyor

Characteristic	Proposal
Power	Connected to grid with power supplied by Hamersley's gas-fired power stations at Dampier and Paraburdoo Onsite 8 MW diesel-fired power station will continue to be used for additional power needs during early stages of construction
Water management	Flood protection levees and diversion drains
Roads	Three new roads ▪ Light vehicle access road from the transfer point on the current conveyor to the new crusher facility at JSE). ▪ New heavy vehicle mine access road from Yandi JC to Yandi JSE. ▪ Realignment of part of the public access road to Newman to allow bypass of heavy vehicle access road. Internal mine roads as required
Other facilities	Administration buildings, plant workshop and carpark

Abbreviations:

CID	Channel Iron Deposit
ha	Hectares
ML/d	megalitres per day
Mtpa	million tonnes per annum

OUTCOMES OF THE CONSULTATION PROCESS

The issues raised by stakeholders have been addressed in this EPS, and specifically, the following studies investigated key areas of concern:

- **Hydrogeological studies** to assess the influences of dewatering on surrounding groundwater systems, optimum methods of water discharge and actions required at mine closure to produce acceptable long-term outcomes (Liquid Earth 2005).
- **Vegetation, flora and fauna (terrestrial, short-range endemics and stygofauna) studies** to assess the potential impacts on the conservation status of those species known or likely to occur in the Yandi JSE area (Biota 2004a, Biota 2004b, Biota 2005).
- **Aboriginal archaeological and ethnographic studies**, in close consultation with Gumala, investigating the presence and significance of Aboriginal heritage features of the project area (Day 2004, O'Reilly and Di Lello 2004).

ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT

KEY ENVIRONMENTAL FACTORS ADDRESSED

The following environmental factors relevant to this proposal were identified:

- Landform
- Groundwater and surface water management
    - dewatering of CID to enable mining below the natural water table
    - disposal of excess dewater
    - drainage
    - closure

- Biodiversity
    - terrestrial vegetation and flora, including threatened species and water dependant vegetation
    - fauna, including subterranean biota and short range endemics
- Aboriginal heritage
- Closure.

Some environmental factors that may be locally significant were not addressed in detail but will be addressed in Hamersley's Environmental Management Program (EMP) for Yandicoogina amended to incorporate management of aspects of Yandi JSE. These factors being air quality, dust emissions, noise and vibration, greenhouse gas emissions, waste management and hazardous materials.

Landform

There will be a change in landscape and disturbance to landforms as a result of mining at Yandi JSE. Most impacts will be temporary, but there will be some local long term changes in landform, following closure, primarily:

- modification to soil profile and lowering in elevation over the JSE CID
- permanent loss of at least part of low lying hill (Backfill Hill or other adjacent landform) from the local landscape
- minor changes to surface topography from remaining drainage embankments and levees.

The integrity, ecological function and environmental values of soil and landform for the Yandicoogina area will generally be maintained through minimisation of disturbance and best practice rehabilitation.

All areas disturbed for mining and associated infrastructure will be rehabilitated following decommissioning prior to closure. Rehabilitation objectives are for a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.

Groundwater

Mine dewatering is required at Yandi JSE to enable mining below the natural watertable. This will result in a cone of depression in and around the mine pit during the mine life. This will have only a limited and localised effect on the adjacent Billiards CID aquifer due to a hydraulic barrier at the junction with the two aquifers. The Weeli Wolli Creek alluvial aquifer is not likely to be affected by dewatering due to the distinct hydraulic separation from the underlying Billiards CID aquifer.

The discharge of surplus water will have no significant impact on the regional hydrology. Hamersley is also investigating the feasibility of reinjection of part of the surplus water and if this proceeds, the water levels in the Billiards CID aquifer may rise locally but will not affect the overlying perched aquifers.

After closure and backfilling to 490 mRL there will be localised changes to CID flows and an increase in salinity due to evaporation near the JSE/Billiards Junction and near Phil's Creek to the north (part of the existing Yandi JC operation). These isolated changes will not have a significant impact on regional groundwater flow or quality and hence will not adversely impact on beneficial or environmental uses of the water.

Surface water

The discharge of surplus water from Yandi JC operations to the Marillana Creek system has resulted previously in small, localised impacts on the creek system. The proposed discharges from the combined Hamersley Yandicoogina operations will occur around the current discharge sites and result in additional minor flows to creeks. Continuous flows will occur for a short distance downstream of the discharge sites before infiltrating into the alluvial aquifer. These temporary alterations to surface water flows should not adversely affect potential beneficial or environmental use of the water, provided they are managed carefully.

Reinjection might further reduce the surplus water discharge and its practicality is being investigated. However, it would be of little benefit if the approved discharges into Weeli Wolli Creek from Hope Downs were to occur.

Minor changes in drainage flows associated with earthworks will not affect the quality or quantity of water in the creeks.

Vegetation and flora

The Yandi JSE proposal is not expected to have any significant effect on regional flora and vegetation values due to the wide distribution of the vegetation types and flora species found within the project footprint and the control measures that will be implemented to minimise impacts on flora and vegetation values. The breadth of botanical studies undertaken has allowed Hamersley to assess the regional significance of vegetation in the project area and the proposal should be able to be implemented while maintaining the abundance, species diversity, geographic distribution and productivity of flora at species and ecosystem levels, thereby conserving regional biological diversity.

The Yandi JSE proposal will result in the progressive removal and rehabilitation of approximately 670 ha of native vegetation over the life of the project. The development may result in some long term changes in composition of vegetation due to altered drainage patterns, however this will not significantly affect local or regional conservation values of flora or vegetation. There is an increased risk of the spread of weeds, however this will be minimised through Hamersley's weed control and hygiene procedures. Proposed weed control programs may also provide a net decrease in weeds in the Yandicoogina area.

Fauna

The Yandi JSE proposal will result in the progressive loss and subsequent restoration of fauna habitat over the life of the project and, as a result, the local abundance of fauna populations (terrestrial and subterranean) may be affected. However there should be no impacts on fauna that are of conservation significance at a regional, state or national level and the diversity, geographic distribution and productivity of fauna at species and ecosystem levels will be maintained, thereby conserving regional biological diversity.

Control of feral animals within and surrounding the mining area will have positive benefits to fauna values in areas beyond the mining area. The ongoing fauna surveys and associated research will also increase the knowledge of fauna ecology in the region.

Aboriginal heritage

Hamersley operates at Yandicoogina under the Yandi Land Use Agreement struck with Gumula Aboriginal Corporation (Gumala); a representative body of the local Aboriginal groups. The Yandi JSE proposal will avoid disturbance of those archaeological and ethnographic sites already identified to be of significance. Hamersley will continue to consult with Gumala regarding management of Aboriginal heritage sites and values, and will manage Aboriginal heritage sites in accordance with the Aboriginal Heritage Act.

Closure

Hamersley has prepared a Conceptual Decommissioning and Rehabilitation Plan for the Yandicoogina Project Area, which was cleared by the DoE in August 2000. A revised closure plan covering the hydrogeological aspects of closure and including aspects of waste fines containment structures at Yandi JC was approved by DoE in March 2005. Both of these plans will be revised to include the Yandi JSE project and combined into one overall Conceptual Decommissioning and Rehabilitation Plan for the Yandicoogina Iron Ore Mine to be submitted to EPA within 12 months of commissioning.

Hamersley will review and revise the Conceptual Decommissioning and Rehabilitation Plan every five years in consultation with DoIR, DoE and CALM. The plan will address:

- strategy for managing long term hydrogeological consequences of mining the CID
- notional removal of infrastructure
- indicative rehabilitation plan
- source of backfill material and notional management of associated environmental issues
- process for establishment of completion criteria.

The Decommissioning and Rehabilitation Plan will be finalised at least two years prior to the cessation of mining. The plan will fully detail the aspects above, including agreed completion criteria.

ENVIRONMENTAL MANAGEMENT

ENVIRONMENTAL MANAGEMENT PROGRAM

It is intended that the Yandi JSE project will be managed under the same framework as the Yandi JC project, and be managed as part of the same mining operation.

The Yandicoogina operation has an Environmental Management Program (EMP) in place, developed as a condition of Ministerial Statement 417 and amended to incorporate management of the expanded mine as per Ministerial Statement 523. The EMP has been approved by the DoE and addresses groundwater and surface water management, flora and fauna, waste management, hydrocarbon management, dust, noise and fire, environmental awareness and training, environmental incident response, greenhouse gases, contaminated sites, Aboriginal heritage, rehabilitation and decommissioning, monitoring and reporting, and environmental auditing and reviews.

The Environmental Management Program will be reviewed and revised where relevant for the purpose of extending the environmental management and monitoring to address all environmental issues arising from the development and operation of the Yandi JSE.

ENVIRONMENTAL MANAGEMENT SYSTEM

Hamersley operates under an ISO14001 framework using their Iron Environmental Management System (or 'IEMS'). The key elements of ISO14001 include assessing environmental risk and legal requirements, developing objectives and targets for improvement, training, operational control, communication, emergency response, corrective actions, audits and review. Rio Tinto has mandated that all its global operations be certified to this standard by July 2005.

In April 2005, the Hamersley sites, including Yandicoogina, successfully maintained their certification to ISO14001, first achieved in October 2003, through three external audits by NCS International Pty Ltd (NCSI).

SUMMARY OF PROPONENT COMMITMENTS

The proponent (Hamersley) proposes the Environmental Management Commitments for the management of Yandi JSE detailed in Table S2.

Table S2 Proponent's Environmental Management Commitments for the management of Yandi JSE

No	Issue	Objective	Action	Phase	Requirements (Advice)
1	Legislation	Comply with relevant legislation	The construction and operation of the project will be undertaken in accordance with the requirements of relevant Commonwealth and State legislation and regulation.	Pre-construction, construction and post-commissioning	
2	Amendments to the project	Refer significant project amendments for assessment	Details of any plan to alter the project from that outlined In the EPS that is likely to result in significant environmental impacts will be provided to the EPA for environmental assessment.	Pre-construction and post-commissioning	
3	Understand hydrogeological system	Understand hydrogeological systems and develop and evaluate options for long term management	Hamersley will continue to evaluate the impacts of mining and decommissioning on the Marillana-Yandicoogina-Weeli Wolli Creek systems and the CID jointly with BHPBIO for the purposes of further understanding the hydrogeological system in order to develop and evaluate options for viable and compatible long term management strategies, including re-injection; results of evaluations will be reported to the Pilbara Iron Ore Environmental Management Committee.	Pre-commissioning and post-commissioning	DoE
4	Groundwater monitoring in the Weeli Wolli Creek system	Monitor groundwater in the Weeli Wolli Creek alluvium	Hamersley will establish groundwater monitoring bores in the alluvium to monitor surface and groundwater levels before dewatering commences; the results of this monitoring will be submitted to the State on an annual basis.	Pre-construction, construction and post-commissioning	DoE
5	Hydrogeological data collection	Collect further hydrogeological data to develop a model for the final void	Hamersley will continue to collect necessary hydrogeological data for the refinement of the model used to predict long term water levels and quality in the final void. This model will be applied to assist design of the final void to minimise long term impacts of mining on local and regional groundwater. A report on this model and the final void outcome will be prepared and submitted to the DoE before finalising the Decommissioning and Rehabilitation Plan.	Pre-construction, construction and post-commissioning	DoE
6	Environmental audits	Conduct regular environmental reviews	Hamersley will conduct internal environmental reviews during the construction (every 6 months) and operation (annually) of the project. These environmental reviews will assess compliance with project commitments, relevant Works Approval and Operating Licence conditions and any other environmental requirements.	Construction and post-commissioning	DoE
7	Environmental reporting	Prepare reports on environmental management and monitoring	Annual and triennial reports that describe the actions taken to comply with environmental management conditions and monitoring commitments will be prepared by Hamersley and issued to the State.	Post-commissioning	
8	Biological	Minimise impacts on riverine vegetation	During the project life, Hamersley will develop and formalise a tree health research and monitoring program to assess the impacts of dewatering on riverine vegetation. The monitoring program will include contingency actions if unacceptable impacts are detected. The results of the tree health monitoring program will be submitted to the State on a triennial basis.	Pre-commissioning, construction and post-commissioning	DoE, CALM
9	Waste disposal	Manage wastes in an appropriate manner	Waste will be managed in accordance with the following requirements: ▪ burning will not be permitted as a means of rubbish or other waste disposal within the project area ▪ all putrescible, biodegradable, inert substance and other general rubbish will be disposed of in a fenced, excavated waste pit that will be regularly backfilled to cover the waste material.	Construction and post-commissioning	DoE
10	Sewage treatment plants	Ensure sewage treatment plants are approved	Plans for sewage treatment plants proposed at Yandicoogina will be submitted by Hamersley for approval by the Western Australian Department of Health.	Pre-construction	DoH, DoE
11	Hydrocarbons	Appropriate storage of hyrdocarbons	All bunding for hydrocarbon storage areas will be constructed in accordance with the requirements of AS1940-1993.	Construction and post-commissioning	DoIR, DoE
12	Contaminated surface runoff	Ensure that contaminated surface runoff does not enter natural drainage	The project will be designed, and management procedures put in place, to ensure that stormwater runoff from areas that may be contaminated by hydrocarbons does not enter natural drainage channels without prior treatment.	Pre-construction and Post-commissioning	DoE

No	Issue	Objective	Action	Phase	Requirements (Advice)
13	Dust	Minimise dust	Dust suppression measures, including application of water from tankers, will be implemented to minimise dust generation during site preparation and construction activities.	Construction and post-commissioning	DoE
14	Aboriginal heritage (archaeological) sites	To comply with *Aboriginal Heritage Act 1972*	If any Aboriginal site is required to be disturbed, Hamersley will seek consent to disturb the site from the Minister for Indigenous Affairs through a section 18 application under the *Aboriginal Heritage Act 1972.*	Pre-construction and construction	DIA, Gumala
15	Rehabilitation	Ensure disturbed areas are rehabilitated	Vegetation and topsoil removed during site preparation will be used to progressively rehabilitate disturbed areas.	Construction and post-construction	DoE, CALM
16	Backfilling of mine void	Minimise impact of use of hill for backfill on flora, fauna, surface drainage patterns and Aboriginal heritage sites	The use of adjacent landforms for the purpose of backfilling of the mine pit void at JSE will be subject to the following criteria for the protection of flora, fauna and heritage: ▪ no loss of DRF populations or TECs or a substantial proportion of other flora and vegetation considered to be of state or regional conservation significance ▪ no impact on Threatened Fauna or substantial impacts on other fauna species of state or regional conservation significance ▪ archaeological and ethnographic sites to be managed in accordance with the Aboriginal Heritage Act 1972 and the Yandicoogina Land Use Agreement. ▪ removal of fill and rehabilitation will be consistent with a final landform which sheds incident water from rainfall.	Decommissioning	DoE, DoIR, CALM, DIA, Gumala
17	Environmental Management Program (EMP)	To manage environmental impacts of Yandi JSE	The Environmental Management Program (EMP) will be reviewed and revised where relevant for the purpose of extending the environmental management and monitoring to address all environmental issues arising from the development and operation of the Yandi JSE operation in consultation with DoE, DoIR and CALM. The revised EMP will include, but not be limited to, the following updated plans: i. water (groundwater and surface water) management plan, for both during and post-mining, incorporating the borefield operating strategy, whole of site water balance and discharge of surplus water, and drainage management measures for the altered drainage patterns ii. dust and noise emission management plans iii. greenhouse gases management plan iv. waste management plan v. flora and fauna protection plans, including monitoring and management of trees in creeklines and surveys for stygofauna vi. fire and weed management plans including a weed control program in the Marillana Creek system focusing on Hamersley's operational area vii. environmental induction program for personnel viii. progressive rehabilitation program for disturbed areas, consisting of a detailed strategy of the progressive rehabilitation program for disturbed areas including reference to procedures to undertake, and monitor and manage rehabilitation and a description of the process for establishment of rehabilitation completion criteria ix. summary of monitoring programs.	Pre-commissioning	DoE, DoIR, CALM

No	Issue	Objective	Action	Phase	Requirements (Advice)
18	Decommissioning and rehabilitation plan	To satisfactorily decommission the mine site and rehabilitate the site and its environs.	Within 12 months of the Yandi JSE proposal being commissioned, a revised Conceptual Decommissioning and Rehabilitation Plan for the Yandicoogina Iron Ore Mine will be submitted to EPA for approval, which will address: ▪ strategy for managing long term hydrogeological consequences of mining the CID ▪ notional removal of infrastructure ▪ indicative rehabilitation plan ▪ source of backfill material and notional management of associated environmental issues ▪ process for establishment of completion criteria. The plan will now incorporate both the Yandi JC and JSE operations. It will be prepared, and reviewed every five years, in consultation with DoIR, DoE and CALM.	Post-commissioning	DoE, DoIR, CALM
19	Decommissioning and rehabilitation plan	To satisfactorily decommission the mine site and rehabilitate the site and its environs.	At least two years prior to the decommissioning of the project, the Decommissioning and Rehabilitation Plan for the Yandicoogina Iron Ore Mine will be finalised and submitted to the Government for approval and will fully detail: ▪ management of long term hydrogeological consequences of mining the CID ▪ removal of infrastructure ▪ rehabilitation plan ▪ backfilling of pit, sourcing backfill and management of associated environmental issues ▪ completion criteria developed in consultation with the DoIR, DoE and CALM.	Post-commissioning	DoE, DoIR, CALM, Gumala
20	Construction Environmental Management Plan	Prepare plan for management of construction activities	Prepare a Construction Environmental Management Plan to cover all aspects of construction. This would include a requirement for surveys of rare and priority flora over all areas prior to any ground disturbance. It would also manage activities of the construction workforce including the requirement for an environmental induction program for construction personnel. The CEMP will include, but not be limited to, the following: i. all contractors with potential environmental aspects to receive an instruction package on legal and best practice requirements for minimising impacts ii. an induction package for all staff and contractors outlining key project objectives and procedures and the need for compliance iii. pre-construction permit requirements under Part V of the EP Act, including Works Approval, borefield licences and others iv. pre-disturbance surveys for flora of conservation significance v. clearing and topsoil management procedures vi. rehabilitation requirements vii. incident reporting and emergency management procedures viii. a schedule of internal audits to verify compliance.	Pre-construction	DoE, DoIR, CALM

Abbreviations:

DIA Department of Indigenous Affairs
CALM Department of Conservation and Land Management
DoE Department of Environment
DoIR Department of Industry and Resources
Gumala Gumala Aboriginal Corporation

CONCLUSION

ENVIRONMENTAL COSTS

The environmental costs of the proposal are as follows:

- Changes in the immediate landscape primarily caused by the removal of material from the CID and resultant depression in the restored landform, and the removal of the adjacent low lying hill from mining for the purpose of backfill (impact of local significance).
- Localised alterations to groundwater flow in the CID and a localised increase in groundwater salinity to around 2000 mg/L in the post-closure landform due to evaporation of water near the surface (which will be 10 – 15 m lower than prior to mining in some areas). These isolated changes will not have a significant impact on regional groundwater flow or quality.
- Minor changes in surface drainage patterns over CID and diversion of minor drainage lines around CID, but which should not impact the quality or quantity of water in the creeks themselves.
- Progressive removal of approximately 670 ha of native vegetation over the life of the project, although with eventual rehabilitation to native vegetation.
- Potential changes in composition of vegetation down gradient of the mine due to altered surface drainage. However this will not significantly affect local or regional flora and vegetation values.
- Increased risk of the spread of weeds. However this will be minimised through Hamersley's weed control and hygiene procedures, and effective rehabilitation should negate the risk.
- Reduction in local abundance of some fauna populations. However this will not have a significant effect on representation of fauna at a regional (Central Pilbara) or sub-regional (Hamersley Ranges) level.
- A number of Aboriginal sites will be disturbed by mining. However based on the archaeological and ethnographic surveys of the Yandi JSE area, the proposal will avoid disturbance of those sites identified to be of significance.

ENVIRONMENTAL BENEFITS

A number of environmental benefits will arise from the implementation of this proposal and continued operation of the Yandicoogina Iron Ore Mine Operation. These include:

- a weed control program in creek lines of the Marillana Creek system focussing on Hamersley's operational area
- support for research programs by the Ecosystems Research Group of the University of Western Australia in assessing plant-water relationships and developing better predictive models of drawdown impacts in the Pilbara
- support for research into the distribution and taxonomy of stygofauna in the Central Pilbara
- continued research on predicting and managing pit void water quality.

Hamersley's continued operation in the region will continue to support the existence of towns, such as Dampier, in the Pilbara and a variety of community groups and public projects in WA.

ENVIRONMENTAL RISKS AND MANAGEABILITY

The proponent has extensive experience in managing the development, operation and environmental compliance of similar projects (including the existing Yandi JC operation) and this experience is anticipated to lead to a greater certainty in achieving desirable environmental outcomes.

The environmental aspects of the proposal will be managed primarily through the Yandicoogina EMP, which will be amended to incorporate all aspects of the Yandi JSE project, the site EMS, relevant licences, the implementation of the proposed environmental management commitments for the Yandi JSE project and the continued implementation of the environmental management commitments for the existing Yandicoogina Project. Hamersley will ensure an acceptable closure outcome through the preparation of a Conceptual Decommissioning and Rehabilitation Plan for the Yandicoogina Project, which will be reviewed every five years, to the satisfaction of stakeholders. The plan will be finalised at least two years prior to decommissioning and will include the long term management of hydrogeological aspects.

Table S3 Summary of key environmental issues, potential impacts and management

ISSUE	PRELIMINARY EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL IMPACT	POTENTIAL MANAGEMENT	PREDICTED OUTCOMES
1. Landform	▪ To maintain the integrity, ecological functions and environmental values of the soil and landform ▪ To ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values	▪ The CID lies in the central part of a broad, east-trending drainage basin ▪ The surface topography has been shaped by alluvial processes with the existing streams winding between low lying mesas and hills ▪ There is a large active mine at Yandi JC that interrupts the valley landform to the northwest of the proposed JSE operation	▪ Mining will create a temporary void in the landscape ▪ Permanent earthworks for construction of drainage levees and temporary waste stockpile on the alluvial plain ▪ Placement of infrastructure temporarily altering the appearance of the natural environment ▪ Mining of adjacent hill (Backfill Hill) and backfilled pit represents permanent change in local landscape	▪ Use of material from adjacent hill to raise pit floor following mining ▪ Placement of waste stockpile back in pit at closure and subsequent rehabilitation ▪ Decommissioning and Rehabilitation Plan	▪ Modification to soil profile and lowering in elevation over JSE CID ▪ Permanent loss of at least part of low lying hill (Backfill Hill) from the local landscape ▪ Minor changes to surface topography from residual mounds from the embankments and levees
2. Groundwater	▪ To ensure that alterations to groundwater flows or quality do not adversely impact on beneficial or environmental uses of the water and that integrity, functions and environmental values of watercourses are maintained	▪ The CID is the major aquifer in the area and exists in an ancient palaeochannel recharged from the overlying alluvial sediments that occur in creeks and drainage lines ▪ The CID aquifer is currently “topped up” by several years of higher than average rainfall and some surplus water discharges from the BHPBIO and Yandi JC mine to the Marillana Creek system ▪ Most of the ore is below the watertable	▪ Dewatering will create a cone of depression in the CID watertable ▪ Surplus water will be discharged to the Marillana and Yandicoogina Creeks, recharging the alluvial aquifers in part ▪ Surface water management will alter minor drainage flows and reduce recharge to the JSE CID ▪ Any storage, handling or use of hazardous materials or hydrocarbons has the potential to contaminate groundwater ▪ The post-mining pit void may restrict groundwater flow and increase the salt concentration of the water	▪ Mining will be offset 200 m from the creeks to minimise impacts on groundwater and vegetation. Dewatering will occur progressively with mining and the initial dewatering will begin one year before mining commences to provide a dry mining surface ▪ The amount of surplus water discharged will be minimised where possible. Reinjection is being investigated to determine whether it is practical to reduce discharges to the creeks ▪ The mine pit will be backfilled to 490 mRL to maintain throughflow in the aquifer and minimise evaporation and concentration of salts ▪ Hazardous materials and hydrocarbons will be managed according to the EMP ▪ A detailed monitoring program will be prepared and submitted to the DoE for approval	▪ The water levels in the creek alluvium near the discharge outlets will be higher throughout the year than at present ▪ There will be a cone of depression in the CID around the mine pit during the mine life but this is not expected to affect the Weeli Wolli Creek and impacts in the Billiards CID will be restricted spatially. There is a small possibility that the Marillana Creek alluvium may be affected by drawdown but any drawdown effects will be offset by surface water discharges. ▪ After closure and backfilling to 490 mRL there will be localised changes to CID flows and an increase in salinity due to evaporation near the JSE junction with Billiards. These isolated changes will not have a significant impact on regional groundwater flow or quality

ISSUE	PRELIMINARY EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL IMPACT	POTENTIAL MANAGEMENT	PREDICTED OUTCOMES
3. Surface water	▪ To ensure that alterations to surface water flows or quality do not adversely impact on beneficial or environmental uses of the water and that integrity, functions and environmental values of watercourses are maintained	▪ Creeks in the area are naturally ephemeral. 10-15 ML/d is discharged from Yandi JC to the Marillana and Yandicoogina Creeks creating permanent flows for a short distance downstream. The water quality of the discharges is high. Upstream in Marillana Creek, the BHPBIO Yandi operation currently discharges around 10 Ml/d	▪ Diversion and drainage of surface water around mining operations may alter flow paths ▪ Disposal of surplus water to the Marillana and Yandicoogina Creeks may create permanent flows for up to 1-2 km downstream ▪ Two new creek crossings on Yandicoogina Creek ▪ Changed landform post closure will permanently alter the surface drainage pattern	▪ Surface water management will alter some drainage flow paths but the destination of flows and creek flow volumes will remain the same ▪ Surface discharge will be sited in Marillana Creek in an area already affected by previous discharge history. The Yandi JC discharges will largely stop when wet processing begins, the Yandi JSE discharges will replace those flows ▪ Discharges will operate under a licence ▪ Creek crossings will be designed consistent with other crossings in the area shown not to cause significant disruption to flows ▪ Diversions and drains will remain after closure to act as safety bunds and prevent surface runoff accumulating in the backfilled mine pit ▪ If practical, reinjection to groundwater may reduce surface discharge volumes	▪ The proposed discharges from the combined Hamersley Yandicoogina operations will result in additional minor flows to creeks. Minor changes in drainage flows associated with earthworks will not impact the quality or quantity of water in the creeks ▪ Post closure, some surface expression of water in the pit void will occur seasonally, which may have salinities to 2000 mg/L

ISSUE	PRELIMINARY EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL IMPACT	POTENTIAL MANAGEMENT	PREDICTED OUTCOMES
4. Flora and vegetation	▪ To maintain the abundance, species diversity, geographic distribution and productivity of flora and fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge	▪ Vegetation comprises spinifex hummock grasslands on low stony hills and ranges, with open Eucalypt woodlands and Acacia shrublands over spinifex on plains and Eucalypt woodlands in major creeks ▪ A small number of one species of DRF occurs at one site near the new conveyor. Five Priority Flora species occur in the JSE project area. No Threatened Ecological Communities are known to occur ▪ Vegetation types potentially impacted are not restricted and are widely distributed in the Pilbara ▪ Riverine vegetation of the major creeks has been identified as being of conservation significance at the Hamersley Ranges sub-region level ▪ The preferred source of post-mining backfill (Backfill Hill) has not yet been surveyed (Alternative source has been surveyed)	▪ Loss of flora and vegetation from clearing for mine and associated infrastructure ▪ Stress in phreatophytic vegetation due to groundwater drawdown around mine dewatering ▪ Establishment of vegetation along creeklines due to excess water discharge and the possible loss of this vegetation post-closure ▪ Minor changes in drainage line vegetation down-gradient of mining area due to reduced flows caused by diversions ▪ Minor changes in distribution of vegetation downgradient of mine due to changes in sheet flow runoff ▪ Spread and introduction of weeds from mining activities ▪ Localised retarding of growth of vegetation due to dust smothering around roads and bare surfaces	Implementation of revised flora and fauna management measures detailed in EMP. Measures include: ▪ Surveying flora and vegetation prior to ground disturbance to avoid species of conservation significance ▪ Minimising area to be cleared ▪ Minimising disturbance of significant flora and vegetation ▪ Marking and avoidance of DRF during construction ▪ Maintaining buffers along creek margins ▪ Investigating re-injection of excess water ▪ Monitoring phreatophytic vegetation and irrigating affected vegetation if required ▪ Rehabilitation of disturbed areas ▪ Weed hygiene and control measures ▪ Dust control measures Construction Environmental Management Plan (CEMP) will include a requirement for surveys of rare and priority flora over all areas prior to any ground disturbance	▪ No disturbance of recorded DRF populations ▪ No significant impact on other flora species of state or regional conservation significance. ▪ The representation of vegetation communities over the project area will change in the long-term due to altered landform as a result of mining and altered drainage patterns. However, there will be no significant effect on regional flora and vegetation values ▪ Increased knowledge of plant-water relationships due to ongoing surveys and research , which will improve riparian management

ISSUE	PRELIMINARY EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL IMPACT	POTENTIAL MANAGEMENT	PREDICTED OUTCOMES
5. Fauna	▪ To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge	▪ Most terrestrial fauna species known or expected to occur in the project area are widely distributed throughout the Pilbara ▪ Six terrestrial species known or expected to occur are of conservation significance, however these species and their preferred habitat are not restricted to the project area ▪ Numerous invertebrates inhabit the project area, and work has commenced to determine whether any of the short-range endemics found have regional conservation significance ▪ The area is rich in stygofauna, and all but one of the species recorded occurs elsewhere in the region. This ostracod occurs in alluvium and is likely to have a wider distribution ▪ Feral animals include horses, donkeys, cattle, cats and donkeys ▪ The preferred source of post-mining backfill (Backfill Hill) has not yet been surveyed (Alternative source has been surveyed)	▪ Loss of fauna habitat from clearing for mine and associated infrastructure ▪ Incidental death of vertebrate species due to vehicle movements ▪ Reduction of stygofauna populations from groundwater drawdown due to mine dewatering lowering the water table sufficiently in some areas to dry the zone in which some stygofauna species live.	Implementation of revised flora and fauna management measures described in EMP. Management measures include: ▪ Fauna surveys prior to ground disturbance activities ▪ Minimising the area to be cleared ▪ Feral animal control ▪ Maintaining buffers adjacent to major creeks ▪ Continued support of stygofauna and short-range endemic research, including confirmation of the distribution of the locally occurring ostracod	▪ Potential affect on local abundance of some fauna populations. However this will not significantly alter the representation of fauna at a regional (Central Pilbara) or sub-regional (Hamersley Ranges) level ▪ Increased knowledge of faunal ecology in the region due to ongoing surveys and research

ISSUE	PRELIMINARY EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL IMPACT	POTENTIAL MANAGEMENT	PREDICTED OUTCOMES
6. Aboriginal Heritage	▪ To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation	Surveys conducted throughout the project area show: ▪ Several Aboriginal archaeological sites occur within the project area. However most consist of artefact scatters of low archaeological significance ▪ A probable grave site exists to the north of the JSE area ▪ Three rock shelters have been identified on the periphery of the footprint for Backfill Hill ▪ Ethnographic associations relate to the creek beds in the project area ▪ The preferred source of post-mining backfill (Backfill Hill) has not yet been surveyed (Alternative source has been surveyed)	▪ Disturbance of Aboriginal archaeological and ethnographic sites due to mining activities	Implementation of revised Aboriginal heritage measures detailed in EMP. Management measures include: ▪ Undertaking archaeological and ethnographic surveys prior to ground disturbance activities ▪ Protecting those sites identified to be of significance from mining by adjusting mine plans ▪ Avoidance of sites wherever practicable and where this is not possible, seek S18 consent to disturb under the *Aboriginal Heritage Act 1972* ▪ Consult and involve the Gumala Aboriginal Corporation in mitigative heritage work prior to disturbance of sites ▪ Maintenance of buffers adjacent to creeklines	▪ A number of Aboriginal sites will be disturbed by mining ▪ Management of Aboriginal heritage sites will be undertaken in accordance with the *Aboriginal Heritage Act 1972* and the Yandicoogina Land Use Agreement ▪ The JSE development will avoid those sites already identified to be of significance ▪ Hamersley will continue to consult and involve the Gumala Aboriginal Corporation in heritage investigations and works

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1. INTRODUCTION

This document is an Environmental Protection Statement (EPS) prepared in accordance with Administrative Procedures of the *Environmental Protection Act 1986* (EP Act) for Hamersley Iron Pty Limited's (Hamersley) proposed Yandicoogina Junction South East Project (Yandi JSE), which will be an extension to the adjacent Yandicoogina Iron Ore Mine Operation (Yandi) in the Central Pilbara of Western Australia (Figure 1 and Figure 2).

1.1 BACKGROUND

Hamersley Iron Pty Limited (Hamersley) is the proponent for this proposal and operates the existing Yandicoogina mine. The mine was commissioned in December 1998 and is a conventional open cut iron ore mine. The current mining area is referred to as Yandicoogina Junction Central (Yandi JC). The crushed ore is transported by the Central Pilbara Railway to the Hamersley ship loading facilities at Dampier Port and Cape Lambert, 300 km north-west of Yandicoogina on the Pilbara coast.

Yandicoogina Junction Central (Yandi JC) 2003

The Yandi JC mine had an initial production of 5-10 Mtpa (Million tonnes per annum) and a constructed design capacity of 15 Mtpa. Production capacity has subsequently increased through process modifications, addition of a wet processing plant (recently commissioned) and an increase in the mining area. When in full operation, the wet processing plant will bring the capacity to 36 Mtpa. A summary of the environmental approvals history for each production increase is provided in Section 1.1.1.

The Yandicoogina area contains a large resource of pisolitic iron ore within a channel iron deposit (CID), associated with the Marillana – Yandicoogina – Weeli Wolli creek systems. The CID is characterised by a continuous iron mineralisation along a palaeochannel, the total length of which is over 80 km. The main ore zone of the CID at Yandicoogina is about 500 m wide with a thickness of 45 to 50m under approximately 10 m of overburden. There are a number of operating and planned iron ore mines in the area, including the BHP Billiton Iron Ore (BHPBIO) Marillana Creek (Yandi) mine, which also involves mining of the CID.

The world-wide demand for iron ore continues to be strong, particularly from the Chinese market. Hamersley considers there is sufficient demand for iron ore to warrant placing additional tonnage into the market. In response to this demand, Hamersley proposes to increase production capacity at Yandicoogina from 36 Mtpa to 52 Mtpa by commencing mining operations in a new pit adjacent to the currently approved mining area, referred to as Yandi JSE and is the subject of this EPS. Ore from Yandi JSE will be conveyed to the existing Yandicoogina rail loadout infrastructure where it will undergo minor additional processing (tertiary crushing and screening) before passing onto the Pilbara Iron Rail system.

1.1.1 Environmental approval history

The Hamersley Yandicoogina Operation is facilitated by the *Iron Ore (Yandicoogina) Agreement Act 1996*. The Agreement Act was established to give effect to Government and Hamersley rights and obligations to enable the project to proceed. Under that Act, all new and existing operations are subject to provisions of the *Environmental Protection Act 1986*.

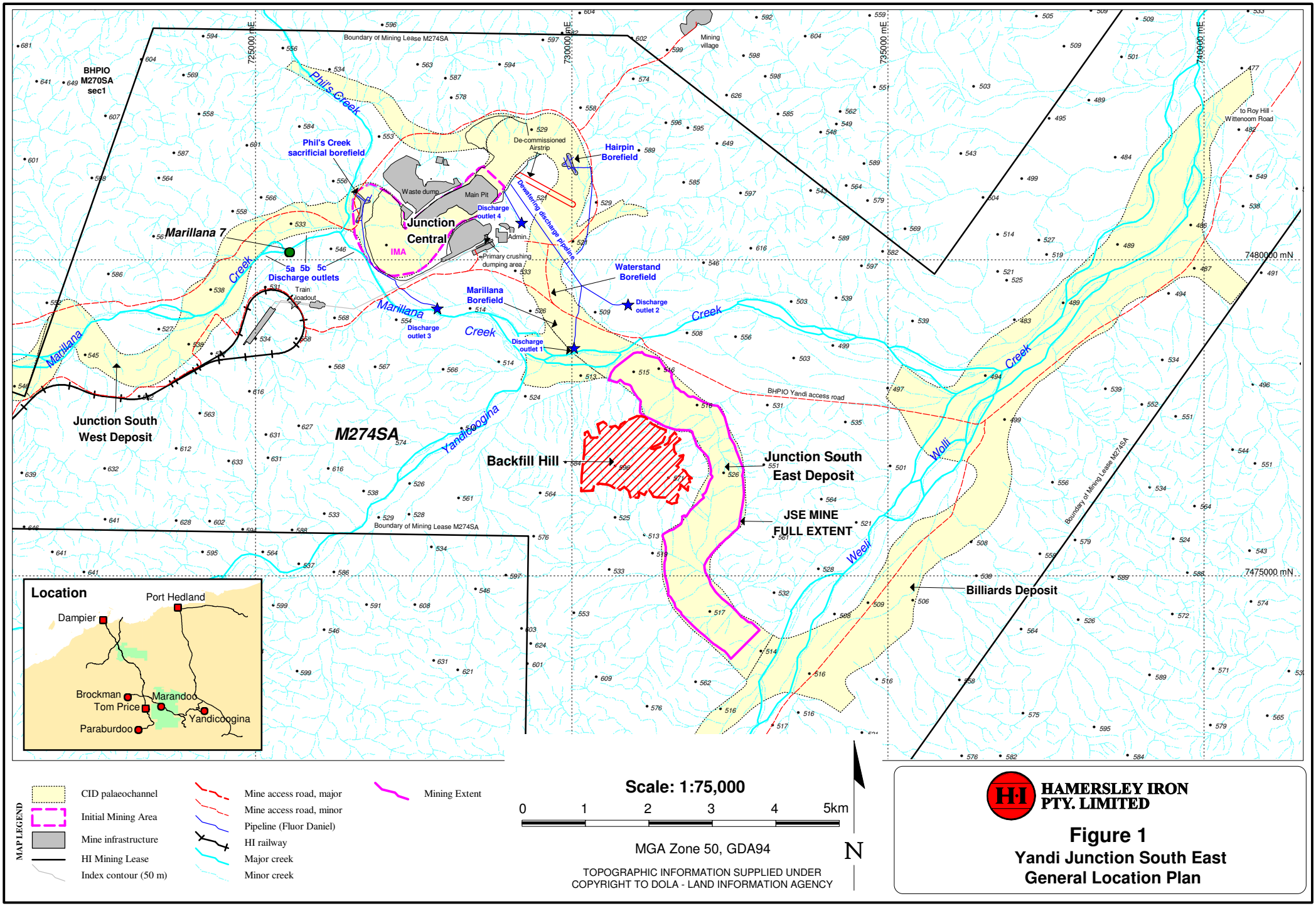
A brief summary of the environmental approval history for the Hamersley Yandicoogina operation is provided below:

- The initial Yandicoogina Iron Ore Mine and Railway proposal with a production capacity of 15 Mtpa was referred to the EPA in 1995 and the level of assessment set at Consultative Environmental Review (CER). The EPA's report and recommendations (Bulletin 809) concluded that the proposal was acceptable subject to a number of environmental conditions. The proposal was subsequently granted Ministerial approval in May 1996 (Ministerial Statement No. 417).
- In 1998, Hamersley's proposal to extend the mining area to an area adjacent to the already approved mine pit was referred to the EPA. The EPA assessed the proposal under section 46 of the *Environmental Protection Act 1986* (EP Act), resulting in revised conditions released as Ministerial Statement 523 in October 1999 to incorporate the extension into the approved mining area (Appendix 1). Subsequently, in 2001 production capacity was increased from 15 to 20 Mtpa.
- In March 2003, the Department of Environment (DoE) approved a further increase in production to 24 Mtpa under a Works Approval (Approval No. 3781). This increase was achieved through modification of the processing plant and stockpile.
- In July 2003 Hamersley's proposal to increase production capacity to 34 Mtpa, through the addition of a wet processing plant (to process low grade ore), was referred to the EPA. This proposal was raised to 36 Mtpa on the basis of production efficiencies found without altering the fundamental proposal. The proposal was approved as a non-substantial change to the approved project in September 2003 and the plant constructed under a Works Approval (No. 3865).

1.1.2 Environmental and water licences

Yandicoogina also operates under a number of environmental licences, primarily:

- Department of Environment (DoE) Environmental Licence (L7340/7) issued under Part V of the EP Act that covers:
  - Category 5: Processing or Beneficiation of Metallic or Non Metallic Ore
  - Category 6: Mine Dewatering
  - Category 85: Sewage Facility
  - Category 64: Putrescible Landfill.
- Water and Rivers Commission (now Department of Environment) licences to take water:
  - GWL107422: Allocation: 10,000,000kL/a – Dewatering purposes, dust suppression, earthwork and construction purposes, mineral ore processing
  - GWL153358: Allocation: 150,000,000 kL/a – Earthwork and construction purposes, mining camp purposes



HAMERSLEY IRON PTY. LIMITED

Figure 1
Yandi Junction South East General Location Plan

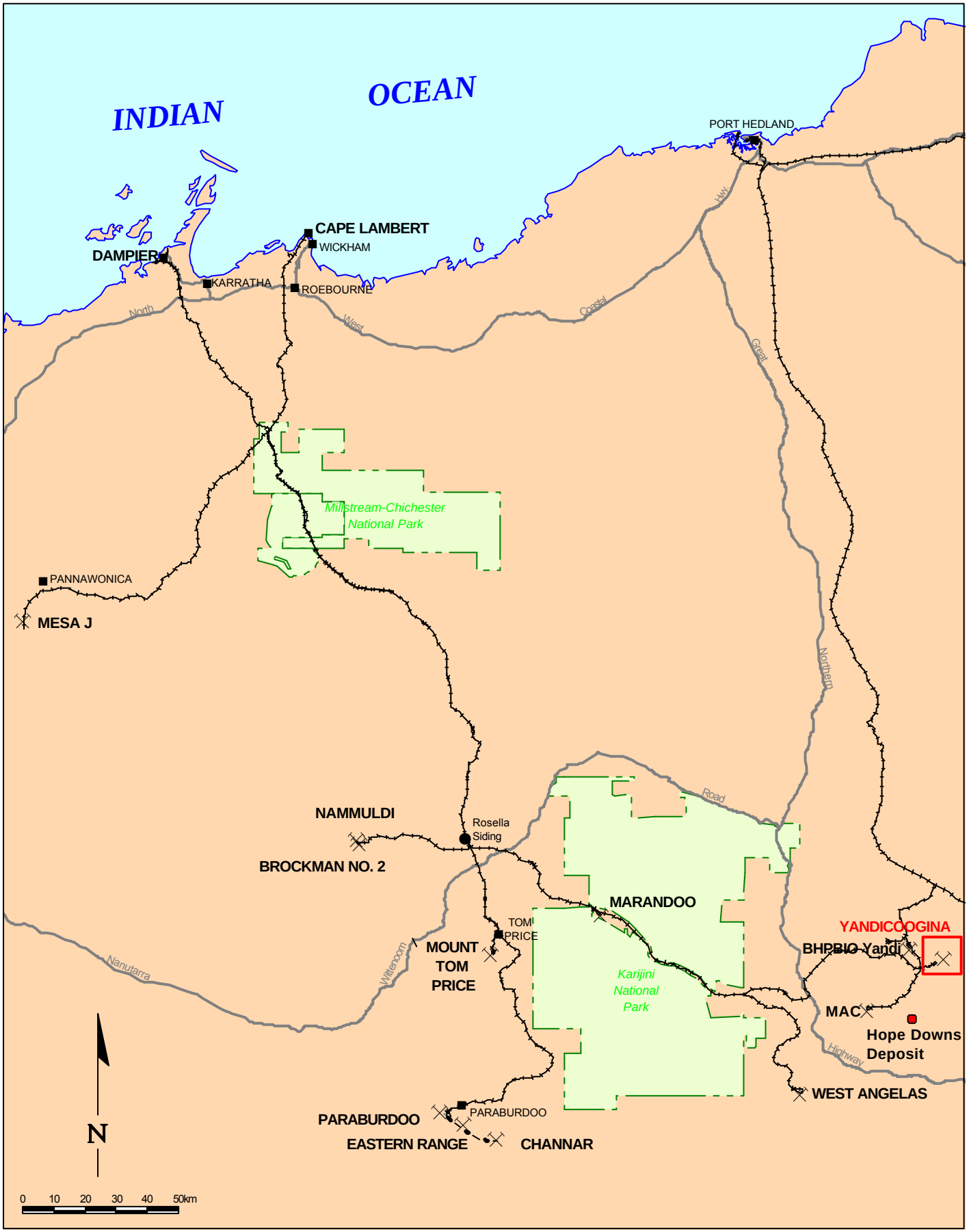


Figure 2

"Regional location of Hamersley's Yandicoogina Operation"

#1118391; July 2005

1.2 PROPONENT

The proponent for the project is Hamersley Iron Pty Limited (Hamersley), a subsidiary of Rio Tinto Limited (Ltd). The business address for Hamersley is:

Level 22, Central Park
152-158 St George's Terrace
Perth WA 6000
GPO Box A42 PERTH WA 6837

The project will be managed by Pilbara Iron Pty Limited on behalf of Hamersley. Pilbara Iron (Services) Pty Limited was established as a single entity within Rio Tinto to manage the Group's Western Australian iron ore operations on behalf of the asset owners, including the rail system.

1.3 THE PROPOSAL

The Yandi JSE proposal comprises:

- the development of a new mine pit in the JSE section of the CID (JSE CID)
- construction of a new dry processing plant for primary and secondary crushing of ore
- a conveyor to link the above plant with the existing processing and rail load-out area.

These additions would allow total production to increase to a potential 52 Mtpa with the capacity of infrastructure of the existing Junction Central (Yandi JC) mine (including load-out and rail infrastructure) expanded to cope with increased throughput. The latter is the subject of a separate approvals process being pursued in parallel to the EPS, which obtained s45C approval under the EP Act on 25 February 2005.

1.3.1 Location

Hamersley's Yandicoogina Iron Ore Mine is located 90 km north-west of Newman and 300 km south-east of Dampier in the Central Pilbara (Figure 2). The Yandicoogina Mine Operation is covered by ML274SA established under the *Iron Ore (Yandicoogina) Agreement Act 1996*. The Yandicoogina Village is located within a Special Lease application covering Windell Location 157.

1.4 Demand FOR IRON ORE

The world-wide demand for iron ore continues to be strong, particularly from the Chinese market. Hamersley considers there to be sufficient demand for iron ore to warrant placing additional tonnage into the market.

Recent growth in world seaborne trade in iron ore has been driven by China, whose imports have risen from 70 million tonnes in 2000 to 208 million tonnes in 2004. This rapid growth in Chinese iron ore imports has been driven by the compound effect of an acceleration in finished steel consumption - which grew at an average rate of 20% Year-on-Year between 2000-2003. Domestic steel production has moved in step with this growth in demand. As domestic ore production is constrained by resource and cost issues, and scrap availability is low, most of the consequential increase in demand for iron

units was realised by imports of iron ore. Rio Tinto Ltd has recently updated its outlook for future Chinese steel demand and concludes that continued additional demand for iron ore will continue.

1.5 THE DEPOSIT

The Yandicoogina Junction South East Channel Iron Deposit (JSE CID) is a section of the same Yandicoogina deposit being mined at the existing Yandi JC mine and further upstream at the BHPBIO Marillana Creek (Yandi) mine. The Yandicoogina deposits are known as channel iron deposits (CIDs) to distinguish them from bedded hematite and hematite-goethite deposits hosted by the Brockman and Marra Mamba iron formations. CIDs differ fundamentally from the bedded deposits in shape, size, structure, texture, mineralogy, quality and age.

The relevant geological characteristics of the orebody are as follows:

- it averages 0.5 km wide and 45-50 m thick (less at the sides)
- is saucer shaped in cross section
- has simple geological structure, the main complexity being erratic clay pockets
- is mostly below the watertable
- is overlain with detrital, laterite or weathered material
- is composed of pisoliths (pea stones) cemented by a goethitic matrix; typically the pisoliths have haematite cores and goethitic rims.

1.6 ALTERNATIVE DEPOSITS CONSIDERED

An evaluation of alternative mining deposits, including Junction South West (JSW), Snooker, Meander and Billiards was undertaken before the establishment of the existing Yandi JC operation (Hamersley 1995). These deposits, although located within the existing mining lease, lacked sufficient drilling information. Consequently, there is uncertainty of mineral resource, and in the instance of the Snooker, Meander and Billiard deposits, infrastructure is not readily available (e.g. processing and support facilities).

The JSE CID has been selected to be developed following hydrogeological and geotechnical studies and as it:

- is near existing infrastructure
- is of suitable size and mineral quality
- can benefit from knowledge gained by mining adjacent sections of the CID
- can be developed without significant impact to the local creek system
- can be effectively managed under existing arrangements for the Yandi JC operation.

The JSW deposit was originally subject to uncertainties around the capacity to mine where the orebody is co-located with the surface creek.

1.7 BENEFITS OF PROPOSAL

Demand for iron ore continues to be strong, particularly from the Asian market. Hamersley's feasibility studies have indicated that this demand, coupled with future projections indicating this demand is expanding, is sufficient to warrant expansion of the Yandicoogina operations. The expansion will result in economic benefits for Australia and Western Australia through:

- contributing to the value of mineral exports
- royalties and taxation payments
- capital investment
- increasing direct and indirect employment opportunities in the region
- increasing demand for goods and services supporting the regional economy.

The ongoing activities of Hamersley will continue to support towns in the Pilbara region. Hamersley originally built the Pilbara towns of Dampier (1966), Tom Price (1966) and Paraburdoo (1971) to support its operations. In addition, Hamersley made a significant contribution to the development of Karratha.

Hamersley will continue to support a variety of community groups and public projects in WA through the WA Rio Tinto Future Fund, Partnership Programs and the Pilbara Donations Committees.

Town of Dampier 2003

Hamersley continues to support its Aboriginal Training and Liaison Unit (ATAL). Established in 1992, ATAL is based in Dampier and is responsible for helping Aboriginal communities maintain traditions and structures of cultural significance. Examples include support for lore and culture activities, support for oral history recording projects, help to establish traditional artefact and art enterprises and support for cross cultural enterprises.

In regards to specific environmental benefits of the Yandi JSE project proceeding, Hamersley has committed to:

- undertaking control of weed species in creek lines of the Marillana Creek system focussing on Hamersley's operational area
- continuing to support research programs by the Ecosystems Research Group of the University of Western Australia in assessing plant-water relationships and developing better predictive models of drawdown impacts in the Pilbara
- continuing to support research into the distribution and taxonomy of stygofauna
- continuing research into predicting and managing water quality in pit lakes.

1.8 PURPOSE AND SCOPE OF THIS DOCUMENT

The purpose of this document is to present an environmental review of the construction and operation of the principal components of the proposal, namely the open cut mine and associated infrastructure at the Yandi JSE mine, in the form of an Environmental Protection Statement (EPS).

1.9 STRUCTURE OF THIS DOCUMENT

The document is structured as follows:

Introduction and background

- Background to the Hamersley Yandicoogina Mine Operations
- Approvals history
- Environmental impact assessment process

Overview of existing environment

Description of the proposal

Environmental review of the proposal

- Stakeholder consultation
- Factor by factor environmental impact assessment and mitigation

Environmental Management

- Outline of the Yandicoogina environmental management program
- Proponent commitments

1.10 ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The EPS was prepared in accordance with Administrative Procedures for environmental assessment prescribed under the EP Act. Figure 3 outlines the process for an EPS level of assessment.

Hamersley initiated the EPS[1] process by referring the proposal to the EPA on 21 September 2004. The EPA notification of its intention to assess the proposal at the level of EPS was made in *The West Australian* on 11 October 2004. After the notification of intent to assess the proposal as an EPS, the proponent prepared the EPS documentation in consultation with stakeholders and other interested parties. Once the report had been finalised it was submitted to the EPA.

[1] The EPS level of assessment is applied typically to proposals of local interest that raise a number of significant environmental factors which can be readily managed. It is also applied when it is considered that Ministerial Conditions are required to ensure the environmental conditions under Part IV of the EP Act are required to ensure the proposal is implemented and managed in an environmentally acceptable manner and where the EPA considers a formal public review period may not be necessary because the proponent has adequately consulted with stakeholders.

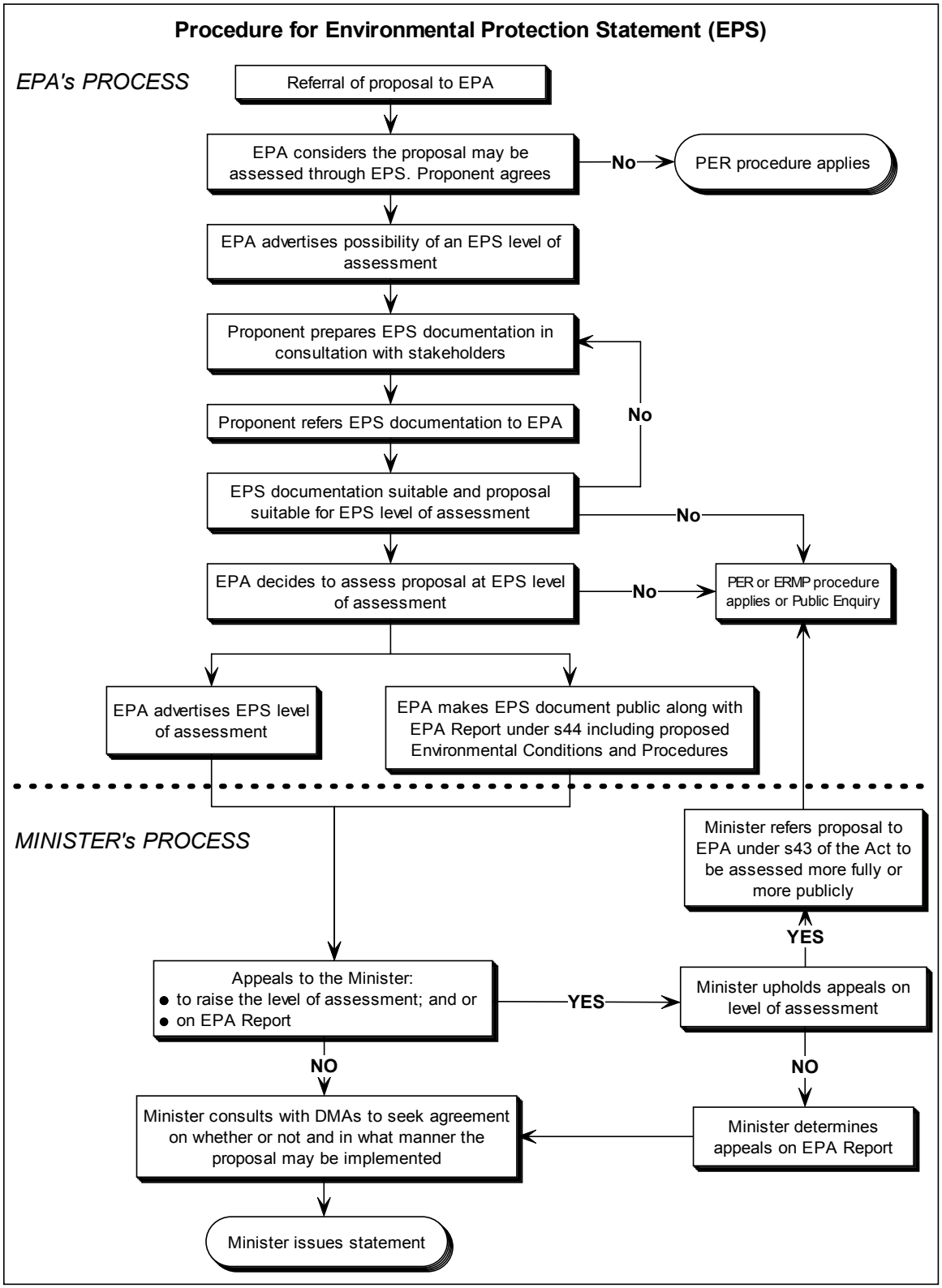


Figure 3 EPS process

The remaining part of the process involves the EPA setting the level of assessment as EPS and releasing the EPA report under section 44 of the EP Act. This includes the conditions and procedures that it considers should be applied to the proposal. The EPA advertises the EPS level of assessment and the availability of the EPA report. The completed EPS is also made available to the public as required by the EPA.

The intent of the EPS process is to require considerable upfront investigation and community consultation to resolve any environmental issues prior to the release of the EPS. The proponent has therefore consulted with Government agencies and other relevant stakeholders as part of the EPS (see Section 4.2 for details of consultation).

To ensure that an EPS level of assessment is appropriate, the EPS document must demonstrate to the EPA that certain criteria have been met. These are:

- the community, key stakeholders and Government agencies have been adequately consulted and their views taken into account
- all necessary studies have been carried out in a competent manner
- results of the studies have been incorporated into the design and intended operation and management of the proposal
- proposal conforms with applicable environmental guidelines, policies, standards and procedures
- required environmental factors have been adequately addressed
- appropriate environmental commitments have been made.

1.11 RELEVANT LEGISLATION AND POLICY

The Yandi JSE proposal will take into consideration and adhere to requirements of all applicable legislation and regulations associated with that legislation. Legislative requirements for Yandi JC are implemented via the Pilbara Iron Environmental Management System (IEMS). This will be extended to include Yandi JSE. In addition to the Agreement Act and the EP Act, applicable State legislation includes:

- *Aboriginal Heritage Act 1972*
- *Agriculture and Related Resources Protection Act 1976*
- *Building Regulations 1989*
- *Bush Fires Act 1954*
- *Conservation and Land Management Act 1984*
- *Dangerous Goods Regulations 1992*
- *Dangerous Goods (Transport Act) 1998*
- *Environmental Protection Regulations 1987*
- *Explosives and Dangerous Goods Act 1961*
- *Health Act (and Regulations) 1911*
- *Land Administration Act 1997*
- *Local Government Act 1995*

- *Mines Safety and Inspection Act 1995*
- *Mining Act 1978*
- *Occupational Safety and Health Act 1984*
- *Rights in Water and Irrigation Act 1945 –1982*
- *Waterways Conservation Act 1976*
- *Wildlife Conservation Act 1950.*

Relevant Western Australian policy and strategies

In addition to existing legislation, the following government agency strategies and policies are of relevance to the environmental assessment and management of this proposal:

- Western Australia State Sustainability Strategy
- Draft Greenhouse Strategy for Western Australia 2003
- 1987 State Conservation Strategy
- EPA Red Book recommendations for Conservation Reserves of Western Australia
- State Water Quality Management Strategy.

Commonwealth legislation and policy

The Yandi JSE proposal will not require approval under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) as the proposal does not significantly impact any matters of national environmental significance[2].

Commonwealth policies and legislation applicable to the proposal include:

- *Aboriginal and Torres Straight Islander Heritage Protection Act 1984* (which operates concurrently with any existing State laws in so far as those laws would not be consistent with this Act)
- *Australian Heritage Commission Act 1975*
- *Native Title Act 1993*
- *Renewable Energy (Electricity) Act 2000* and the *Renewable Energy (Electricity) Regulations 2001*
- Efficiency Standards for Power Generation
- Energy Efficiency Best Practice Program
- The Greenhouse Challenge.

[2] Matters of national environmental significance include World Heritage properties, Ramsar wetlands, nationally threatened species and ecological communities, migratory species, Commonwealth marine areas and nuclear actions.

The following national strategies may also be relevant to the proposal:

- National Strategy for Ecologically Sustainable Development
- Intergovernmental Agreement on the Environment
- National Greenhouse Strategy
- National Conservation Strategy for Australia
- National Strategy for Conservation of Australia's Biological Diversity.

International agreements or treaties and national agreements and policies that may directly or indirectly affect this project include:

- Montreal Protocol on Substances that Deplete Ozone
- Convention on Biodiversity
- United Nations Framework Convention on Climate Change and Kyoto Protocol (although not ratified by Australia).

2. OVERVIEW OF EXISTING ENVIRONMENT

2.1 PHYSICAL ENVIRONMENT

2.1.1 Climate

Rainfall in the area is highly variable and results from both cyclonic and thunderstorm activity with about 55% of rain falling in January to March. The mean monthly rainfall at Yandicoogina varies between 128 mm in February to less than 5 mm in August (no rainfall recorded for September during monitoring period of 1998-2003) with an average of 41 rain days each year (Figure 4).

The Bureau of Meteorology information on climate change shows that the region has experienced a five to 10 mm increase in rainfall per ten years according to data from 1900 to 2003.

The mean temperatures during the year range from 31.1^{0}C in January to 16.0^{0}C in July (Figure 5). Annual potential evaporation is estimated at 3600 to 4800 mm, well in excess of annual rainfall.

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

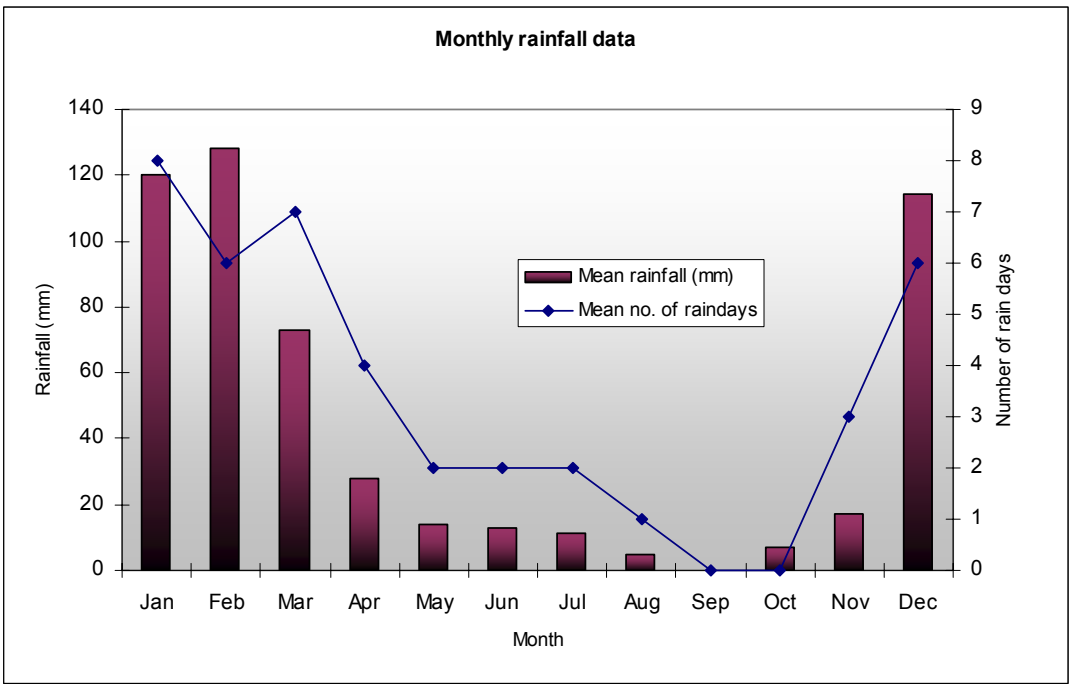


Figure 4 Mean monthly rainfall data from the Hamersley Yandicoogina operation weather station (1998-2003)

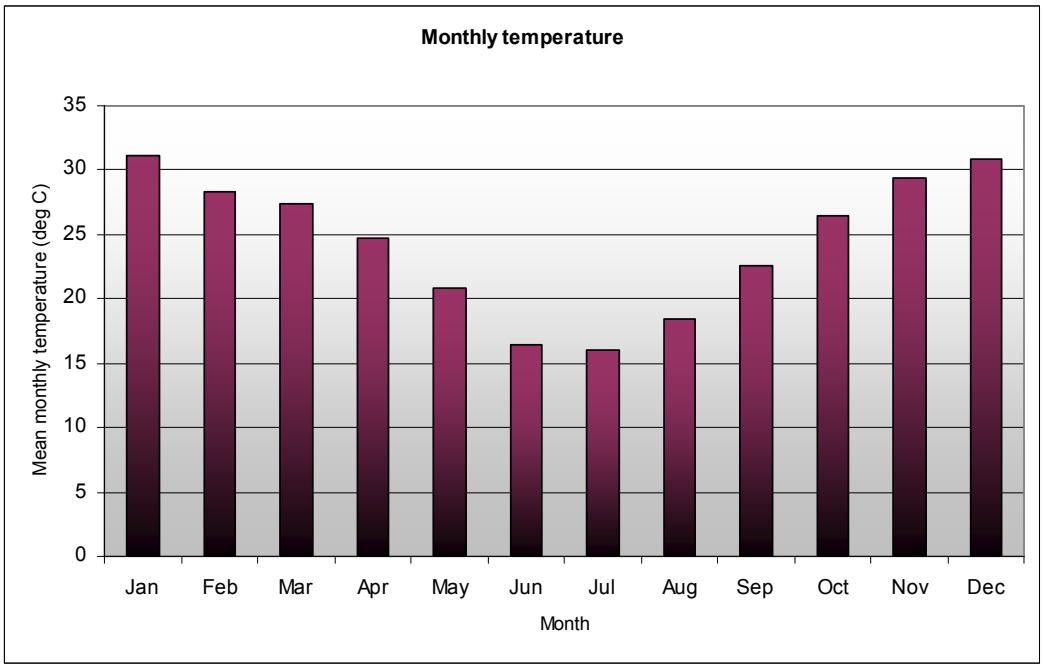


Figure 5 Mean monthly temperature from the Hamersley Yandicoogina operation weather station (1998-2003)

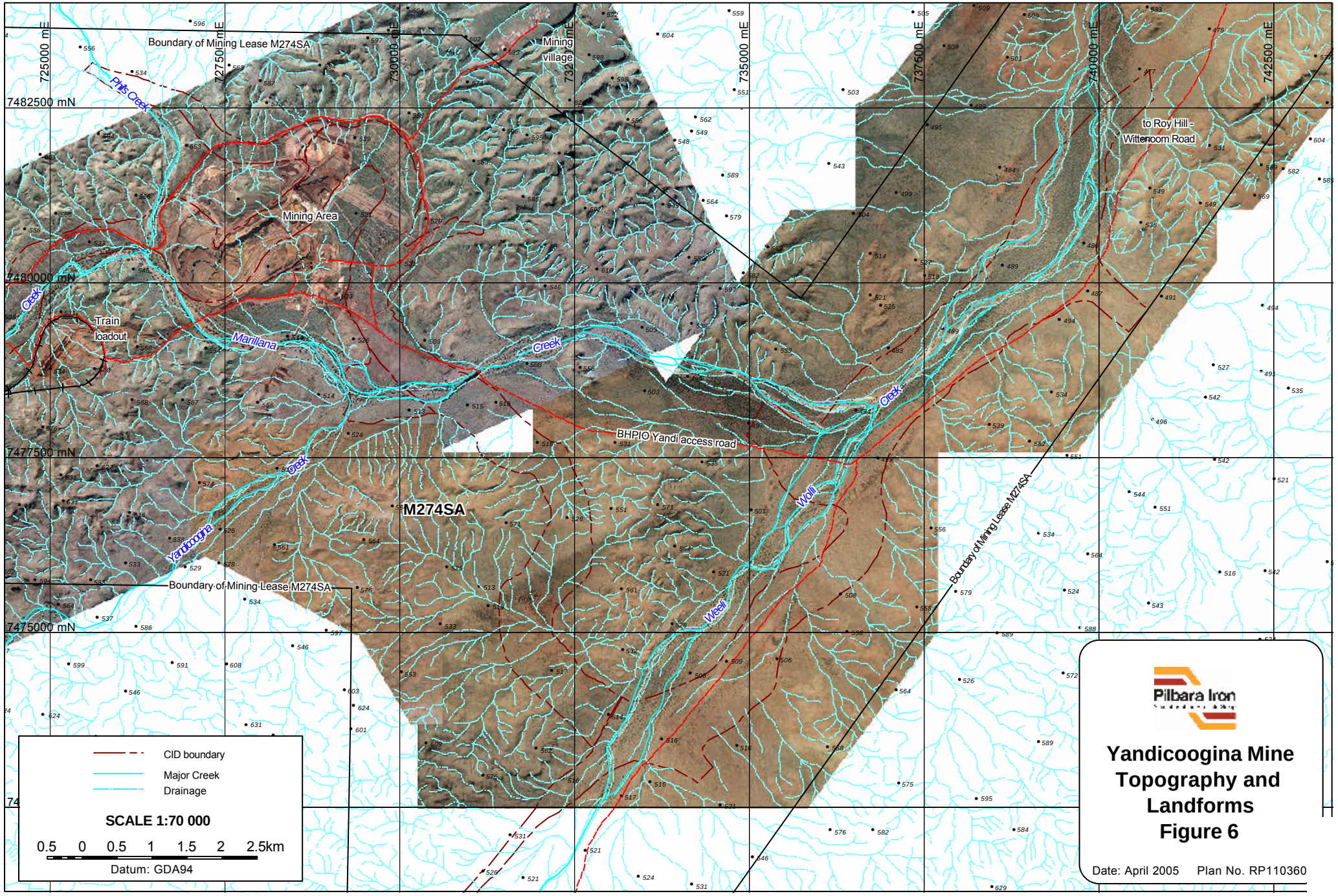
2.1.2 Topography and surface drainage

The channel iron deposit (CID) lies in the central part of a broad, east-trending drainage basin with the Hamersley Range to the north and an un-named range to the south. The CID outcrops as a series of flat-lying mesas above the surrounding alluvial plain. The current topography near Yandicoogina has been shaped by alluvial processes (Figure 6).

The CID is roughly aligned with the present day Marillana Creek which enters the Yandicoogina Creek before feeding into the Weeli Wolli Creek (Figure 7). The Marillana and Weeli Wolli Creeks, both of which are ephemeral (seasonal flow) have catchment areas of 2250 km^2 and 1750 km^2 respectively, above their confluence. In the vicinity of Hamersley's Yandicoogina operations, a smaller creek system (Phil's Creek) drains into Marillana Creek just upstream of the Marillana-Yandicoogina confluence. There is also a dense network of drainage lines formed by erosion from high intensity rainfall on the sparse vegetation cover and shallow soils (Figure 6) – there is little sheet flow drainage within the Yandicoogina area. All surface drainage in the area eventually feeds into the Fortescue River system north of the Hamersley Range.

Streamflow is completely dependent on rainfall and in normal circumstances streams are dry for most of the year, except for occasional pools.

Landform and surface drainage is further described in Sections 6.1 and 8.1.



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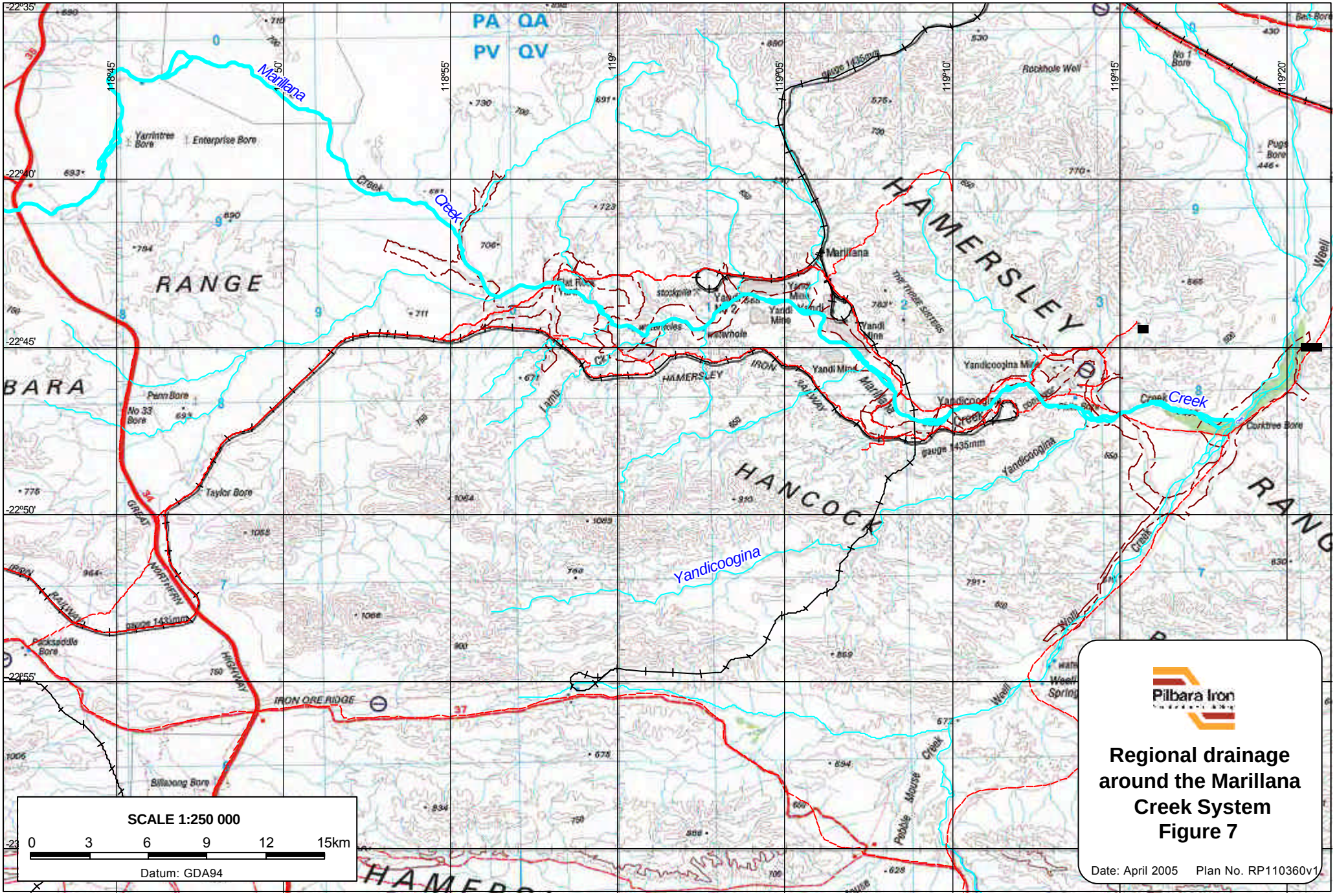

250k Raster topography supplied by Geoscience Australia

2.1.3 Local geology

The CID has formed in a channel eroded into a bedrock of shale, dolerite and banded iron formation of the Weeli Wolli Formation which overlies the Brockman Iron Formation. The regional bedrock contains the broad easterly-trending Yandicoogina syncline[3]. The syncline is bounded by the Lower Proterozoic Brockman Iron Formation which forms the scarp of the Hamersley Range to the north (BHP Iron Ore 1995).

The CID infills the palaeochannels of the ancestral equivalents of the Marillana and Yandicoogina Creek system and was deposited during the Tertiary Period some sixty five million years ago. The deposit averages 500 m wide and is approximately 45-50 m thick (Hamersley 1995). The CID is mostly below the watertable and is overlain with detrital, laterite or weathered material, however it outcrops along some parts of the JSE section. The deposit is composed of pisoliths (pea stones) cemented by a goethic matrix; typically the pisoliths have haematite cores and goethitic rims.

Alluvial deposits along the present day creeklines are generally about 50 m wide and up to 10 m deep (Hamersley Iron 1995). The top two metres has very coarse sediments with lower sections composed of silts and clays.

2.1.4 Hydrogeology

Groundwater occurs in the alluvial creek bed deposits, the CID and the underlying Weeli Wolli Formation and Brockman Iron Formation (basement rocks). The CID is the major aquifer in the area and provides a conduit for regional groundwater movement in a generally easterly direction. Average hydraulic gradients within the aquifer are around 1.5 m/km with approximately 2500 to 3000 m^3/day of groundwater flow down many sections of the CID. The basement rocks are generally impermeable and wells in them yield little or no groundwater.

The alluvial deposits in the stream beds are expected to have a much lower hydraulic conductivity than the CID. The alluvial aquifer is particularly significant as it supports significant stands of phreatophytic riverbed vegetation.

Section 7.1 describes the hydrogeology of the project area in more detail.

2.2 BIOLOGICAL ENVIRONMENT

2.2.1 Terrestrial vegetation and flora

The vegetation of the Yandi JSE area is typical of the Central Pilbara comprising of spinifex hummock grasslands on low stony hills and ranges, with open Eucalypt woodlands and *Acacia* shrublands over spinifex on plains, and Eucalypt woodlands in major creeks (Biota 2004a).

Vegetation of the Central Pilbara

[3] A fold in the bedrock that is concave upwards.

These vegetation types fall into three main vegetation groups, related to topography:

- **Low stony hills**

  Low stony hills generally comprise a scattered overstorey of Eucalypts and Acacias over moderately dense spinifex.

- **Valleys (Mosaic communities)**

  Undulating low stony plains in valleys typically comprise Bloodwoods over sparse mixed shrubs and spinifex. Alluvial flats are dominated by *Acacia* communities over a moderately rich understorey of shrubs, herbs and tussock grasses.

- **Creeks**

  Drainage lines vary from small gullies in upper hills to more major creeklines. Minor drainage lines differ very little from the vegetation type surrounding them and are usually species poor. Major creeklines comprise typically of woodlands and forests of Eucalypts and other tree species over mixed understorey of shrubs and grasses.

Section 9 contains a more detailed description of the vegetation and flora of the Yandi JSE area that are potentially affected by the proposal.

2.2.2 Terrestrial fauna

The fauna of the area are relatively well known through a series of recent biological surveys undertaken for proposed resource developments (Biota 2004b). Most terrestrial fauna species known to or expected to occur in the Yandi JSE area are widely distributed throughout the Pilbara and the Eyrean Subregion. The fauna is typified by arid-adapted vertebrates with a number of wide ranging species, especially birds, whose distribution extends beyond the Eyrean Subregion.

A recent desktop review indicated 70 species of birds, 3 species of amphibians, 56 species of reptiles, and 13 native mammals as occurring within the general area of the Yandi JSE project (Biota 2004b). Of these, one reptile, one mammal and four bird species are declared as Rare, Threatened or Vulnerable in State and/or Commonwealth legislation (Section 10.1.1).

Major fauna habitats correspond to the three main vegetation groups described in Section 2.2.1. Refer to Section 10 for a detailed description of the fauna of the Yandi JSE area.

2.2.3 Subterranean biota

Most stygofauna[4] species recorded as occurring from wells within the Yandi JSE project area have been recorded elsewhere in the Yandi JC operational area and the region.

[4] The term stygofauna is used in this report in reference to stygobites: obligate groundwater-dwelling, aquatic fauna (Biota 2005).

The abundance and diversity of stygofauna from the Yandicoogina area is considerable with seven higher-level taxa having been recorded (Biota 2005):

- Amphipoda
- Copepoda
- Hydracarina
- Isopoda
- Ostracoda
- Oligochaeta
- Platyhelminthes.

Section 10.1.5 contains a more detailed description of the stygofauna of the Yandi JSE project area.

2.3 SOCIAL ENVIRONMENT

2.3.1 Local government

Yandicoogina is within the Shire of East Pilbara (Figure 2). Other main Pilbara regional centres are Tom Price, Paraburdoo, Roebourne, Karratha and Port Hedland. These centres provide services to the pastoral, natural gas, salt, iron ore and other mining industries within the Pilbara.

2.3.2 Surrounding landuse

Hamersley's Yandicoogina Mine is situated on the Marillana Station pastoral lease, held by a BHPBIO related company. In addition to the traditional use of land by Aboriginal groups, other landuses in the region include tourism, conservation and other mining operations.

Karijini National Park lies approximately 70 km to the west of Hamersley's Yandicoogina operation and Millstream-Chichester National Park approximately 190 km to the north-west (Figure 2).

The nearest mining development is BHPBIO's Yandi operation, located approximately 12 km to the west, upstream of Hamersley's Yandicoogina operation on Marillana Creek. Hamersley and BHPBIO share the existing access road and aerodrome under agreed arrangements.

2.3.3 Aboriginal heritage

Settlements of Aboriginal people are widely dispersed in the Pilbara, largely due to historic factors. The main communities being:

- Youngaleena: 25 km east of Wittenoom
- Wakathuni: 20 km south of Tom Price
- Bellary Springs: 20 km north of Paraburdoo
- Newman
- Roebourne
- Onslow.

Native Title

The Bunjima, Niapaili and Innnawonga language groups lodged a native title claim over the Yandicoogina area in June 1996. The claim is managed by the Gumala Aboriginal Corporation (Gumala).

In March 1997, Hamersley entered into the Yandicoogina Land Use Agreement with the Aboriginal parties which facilitated the granting of tenure for the Yandicoogina Project. The agreement provides benefits to the Aboriginal parties over 20 years for education, training, employment, business and community development.

Archaeological and ethnographic sites

Several archaeological sites have been identified within the Yandicoogina area. Consultation with Aboriginal representatives has indicated that no sites of ethnographic significance are present in the Yandi JSE project area. Refer to Section 11 for a detailed description of Aboriginal heritage values.

2.3.4 European heritage

No sites of European heritage significance are known within the Yandicoogina project area.

3. DESCRIPTION OF PROPOSAL

This section describes the mining and ore processing aspects of the Yandi JSE proposal.

3.1 KEY CHARACTERISTICS OF PROPOSAL

The principal activity of the Yandi JSE project will be crushing and screening of iron ore obtained from an open cut mine in the CID. The arrangement of the Yandi JSE mine and infrastructure in relation to the existing Yandi JC operation is depicted in Figure 8.

The key components of the Yandi JSE proposal are summarised below, with a more detailed description in Section 3.2 and 3.3:

- New mine pit along the CID with attendant waste rock (or low grade) dumps, flood protection levees and diversion drains.
- New access roads and internal mine roads (sealed and unsealed), upgrade and extension of communications systems and extension of the existing High Voltage electricity network.
- Lube and fuelling facility adjacent to the new mine pit connected to the Junction Central fuel facility by an above ground pipeline.
- Two new cluster well fields, plus a sacrificial bore centred in the starter pit to dewater the CID ahead of mining – then various dewatering well fields along the JSE CID during mining with a supply pipeline to Yandi JC and discharge or reinjection infrastructure for excess water. Potable water for the new offices and plant at Yandi JSE will be sourced from dewatering or by a new well. Sump dewatering will be utilised to manage accumulated surface water and groundwater inflows into the base of pit.
- Dry primary/secondary crushing plant with ROM pad, plus administration buildings, plant workshop and carpark.
- Overland conveyor to convey crushed ore from new crushing plant to transfer station on existing overland conveyor system.
- Ford style crossing of Yandicoogina Creek to JC for heavy vehicles, with minor realignment of the existing unsealed road to Newman, plus an emergency light vehicle crossing of Yandicoogina Creek to the west of the orebody alongside the piled bridges for conveyor crossings.

Key components of the proposal are indicated on Figure 8. The key characteristics of the proposal are listed in Table 1.

3.2 DESCRIPTION OF MINING AND PROCESSING OPERATION

3.2.1 Site preparation

Dewatering

Mine dewatering will be required for the Yandi JSE operation as approximately 80% of mining will take place below the natural watertable, as with current operations at Yandi JC. A dewatering regime will be developed for Yandi JSE to progressively drain the ore body ahead of mining, in a similar fashion to that already implemented at Yandi JC. A schematic of the JSE CID and the dewatering operation is included in Section 7.1.

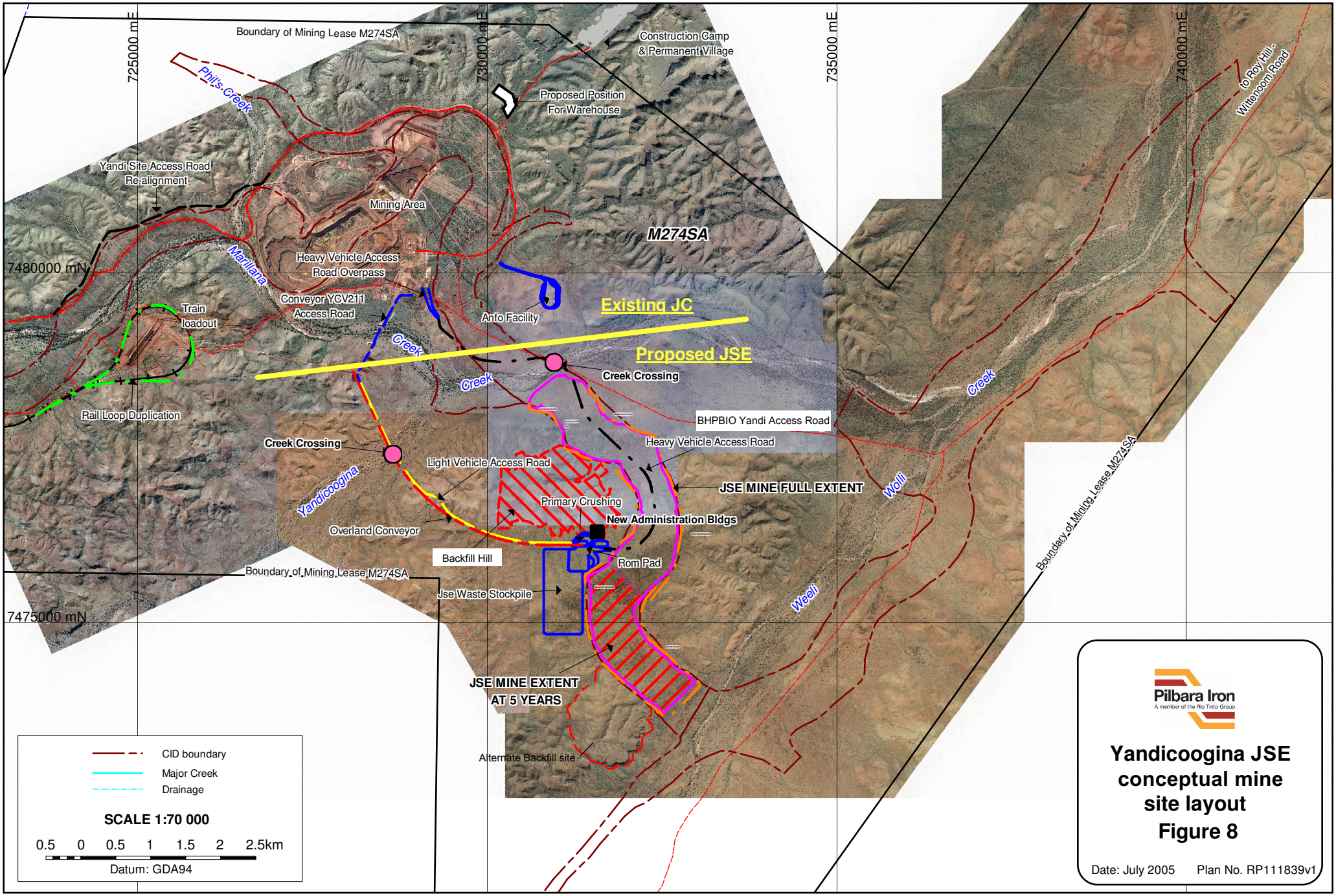

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Table 1 Key characteristics of the Yandi Junction South East Project

Characteristic	Proposal
Land clearing	
Infrastructure (ROM pad, plant, conveyor, roads & miscellaneous)	54 ha
Waste dump	60 ha
Pit (including drains and roads)	395 ha
Backfill Hill (mine void backfill source)	160 ha
Total land clearing	669 ha
Mining	
Length of CID to be mined	5.8 km
Area of CID to be mined	370 ha
Mining rate	To a maximum of 16 Mtpa (total Yandi: JC & JSE = 52 Mtpa)
Ore reserve to be mined	280 Mt
Estimated mine life	16 years (current estimate)
Mine pit profile	About 65 m deep; 40 m below pre-mine watertable
Waste dumps	Waste rock dumps and low grade dumps to be constructed within a 60 ha paddock dump formation
Dewatering requirements	Initial: 27-30 ML/d Maintenance: 15-20 ML/d Sump dewatering (approx. 1ML/d)
Volume of dewater used (Yandi JC and JSE)	Approximately 18 ML/d: ▪ 3 ML/d Yandi JSE (dust suppression and potable use) ▪ 15 ML/d Yandi JC (wet processing plant, dust suppression, potable use)
Number of dewatering wellfields	Initially two clusters of wells and a sacrificial well As mining progresses, three additional cluster wellfields, plus sumps
Closure strategy	Use out of pit waste dumps and ROM pad, plus additional mined fill to backfill the final pit void to at least 490mRL. Rehabilitation of backfilled material to commence once final landforms are constructed and stable.
Proportion of overburden and waste material backfilled (versus out-of-pit)	100% (excluding material for drainage embankments remaining)
Proportion of mine void to be filled with overburden	About 55%
Processing	
Dry primary and secondary crusher capacity	24 Mtpa
Railed ore	up to 16 Mtpa
Infrastructure	
Overland conveyor	Single horizontally curved unit approximately 4 800 m long to convey crushed ore from Yandi JSE crusher facility to the transfer station on the existing overland conveyor
Power	Connected to grid with power supplied by Hamersley's gas-fired power stations at Dampier and Paraburdoo Onsite 8 MW diesel-fired power station will continue to be used for additional power needs during early stages of construction
Water management	Flood protection levees and diversion drains

Characteristic	Proposal
Roads	Three new roads ▪ Light vehicle access road from the transfer point on the current conveyor to the new crusher facility at JSE). ▪ New heavy vehicle mine access road from Yandi JC to Yandi JSE. ▪ Realignment of part of the public access road to Newman to allow bypass of heavy vehicle access road. Internal mine roads as required
Other facilities	Administration buildings, plant workshop and carpark

Abbreviations:

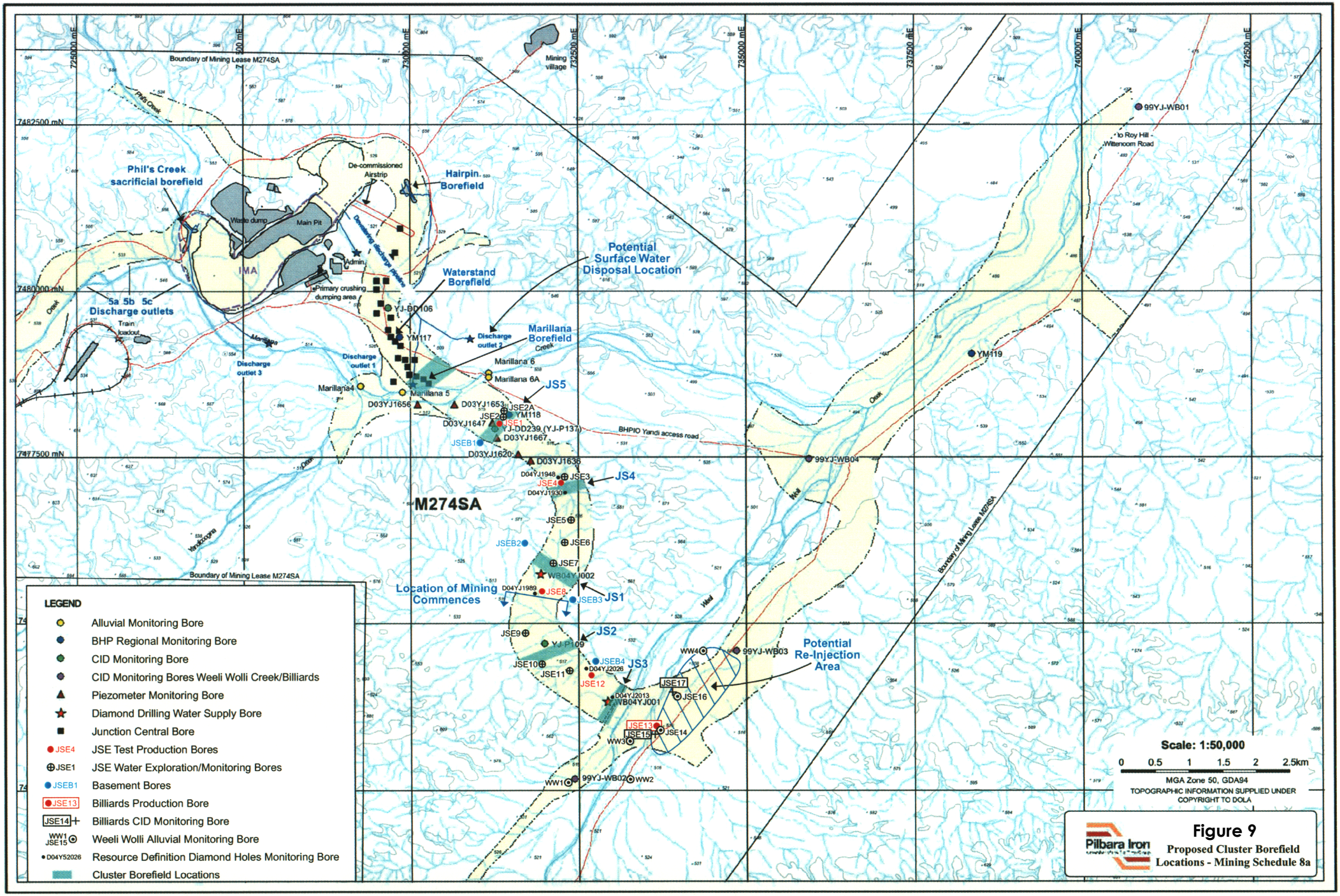
CID	Channel Iron Deposit
ha	Hectares
ML/d	megalitres per day
Mtpa	million tonnes per annum

Dewatering will be carried out by using sacrificial "cluster" wells for the bulk of the dewatering, with some sump dewatering to manage the remnant residual groundwater towards the base of the orebody (Figure 9). Sump pumping also removes surface water accumulation and maintains adequate dewatering during transition periods with wellfield movements.

The dewatering layout will consist of two clusters of wells to the north and south of the initial mining area and a sacrificial well in the central area that will be lost to mining early in the mine life but will assist with the initial rapid dewatering phase. The clusters of wells will either be mined through or isolated by 2010-2012 and three additional cluster wellfields will be required for dewatering late in mine life. A number of dewatering configurations have been examined (Liquid Earth 2005) however the final layout and locations of the wells are dependent on the final mining plan and schedule.

Surplus water from dewatering that cannot be utilised by Yandi JC or JSE operations will be discharged to the local creek system around the current discharge sites (Figure 9) or reinjected back into the aquifer. It is likely that at least a large portion of the water from the Yandi JC-JSE operation dewatering will be discharged into Marillana Creek, as happens at present. The discharge locally saturates the creek bed alluvium and some infiltrates and locally recharges the CID aquifer while the remainder proceeds down the Marillana Creek alluvium or evaporates. The quantity of discharge will be reduced upon commissioning of the wet processing plant, which will use some of the dewatering water for ore processing. To reduce the volume of water to be discharged into the creek, Hamersley is undertaking investigations to determine whether re-injection into the downstream CID aquifer is a practical alternative. These options are described in Section 7.4.2.

Dewatering, use and disposal of water for Yandi JSE and JC will be managed as a single system.


Boundary of Mining Lease M274SA
Mining village
725000 mE
730000 mE
732500 mE
735000 mE
737500 mE
740000 mE
742500 mE
7482500 mN
7480000 mN
7477500 mN
Phil's Creek sacrificial borefield
De-commissioned Airstrip
Hairpin Borefield
Waste dump
Main Pit
Dewatering discharge pipeline
Admin
IMA
Primary crushing dumping area
Waterstand Borefield
Potential Surface Water Disposal Location
5a 5b 5c Discharge outlets
Train loadout
YJ-DD106
YM117
Discharge outlet 2
Marillana Borefield
Discharge outlet 1
Discharge outlet 3
Marillana 6
Marillana 6A
JS5
Marillana4
Marillana 5
D03YJ1656
D03YJ1653
JSE2A
JSE2B
YM118
D03YJ1647
JSE1
YJ-DD239 (YJ-P137)
D03YJ1667
JSEB1
D03YJ1620
BHPIO Yandi access road
99YJ-WB01
to Roy Hill - Wittenoom Road
YM119
99YJ-WB04
D03YJ1636
D04YJ1948
JSE3
JS4
JSE4
D04YJ1930
M274SA
JSE5
JSE6
JSEB2
JSE7
WB04YJ002
D04YJ1989
JSE8
JSEB3
JS1
Location of Mining Commences
JSE9
JS2
YJ-P109
JSEB4
JS3
JSE10
JSE11
D04YJ2026
JSE12
D04YJ2013
WB04YJ001
JSE17
JSE16
WW4
99YJ-WB03
Potential Re-Injection Area
JSE13
JSE15
JSE14
WW3
WW1
99YJ-WB02
WW2
Boundary of Mining Lease M274SA
Scale: 1:50,000
0 0.5 1 1.5 2 2.5km
MGA Zone 50, GDA94
TOPOGRAPHIC INFORMATION SUPPLIED UNDER COPYRIGHT TO DOLA
LEGEND
Alluvial Monitoring Bore
BHP Regional Monitoring Bore
CID Monitoring Bore
CID Monitoring Bores Weeli Wolli Creek/Billiards
Piezometer Monitoring Bore
Diamond Drilling Water Supply Bore
Junction Central Bore
JSE4 JSE Test Production Bores
JSE1 JSE Water Exploration/Monitoring Bores
JSEB1 Basement Bores
JSE13 Billiards Production Bore
JSE14 Billiards CID Monitoring Bore
WW1 JSE15 Weeli Wolli Alluvial Monitoring Bore
D04Y52026 Resource Definition Diamond Holes Monitoring Bore
Cluster Borefield Locations
Pilbara Iron
Figure 9
Proposed Cluster Borefield Locations - Mining Schedule 8a

Clearing and earthworks

Vegetation and topsoil are removed ahead of mining. The removed vegetation and topsoil are either used immediately in rehabilitation of disturbed areas or post-mining landforms over the CID or stockpiled for later use. It is likely that topsoil stockpiles may eventually cover a number of hectares within the disturbance footprint.

Constructing the expanded stockpile area at Yandi JC

Overburden and waste material, which is generally up to 10 m deep, is removed and dumped in the mine void as backfill or stored at the waste rock dump until it can be returned to the mine void. Removal of overburden does not normally require ripping or blasting. Waste stripped from the initial development of the JSE mine area will be used in construction (e.g. flood protection levees, ROM pads).

Drainage

Surface drainage will be controlled by the establishment of levees and drains around the mine pit and the processing facilities. The indicative locations of these features are shown in Figure 8. The levees and drains will be constructed in a similar fashion to those already in place at the Yandi JC mine. Overburden from the pre-strip works in advance of mining will be used to construct the levees.

3.2.2 Mining operations

The Yandi JSE mining operation will essentially be the same as for existing operations at Yandi JC that utilise conventional drill and blast, load and haul methods. To achieve appropriate ore blending, several mine faces will be worked simultaneously and the JSE product mixed with JC ore.

The mining operation involves blast hole drilling and blasting with the resultant material loaded into haul trucks which transport the material along haul roads to the ROM pad and crusher facility – if crusher feed, or to the waste or low-grade stockpile if not. Low grade ore will be stockpiled for blending with high grade ore and where ore is of high clay content it will be hauled to the wet plant at the Yandi JC mine for processing.

As a precautionary measure to protect the hydrogeological integrity of the Marillana-Yandicoogina and Weeli Wolli Creek systems and to avoid encroachment into areas of significance to local Aboriginal people, mine planning for the Yandi JSE mine has allowed a 200 m offset between the mine pit and these major creeks. Should subsequent investigations and negotiation confirm that a lesser separation can provide the same protection for these values, this distance may be reduced. The remainder of this document uses 200 m as the arbitrary offset.

3.2.3 Ore handling and processing

Crushing

Haul trucks will transport Run of Mine (ROM) material to a crusher facility to be constructed alongside the Yandi JSE pit (Figure 8). The facility will consist of a primary and secondary crusher to produce material of a size less than 75 mm.

Tertiary crushing and screening of the 75 mm material will occur at the existing infrastructure (currently undergoing expansion) within the rail loop, to produce a final product with a minus 10 mm size specification. This facility is not part of the Yandi JSE proposal.

Transport

A new overland conveying system will be constructed to transport secondary crushed material from the crushing facility at the Yandi JSE mine to the tail end of the existing overland conveyor servicing the Yandi JC mine (Figure 8).

The conveyor will be installed as a single horizontally curved unit thereby eliminating the need for a transfer station. The conveyor will be fed from an inline feed chute and will discharge into a surge bin at the transfer station on the existing overland conveyor. Dust covers will be fitted to the length of the conveyor to minimise dust generation and product saturation during rain events.

Existing overland conveyor

Wet plant

A wet processing plant has been constructed recently at the existing Yandi JC mine to process ore with a high clay content. It is not anticipated that ore from the JSE CID will require processing via the wet plant, however if low grade ore is encountered during mining of the JSE CID it will be hauled to the wet plant for processing. The wet plant is part of the existing Yandi JC operation and does not form part of the Yandi JSE project.

3.3 SUPPORT INFRASTRUCTURE REQUIRED

Power

Power requirements at Yandicoogina are sourced from the Hamersley gas-fired power station located in Dampier. The Yandi JSE project will upgrade the high voltage take-off facilities at Yandi JC and install infrastructure to connect that power supply to the JSE site and plant. Once commissioned, Hamersley's upgraded Paraburdoo gas-fired power station will supplement the grid supply. An onsite diesel-fired generator at Yandi JC currently operates at up to 8 MW supplying top up power during peak demand periods in the present construction phase at that site. This station will continue to operate intermittently during the initial construction phases of the Yandi JSE mine to provide additional power requirements. Mobile, skid-mounted generators will be required to power new well fields until power is reticulated to these areas.

Water use

The proposed water distribution at Yandi JSE is shown in Figure 10. As well as using dewatering product as far as possible on site for potable, cleaning and dust suppression requirements, there will be a capacity to send water from Yandi JSE to supply Yandi JC should that operation be unable to meet demand from its dewatering. It is intended to use dewatering as a potable supply for Yandi JSE. Should that be impractical due to health or other reasons, a dedicated production well(s) could be

developed for potable water at the new offices and plant at Yandi JSE. Both dewatering and any potable borefields will be subject to licensing by DoE.

A preliminary water balance model has been developed for the entire Yandicoogina operation, including the proposed Yandi JSE project, using the *Goldsim* model package (Liquid Earth 2005). The forecast water balance, which assumes the 'wet processing' plant at Yandi JC operates for the life of mine, indicates disposal of surplus water is required until 2015 (Figure 11). Beyond 2015, the operations may potentially have a process water shortfall. Careful management of the well fields will be required to ensure that abstraction is minimised within the constraints of dewatering requirements, to ensure that after 2014 there is sufficient water supply to meet wet and dry processing requirements. The water balance model will continue to be refined.

Waste management

The existing landfill site will function satisfactorily to include solid waste from the Yandi JSE project.

Administration and workshop buildings at Yandi JSE may require a new sewage treatment facility to be appropriately licensed, should its capacity exceed 10 m^3/d.

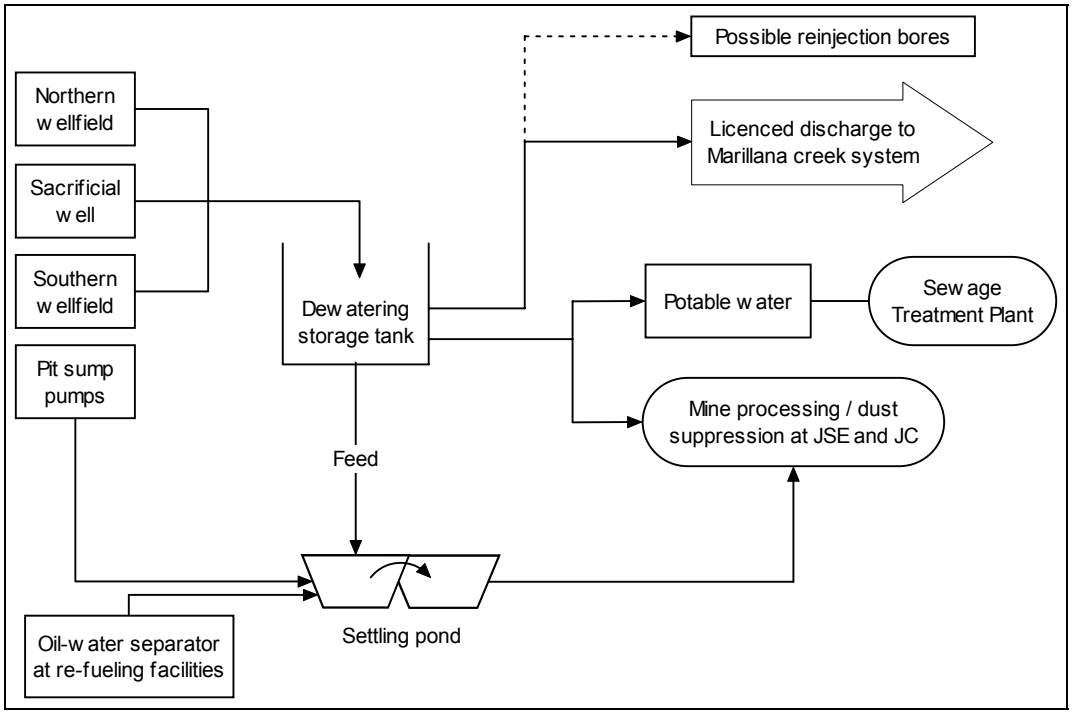


Figure 10 Proposed water distribution at Yandicoogina operation

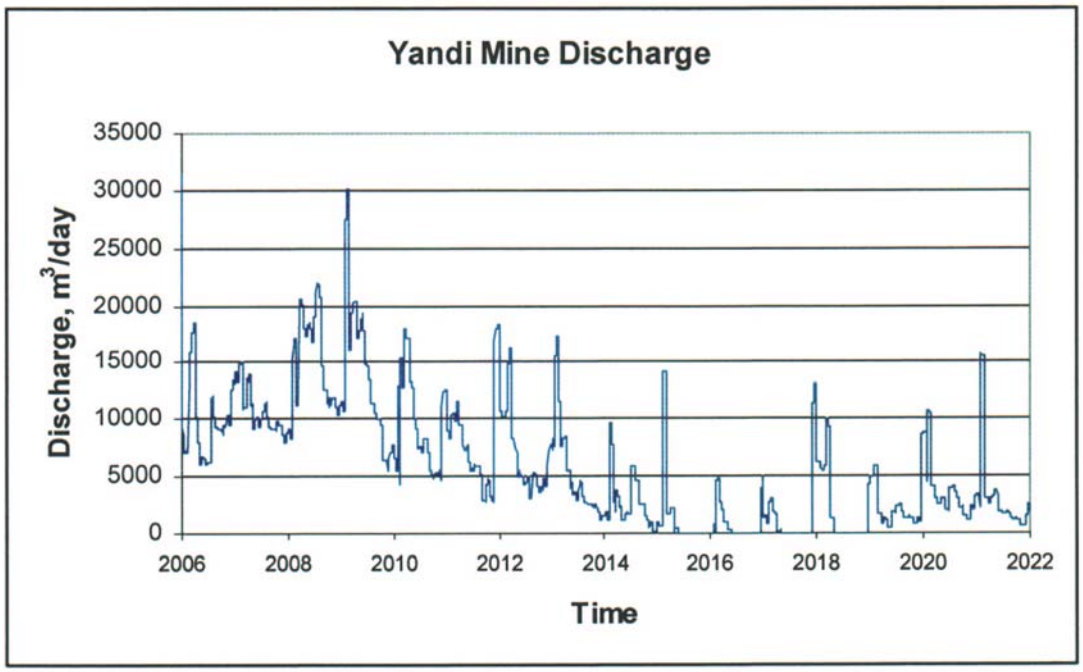


Figure 11 Predicted surplus water from combined Hamersley Yandicoogina operations

Access roads

The principal internal access roads (new or upgrade of existing) that will be required for the Yandi JSE operation include:

- new overland conveyor maintenance and crusher facility light vehicle access road from the transfer point on the current conveyor to the new crusher facility at Yandi JSE. The light vehicle track will use the conveyor bridge and a ford-style crossing to cross Yandicoogina Creek
- new heavy vehicle mine access road to allow mine fleet vehicles to move between Yandi JC and JSE
- realignment of part of the public access road to Newman to the east of its present location to avoid the new heavy vehicle road.

Other access roads to be upgraded as part of expansion of existing infrastructure include the road running from the existing conveyor transfer point to the tertiary crushing facility.

Mine roads

There will be internal mine roads developed in and alongside the Yandi JSE pit that will change in alignment and number as required.

3.4 PERSONNEL AND ACCOMMODATION

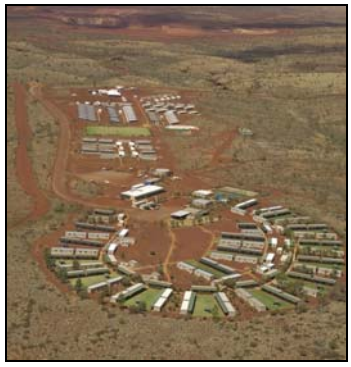
Currently, approximately 326 personnel are employed for the current Yandi JC mine operation. Personnel work on a fly in-fly out basis from Perth (WA) or from where the personnel are recruited.

Another 264 personnel will be required for Yandi JSE for ongoing operation and an additional 42 for restructuring and support personnel.

All operation personnel are housed at the permanent village. The permanent village has been designed and constructed to be sympathetic in height and appearance to the surrounding landscape. The original siting of the mine village was designed to provide an outlook which fosters an appreciation of the Pilbara landscape amongst workers. The village will require an expansion of facilities to accommodate the expected increase in personnel.

A temporary construction workforce of up to 500 contractors will be required for the construction of the expanded mining operation and associated infrastructure at Yandicoogina. An accommodation camp has been established for construction personnel.

The permanent village and construction camp are both part of the existing mining operation and their expansion has been assessed separately from the Yandi JSE proposal.



Yandicoogina Village

Yandicoogina Construction Camp 2003

4. STAKEHOLDER CONSULTATION

4.1 PREVIOUS CONSULTATION

There has been substantial stakeholder consultation and public review of the Yandicoogina operation as part of previous environmental approval processes.

The environmental impact assessment of the initial Yandi JC proposal was undertaken at the level of assessment of Consultative Environmental Review (CER). In addition to consultation undertaken during the preparation of the CER document, the assessment process included a four week public review, during which submissions were invited from interested members of the public. Similarly, the s46 Environmental Review was also subject to a four week public review period.

Targeted consultation with key stakeholders has continued during the operation of the mine, particularly when minor changes to the operation have been proposed.

4.2 CONSULTATION UNDERTAKEN FOR EPS

Key agencies have been actively consulted during the preparation of the EPS, including:

- Environmental Protection Authority Services Unit (EPASU)
- Department of Environment (DoE) – Northwest regional office and water specialists based in Perth
- Department of Conservation and Land Management (CALM) – Pilbara Regional and Science offices.

Non-government organisations (NGOs) considered key stakeholders and consulted during the preparation of the EPS, were:

- Conservation Council of Western Australia
- Wildflower Society
- Gumala Aboriginal Corporation (Gumala).

Discussions were also held with representatives of companies who operate or have proposed mines with the potential to interact with Yandi JSE. These discussions were used in the assessment of potential cumulative interactions. Companies consulted were:

- BHPBilliton Iron Ore
- Hope Downs.

The main issues raised by stakeholders related to water and closure management, cumulative hydrological impacts from other mining activities in the area, vegetation disturbance and disturbance of Aboriginal heritage values. Table 2 summarises those issues raised by stakeholders during consultation sessions and review of the Draft EPS document and Hamersley's responses to these issues. Although not all comments made by stakeholders during the review of the Draft EPS are shown (Table 2 indicates the key comments only), all feedback was incorporated and the document amended accordingly.

Table 2 Key issues raised during consultation specific to the Yandi JSE proposal

Stakeholder	Consultation(s)	Key issues	Responses
Agencies			
EPA Service Unit	Correspondence, ongoing liaison and briefings	Water discharge not to cause deleterious effects over a large section of creek.	Discharge will only affect small sections of Yandicoogina Creek with flow gradually peaking in 2009 decreasing to no flow by 2015. Hamersley is investigating the feasibility of re-injection of a part of excess dewatering. Addressed in Section 7.4.2, 8.4.2 and 9.4.3.
		Salinisation of mine void lakes.	The mine pit will be backfilled to a level that restricts salinity increases from exposure of surface water to evaporation to within approved targets for nearby mines. Addressed in Section 7.4.4 and 8.4.4.
		Aboriginal heritage management.	Hamersley has entered into a land-use agreement with Gumala which provides for consultation with Aboriginal representatives and heritage management. All heritage sites are managed in accordance with the Aboriginal Heritage Act 1972 and the Yandicoogina Land Use Agreement. Heritage management addressed in Section 11.4.3.
		Mine closure as an integral part of mine planning.	Preliminary investigations into closure issues, particularly water management have already been undertaken (Section 7.4.4 and 12.2) and are the same as the concept currently approved for Yandi JC. Hamersley will prepare a Conceptual Decommissioning and Rehabilitation Plan within 12 months of commissioning, which will address closure issues for both Yandi JSE and JC. The plan will be revised every 5years and finalised at least two years prior to end of mine life (Section 12).
		Consideration of possible environmental offsets.	Hamersley has committed to: ▪ Undertaking control of weed species in creek lines of the Marillana Creek system focussing on Hamersley's operational area (Section 9.4.5) ▪ Continuing to support research programs by the Ecosystems Research Group of the University of Western Australia in assessing plant-water relationships and developing better predictive models of drawdown impacts in the Pilbara (Section 9.4.2) ▪ Continuing to support research into the distribution and taxonomy of stygofauna (Section 10.5)

Stakeholder	Consultation(s)	Key issues	Responses
		Cumulative impacts particularly in terms of groundwater and surface water.	Cumulative dewater discharge impacts assessed based on other mining operations environmental approvals. Addressed in Section 7.4.2 and 8.4.2.
		Consistency with the WA State Water Quality Management Strategy.	The management of water resources is focussed on protecting creeklines from adverse impacts and minimising the resource use. Discharge water quality will be similar to most surface waters and acceptable for discharge to the creek system.
		Potential impacts of climate change on rehabilitation.	Long term climate change will equally affect rehabilitation areas and existing natural vegetation. It is not considered appropriate to select plant species that are not typical of the existing vegetation. Addressed in Section 12.2.3.
		Knowledge of short-range endemic invertebrate fauna is poor.	The intent of the short-range endemic fauna survey was agreed with CALM and EPASU officers to be provision of further information to the knowledge base of these species. It is envisaged that further research by government agencies and private industry will eventually provide the taxonomic and distributional information required to allow assessment of conservation significance of these species. Addressed in Section 10.4.1 and 10.5.
		The significance of the invertebrate fauna needs to be progressed.	As above.
		Timing and adequacy of biological surveys.	Given that the biota of this area are relatively well known on the basis of previous work, surveys were undertaken during optimal season (timing) and are considered to be adequate despite recent fires. Surveys also build upon previous surveys in the region. Addressed in Section 9.1.5.
		Comprehensive consultation with relevant stakeholders including non-government organisations (e.g. Pilbara Native Title Service, Wildflower Society, Conservation Council).	Targeted consultation of relevant stakeholders conducted during preparation of EPS. See below.
		Vegetation and flora survey to be in accordance with EPA Guidance Statement 51.	Vegetation and flora survey conducted in accordance with EPA Guidance Statement 51. See Section 9.1.
		Significant limitations that effects interpretation of vegetation and flora data need to be listed.	Survey limitations described in Section 9.1.5.

Stakeholder	Consultation(s)	Key issues	Responses
		Need to indicate why the vertebrate fauna survey was conducted as a level 1 survey and how it varies from the requirements set out in EPA Guidance Statement 56.	Vertebrate fauna of the area have been thoroughly surveyed previously by a number of field surveys programs conducted in accordance with EPA Guidance Statement 56 for Hamersley's Yandicoogina and other mines. A desktop review of these past studies against the habitats identified in the flora survey was deemed sufficient for this assessment. The approach was confirmed by CALM regional staff prior to the commencement of the survey. See Section 10.1.
		Areas that could not be surveyed due to the impacts of fire will need to be evaluated prior to construction to determine whether conservation significant species exist within these areas.	The report of the specialist flora consultants undertaking the survey suggests that the prediction of the location of any rare species can be made from habitat type identified. Hamersley's flora survey group will examine the JSE area for rare or priority flora prior to any ground disturbance. See Section 9.5.
		Potential impacts to (and management of) riparian vegetation from reduced groundwater availability associated with mine dewatering and from stoppage of dewatering discharge needs to be addressed.	Hamersley has a riparian tree health monitoring plan that details strategies for monitoring potential impacts of groundwater drawdown. Where monitoring indicates unacceptable dewatering impacts on riparian vegetation, Hamersley's contingency measures include localised recharge and shallow irrigation. Addressed in Section 9.4.2.
		Hamersley to use same approach to establishing completion criteria as BHPBIO	Commitment to amend EMP to include a progressive rehabilitation program including description of process of developing completion criteria. This is consistent with the approach outlined by EPA in their draft conditions (condition 6-1) contained in the EPA Report and Recommendations for the BHPBIO Marillana Creek Life of Mine Proposal (Bulletin 1166, EPA April 2005) Addressed in Section 12.3.5

Stakeholder	Consultation(s)	Key issues	Responses
EPA Service Unit	Review of Draft EPS	It is noted that Backfill Hill, which is a proposed source of backfill, has not yet been surveyed for vegetation, flora, fauna and Aboriginal heritage and culture values. It should be clearly stated in the EPS that if surveys on the hill identify any environmental values, including biological, Aboriginal heritage or landscape, the hill will not be mined and an alternative hill will be sourced. Please identify all options for additional backfill material, including the amount of material to be sourced. Please provide a diagram of Backfill Hill and any other hill proposed to be used as additional backfill material.	Figure 8 has been amended to include the location of Backfill Hill and the alternate hill to the south east of the JSE CID. Section 12.2.2 of the EPS states: "If these criteria [environmental criteria for use of adjacent landforms for backfill as stated in proponent commitments] are not met, a proportion or none of Backfill Hill may be available for use as fill and an alternative hill to the south east of the JSE CID will be used. The environmental and heritage values of this hill are known and the use of it for fill would not compromise the EPA's objectives for flora, fauna and heritage. The use of the alternative hill however represents significant additional haulage cost to the proponent and consequently is not the preferred choice for this purpose." As well as being subject to the environmental criteria stated in the proponent commitments, the use of Backfill Hill (or alternate landform) would also be subject to formal approval of the Decommissioning and Rehabilitation Plan. Approximately 30 million cubic metres of swelled fill is required to be sourced for backfill (Section 12.2.2 of EPS).
		Environmental induction program for construction personnel should be included in the Construction Environmental Management Plan.	Induction requirements for construction personnel are now in the proponent commitment that addresses the CEMP (Section 13.4).
		Detail regarding the aspects that will be addressed in the Construction Environmental Management Plan should be provided under this commitment.	Details regarding the CEMP aspects to be addressed have been added to the proponent commitments.
		The EPA Service Unit notes that the CID is the major aquifer in the area. The impacts on the regional hydrology from mining the CID are not clear, and need to be discussed in more detail in the EPS document.	Section 7 (Groundwater) of the EPS discusses the hydrogeology of the project area, which includes discussion of regional groundwater implications. In summary, regional groundwater is dominated by surface hydrogeology and only localised drawdown of the CID aquifer is expected. The local drawdown effect contours in the CID are presented in Figure 14 of the EPS. Section 8 (Surface water) of the EPS discusses the hydrology of the project area, which includes discussion of surface drainage patterns and diversion structures. In summary, there will be minimal regional impact on hydrology (surface flows) as there will only be localised diversions and no impedance of major flows.

Stakeholder	Consultation(s)	Key issues	Responses
		The referral document dated 21 September 2004 stated that the proposed works included construction of two new sidings on the main rail line. The Draft EPS does not address this activity.	The construction of two new sidings on the main rail line are now not included in the Yandicoogina Junction South East Project and therefore, have not been included in the description of the proposal. The construction of the new sidings is subject to a separate approval process.
		Hamersley is commended on its research into investigating alternative discharge methodologies, including re-injections trials.	Noted.
		The EPA Service Unit notes that the waste fines from the wet processing of iron ore will not be deposited within the mine void at Yandicoogina JSE.	The location for disposal of waste fines from the operation of the wet processing plant at JC will not be affected by the JSE project. Cells for disposal of waste fines will continue to be sited in the JC mined out pit.
		Information is required regarding the two new creek crossings on Yandicoogina Creek. In particular, the potential environmental impacts and proposed management.	Section 8.4.3 of the EPS was amended to clarify the creek crossing requirements and potential impacts.
		The Yandi Expansion Vegetation and Flora Survey report by Biota identified the vegetation along sections of Yandicoogina Creek as regionally significant. Vegetation was identified as being in excellent and moderately good condition, with some weed species at low density. The EPS should discuss what management practices will be put in place to ensure that this riparian vegetation is maintained in good or excellent condition.	The Biota flora report specifically states that there are no flora of 'regional conservation significance' in the project area. The creek flora associations are described as of 'local' or 'subregional' importance. The main threatening process is described as weed infestation. Weeds are spread predominantly by pastoral activities in these areas. Hamersley's EMP currently in place for Yandi JC covers the control of weeds. In addition, Hamersley has committed in the EPS to undertake weed control within Hamersley's operational area targeting weeds degrading creeks.
		The EPS should discuss whether there will be short or long term impacts on downstream ecological systems, particularly the phreatophytic vegetation, as a result of dewatering, groundwater discharge and increased salinity levels.	The potential impacts of groundwater drawdown and their management during operations are covered in Section 9.4.2 and disposal of surplus water in Section 9.4.3. While current planning for closure seeks to limit the local rise in salinity, some vegetation will be subject to salinity levels above those experienced pre-mining. Prediction of the extent of this effect and the best way to manage it will require further research and discussion in the Decommissioning and Rehabilitation Plan.
		The EPS should address the issue of the potential for cumulative environmental impacts of mining in the region. In particular, information needs to be provided on the cumulative impacts on groundwater and surface water from the Hamersley Yandicoogina operation and the adjacent BHP Billiton Iron Ore Yandi mine and Hope Downs mine.	Hamersley's understanding of the cumulative affects of its dewatering for mining are explained in Section 7 of the EPS. Based on information available to Hamersley, the incremental contribution of its dewatering and discharge should not have regional implications. Definitive assessment of regional impacts is best conducted by the responsible government agency which has access to data beyond that available to individual companies.

Stakeholder	Consultation(s)	Key issues	Responses
		These principles should be broadly addressed in the EPS document, either as a separate section or in the discussion of environmental factors: 1. the precautionary principle 2. the principle of intergenerational equity 3. the principle of the conservation of biological diversity and ecological integrity 4. principles relating to improved valuation, pricing and incentive mechanisms 5. the principle of waste minimisation.	These principles are clearly reflected in Hamersley's environmental policy (Section 13.1), Iron Environmental Management System (Section13.2), Environmental Management Program (Section13.3), and the Rio Tinto corporate environmental standards that are implemented across the Rio Tinto Group (Appendix 2)." Addressd in Section 13.
Department of Environment Resource Science Division	Review of Draft EPS	The final EPS document should incorporate the results of the further work being done at present. Specific comment should be included in the EPS confirming that the proposed cluster borefield JS3, just north of Weeli Wolli Creek, has been shown from investigation drilling and boretesting to be feasibly operated without detrimental impact on the Creek and alluvial aquifer.	Hamersley has recently commenced the Feasibility Stage hydrogeological investigation site work. Additional detail on downstream dewatering impacts and the options for incorporating a component of aquifer recharge in JSE water management will be available on completion of prolonged pumping and re-injection trials, scheduled to run from late July to late August 2005. This will be incorporated into the operational EMP as part of the Water Management Plan.
		The EPS should define the expected differences in surface water conditions between the two possible options for the Hope Downs site: 1. The mine does not begin operation. 2. Hope Downs is mined according to that company's current mine proposal.	Options may exist in future to dispose of considerable volumes of water to Weeli Wolli Creek downstream of the junction with the JSE CID. Should the relatively large volume of water planned for discharge during the operations of the Hope Downs mine proceed, it is unlikely that an additional discharge of 5-10 Ml/d from the JSE operation would have perceptible cumulative impacts. Should that operation not proceed, any discharge to this area would need to consider how to avoid disrupting natural surface flows.
		The final EPS should incorporate improved understanding derived from water investigations subsequent to the March hydrogeological report, and from rehabilitation trials and mine operations at Junction Central. The hydraulic separation of the alluvial aquifer from the Junction palaeochannel aquifer, and from the Billards aquifer, needs to be demonstrated conclusively before the JSE3 borefield can be approved.	The timing of the EPS process will not allow improved understanding from the Feasibility Stage hydrogeological investigation work to be incorporated into the EPS document. However, Hamersley will brief DoE on findings of investigation work and prolonged pumping and re-injection trials once results have been analysed and incorporated into groundwater and water balance models. The findings of these studies will be used in designing the eventual project and be subject to government scruting though the water licensing process.

Stakeholder	Consultation(s)	Key issues	Responses
DoE (Karratha & Perth)	Ongoing liaison and briefings	Cumulative impacts of BHPBIO's discharge and future Hope Downs discharge.	Cumulative dewater discharge impacts assessed incorporating discharge parameters of other approved mining operations. Addressed in Section 8.4.2.
		Change in vegetation dependence on water in response to altered hydraulic regime.	Discharge will only affect alluvials within one km stretch from discharge point. Careful management of discharge and gradual increase and decrease in volumes in response to changes in surplus should ensure changes in vegetation dependence to flows do not result in significant vegetation declines when flow is ceased. Hamersley is investigating feasibility of re-injection of some excess water to decrease the volumes being discharged. Addressed in Sections 7.4.2, 8.4.2 and 9.4.3.
		Management of stormwater and erosion issues.	Construction of levees and diversion drains to control stormwater (Sections 6.4.2 and 8.4.4). Structures stabilised through appropriate design and revegetation to prevent erosion (Section 12.3.3).
		Setbacks from major creeks.	Hamersley maintain buffers/ mining exclusion zones adjacent major creeks to protect creek and Aboriginal ethnographic values. Addressed in Sections 9.4.4 and 11.4.1 and 11.4.3.
		Closure and implications of BHPBIO operations.	A conceptual closure approach has been developed (Section 12) that will increase the groundwater salinity in the CID to between 1000 and 2000 mg/L. The BHPBIO Yandi operations and discharges were included in the modelling of Hamersley's closure.
		Re-injection of dewater.	Hamersley is investigating feasibility of re-injection of part of the surplus water. Addressed in Section 7.4.2.
		Uncontrolled discharge is the option of least preference.	Hamersley uses a portion of the mine dewater in mine operations (e.g. for dust suppression) and are also investigating feasibility of re-injection of part of the excess dewater. Addressed in Section 7.4.2.

Stakeholder	Consultation(s)	Key issues	Responses
		Whole of site water balance (for both operations - the new borefield license should be integrated with the existing license.	A site water balance model has been developed using Goldsim model package (see Water Use Section 3.3). A Water Management Plan is to be prepared that encompasses both the Yandi JC and JSE operations.
		Part V issues to be addressed during Part IV work – in particular, issues of clearing and well field licensing.	Clearing issues covered within the EPS approval framework9.4.1). Proposed wellfield to be licensed is shown in Figure 9. Conceptual approach to management of dewatering (including monitoring) is described in Sections 7.4.1 and 7.4.6
		Hamersley to consult with Seth Johnson in Perth on groundwater issues and have him review any modelling.	Hamersley consulted with DoE Perth staff regarding groundwater issues. As part of DoE review of Draft EPS, groundwater modelling methodology and results will be reviewed.
		Operating license might well be combined with the current license for Yandi JC if this was to be run as an integrated operation.	Hamersley propose to manage the Yandi JC and JSE operations as one operation.
DoE (Karratha)	Review of Draft EPS	BHPBIO are undertaking similar research and investigations into dewatering effects. Will there be collaboration regarding research findings?	Hamersley has led the research into dewatering effects of mining on trees in the Pilbara through its support of the Ecosystems Research Group at UWA for the past 10 years. Hamersley conducted a workshop for government, researchers and companies on this topic in the lead-up to the EPS development. A BHPBIO representative attended and it is understood that such cooperation will continue with any research funded by BHPBIO.
		BHPIO has proposed a series of irrigation points along Homestead Creek for Orebody 23 to undertake irrigation of stressed trees should dewatering impact tree health. Is Hamersley investigating a similar contingency?	Hamersley has committed to irrigation as one option for managing temporary effects of drawdown stress. This is stated in the EPS in Section 9.4.2. Hamersley is continuing its ongoing liaison with regulatory agencies on the long term benefits and overall ecological value in irrigating water stressed trees. Hamersley notes CALM's concerns with irrigation and government representatives will be participating in a practical workshop to discuss these issues with Hamersley later in 2005.
		Will the production of waste fines increase due to mining at Yandicoogina JSE?	Following the cessation of mining at Yandi JC, JSE ore will be used as feed to the JC wet plant. On the current mine plan, around 6 Mt of waste fines might be generated from the contribution of JSE ore over mine life. This volume of waste fines should be able to be accommodated within the current provision for waste fines cells within Yandi JC.

Stakeholder	Consultation(s)	Key issues	Responses
		Are additional in-pit waste fines cells required through the life of mine?	No additional in-pit waste fines will be required based on current understanding. Hamersley has provision for three in-pit waste fines cells in Yandi JC which should be sufficient. In any event, as most of the Yandi JC CID will have been mined out, there will be space available inside the mine void should additional waste fines cell capacity be required above that already approved.
		Hamersley has highlighted that additional discharge points (additional to the existing licensed discharge points) will be required. Will all discharge points be in a localised area? What will cause the least impact, localising all discharge, spreading out discharge points etc?	Discharge of excess dewatering is planned to occur within the same locality as the current licensed discharges to Yandicoogina Creek (Figure 9). Discharging to the same area of creek should minimise the area of creekbed where water levels are raised artificially. Additional discharge points will be required as the piping from JSE will come to the south side of Yandicoogina Creek. Piping crossing the Creek to discharge at the precise sites used currently would be exposed to damage from flooding.
CALM	Ongoing liaison and briefings	Design of stygofauna survey program to be negotiated with CALM.	Stygofauna survey was consistent with EPA Guidance Statement No. 54. Addressed in Section 10.1.5.
		Flora and vegetation studies to utilise current floristic classification for the region.	Survey undertaken in accordance with EPA Guidance Statement No. 56. Survey assessed vegetation using Beard's (1975) mapping and mapped at vegetation type level. Refer to Section 9.1.

Stakeholder	Consultation(s)	Key issues	Responses
CALM	Review of Draft EPS	The proposal to discharge surplus water from the Yandi JSE operations into Marillana Creek is not supported by CALM. CALM does not believe that discharging excess water into stream channels is the use of best practice methodologies/technologies, given the potential impacts of increased water quantity and water flow on the surrounding environment, including biodiversity conservation values	Discussions with DOE have indicated that Hamersley's approach to managing disposal of surplus water is consistent with current best practice, in that it: - employs options to use a maximum of water prior to discharge - uses best available technology (note that reinjection of large volumes of water in Pilbara aquifers is unproved as yet) - does not discharge any contaminated water with dewatering (used on site for dust suppression) - complies with recognised environmental standards – as assessed by EPA's recent approval of this discharge mechanism in Marillana Creek for the BHPBIO Yandi expansion - undertakes research to seek other options. Hamersley has referred to Section 3 of EPA Guidance Note 55 on implementing best practice in proposals. Hamersley acknowledges the discharge of surplus dewater water into the Marillana Creek system will continue a process which has led to changes in vegetation communities (particularly increasing the density of saplings of river-dwelling trees) at the discharge point and for a short distance downstream of the discharge point. Phreatophytic vegetation may also adapt to the increase in water level in the alluvials. There may be some death of vegetation whilst the area readjusts to natural water level conditions but this is expected to be localised and restricted to vegetation that established during the artificial water level conditions.
		CALM believes that a more acceptable methodology for dealing with surplus water, which better meets Rio Tinto's corporate commitments in its Sustainable Development Policy, is the reinjection of excess water into the underlying aquifer.	Hamersley is investigating the feasibility of re-injection of a portion of the surplus dewater water into the downstream Billiards CID aquifer (Section 8.4.2). In addition, Hamersley has committed to including a full Water Management Plan in the Yandicoogina EMP (Section 8.5) and the discharge design, monitoring and reporting will be subject to an environmental licence issued under the EP Act (Section 8.4.2). Note, in its recent assessment of BHPBIO's *Marillana Creek (Yandi) Life of Mine Proposal* (Bulletin 1166, April 2005), the EPA considered BHPBIO's proposal to discharge similar amounts of water immediately upstream of Hamersley's Yandicoogina operations, without requirement to investigate recharge, as being able to be managed to meet EPA's objectives for surface water.

Stakeholder	Consultation(s)	Key issues	Responses
		Given that there is an occurrence of the Declared Rare Flora (DRF) *Lepidium catapycnon* in the vicinity of the proposed operations, Pilbara Iron should still apply for a permit to take the species, in the event that it is disturbed unintentionally during construction or operations.	Consistent with its approach to other projects in the area, Hamersley will make every attempt to safeguard DRF but will also apply for a permit to take DRF to cover any accidental damage. Addressed in Section 9.4.1:
		The proposed mining of "Backfill Hill' for sourcing the backfill required for mine closure could only be supported if a thorough flora and fauna survey was undertaken and if impacts to values were deemed acceptable by CALM and DoE. Survey findings would need to be reviewed by CALM in order to identify the conservation values that will be placed at risk by the proposal.	Proponent commitments (Table 13) provide such criteria for the mining of adjacent landforms for backfill. The necessary vegetation, flora, fauna and heritage investigations will be undertaken and the use of the hill approved formally as part of the Yandicoogina Decommissioning and Rehabilitation Plan. A conceptual plan will be prepared with advice from CALM and other relevant agencies and submitted to the EPA for approval within 12 months of the Yandi JSE proposal being commissioned. At least two years prior to decommissioning of the Yandicoogina project, the plan will be finalised and submitted to the Government for approval (Section 12.2.2).
		Approximately one-third of the study area had been burnt two weeks prior to the flora and fauna survey, and subsequently the areas were not surveyed for rare flora. The proponent should commit to undertaking rare flora searches in the burnt areas, as recommended by Biota in the Yandi Expansion Vegetation and Flora Survey (December 2004).	Hamersley has committed to amending the existing Yandicoogina EMP prior to pre-mining at Yandi JSE, to address issues arising from the Yandi JSE project, including a flora and vegetation survey of the areas affected by fire in the JSE project area. Addressed in Section 9.5.
		Final development and formalization of the phreatophytic tree health monitoring program including monitoring triggers and management requires consultation with CALM. CALM is not supportive of the use of shallow irrigation as a contingency measure to provide water to affected areas, as it allows vegetation to become dependent on shallow water sources, and over a period lose the ability to access deeper groundwater sources.	The phreatophytic tree health monitoring program is to be further developed and formalised as part of amending the Yandicoogina EMP. CALM is listed as an advising agency for the amendment of the EMP and Hamersley will continue to consult CALM in the development and formalisation of the monitoring program. Hamersley acknowledges CALM's position regarding shallow irrigation as a contingency, therefore, Hamersley will also investigate other contingency options, such as localised alluvial recharge (in consultation with CALM and other relevant agencies as part of developing and formalising the monitoring program).
		The potential spread of weeds is a significant issue (particularly ruby dock and kapok), and it is important that strict weed hygiene measures are implemented by the proponent during all stages of the project including construction, operations and rehabilitation.	Strict weed management procedures will be implemented in the Construction and operations Environmental Management Plans. Further, Hamersley has committed to undertake broader weed control programs. These would be developed in consultation with CALM and DOE.

Stakeholder	Consultation(s)	Key issues	Responses
		Invertebrate survey – It is noted that a one genus recorded from the invertebrate survey is known to contain short range endemic taxa (Synsphyronus - pseudoscorpion). Given that very little is known on the distribution and habitat preferences of the Synsphyronusi species recorded in the project area, Pilbara Iron should investigate conducting further targeted surveys for the species and other short range endemic taxa in the project area and surrounds.	Hamersley will continue to support surveys which provide further information on the distribution and abundance of short range endemics such as pseudoscorpions. Future fauna surveys for Hamersley projects will pay particular attention to this issue.
		Subterranean Fauna - It is noted that a single stygal taxon is currently only recorded from the impact area (*Gomphodella* sp., Ostrocod). CALM recommends that further surveys be undertaken in the Yandicoogina area to determine whether the species occurs elsewhere.	Hamersley has committed to "continue to support research to improve knowledge of the taxonomy, distribution and ecology of stygofauna within the Pilbara Region" (Section 10.5). A further survey was conducted at Yandi during April 2005, with the identification of specimens still being undertaken. Further sampling for stygofauna is anticipated in 2007 as part of Hamersley's ongoing stygofauna sampling programme.
		Subterranean Fauna - Given that an undescribed stygal taxon was found in the impact area, Pilbara Iron needs to include a commitment that it will manage the threat of groundwater drawdown on the species until a time that its actual conservation status is confirmed. Appropriate measures for managing the threat should be determined in consultation with CALM.	Dewatering from JSE will not influence the creek aquifer where the apparently undescribed stygal taxon was found for at least 5-10 years following commissioning. Before that time, Hamersley will seek to resolve the status of this species through further surveys as part of its ongoing stygofauna sampling program. Should that site be of major conservation significance to a unique taxon, Hamersley will put in place a suitable management program.
		Rehabilitation and Closure - Pilbara Iron should consider developing a life of mine plan for its Yandicoogina operations.	An indicative life-of-mine plan is presented in the EPS, Section 12.2.3 and Figures 23-26. More detail will be developed in the Decommissioning and Rehabilitation Plan.
		Rehabilitation and Closure – If Backfill Hill be used as a source of backfill for the pit, it is important that the same topsoil collected from Backfill Hill be used for its rehabilitation after it is mined.	Hamersley will endeavour to source topsoil for rehabilitation of Backfill Hill solely from topsoil generated during the mining of that Hill.
Department of Industry and Resources	Review of Draft EPS	The extent that the out of pit waste dumps will be rehabilitated needs to be clarified. It is important that whilst out of pit, the waste dumps need to be stabilised so as to prevent sediment or excessive amounts of dust entering into the surrounding environment. This is particularly important as there is potential for the waste dumps to remain out of pit for an extended period of time (years).	Section 12.3.1 clarifies the extent of rehabilitation of these stockpiles: "Out-of-pit waste dumps will be constructed as per DoIR guidelines to ensure that interim surfaces are stable and non-eroding. Should dusting become an issue on dumps some form of control via vegetative cover may be required (although final fate of waste dumps will eventually be that they are to be returned to the pit)".

Stakeholder	Consultation(s)	Key issues	Responses
		Commitments need to be made in the final EPS document so as to ensure that the long term viability of the stockpiled topsoil is maintained.	Section 12.3.4 addresses this subject: "Long term viability of topsoil stockpiles will be maintained through the use of Hamersley's standard prescriptions for topsoil management to be applied at initial construction and through mine life".
		Prior to Hamersley mining Backfil Hill, they are requested to submit to DoIR a rehabilitation plan for the hill once it has been mined.	A Conceptual Decommissioning and Rehabilitation Plan, addressing rehabilitation of all areas, will be prepared with advice from DoIR within 12 months of the Yandi JSE proposal being commissioned. At least two years prior to decommissioning of the Yandicoogina project, the plan will be finalised and submitted to the Government for approval.
		Hamersley need to submit the final design of the drainage levees and diversion drains to the appropriate regulatory authority so as to ensure that all of the relevant geotechnical and hydrological considerations have been considered in their design. This needs to be done prior to their construction.	Hamersley will investigate whether final designs for the geotechnical/hydrological aspects of the diversion levees and diversion drains needs to be submitted to DoIR.
NGOs			
Conservation Council of WA	Briefing and discussion of proposal	Projects with large footprints should be assessed as PER (however work done by companies such as Hamersley would be equivalent to that required for a PER).	Hamersley has undertaken comprehensive flora, fauna and heritage surveys and hydrogeological studies that cover the proposal area and will undertake additional survey work prior to any ground disturbance activities. Addressed in Section 9.1, 10.1 and 11.1.
		The correlation of the Yandicoogina biological surveys with broader regional surveys such as the Pilbara Region Biological Survey.	Biota (2004a) utilised floristic data collected from other sites in the region to assess commonality of vegetation types and flora species. Hamersley (through Rio Tinto Limited) is supporting the provision of broadscale biodiversity data for the Pilbara by funding work in this area by the Australian Museum.
		Mining companies should contribute to CALM's Pilbara Region Biological Survey as they potentially benefit from the work.	Hamersley is actively contributing to the survey through the sharing of biological survey results and logistic support.

Stakeholder	Consultation(s)	Key issues	Responses
		Consider offsets such as working with pastoralists to reduce the frequency of burn-offs in the central Pilbara or controlling environmental weeds.	Hamersley has committed to: ▪ Undertaking control of weed species in creek lines of the Marillana Creek system focussing on Hamersley's operational area (Section 9.4.5) ▪ Continuing to support research programs by the Ecosystems Research Group of the University of Western Australia in assessing plant-water relationships and developing better predictive models of drawdown impacts in the Pilbara (Section 9.4.2) ▪ Continuing to support research into the distribution and taxonomy of stygofauna (Section 10.5) Hamersley has very limited ability to influence the management of pastoral stations where it is not the lease holder.
		Continue to design and operate mine villages in such a way to help the work force relate better to their local environment.	Upgrade to the village required for the Yandi JSE project has been subject to a separate approval process. In general, Hamersley landscape gardens at the village with local natives and undertake workforce inductions that have an environmental component. The original siting of the mine village was designed to provide an outlook which fosters an appreciation of the Pilbara landscape amongst workers (Section 3.4).
		Assessment of cumulative impacts of mining operations in the region is difficult for individual companies to address without advice of government on the likely effects of other projects.	Cumulative dewater discharge impacts were assessed in consideration of other mining operations, or proposed operations, environmental approvals. Cumulative impacts on flora and fauna values assessed utilising the key threatening processes information from the 2002 Biodiversity Audit of WA. Addressed in Sections 7.4, 8.4, 9.4, 10.4.
Wildflower Society	Correspondence, briefing and discussion on proposal	Disruption to overland flow causing 'drainage shadow' type impacts.	Natural drainage patterns are maintained wherever practicable through appropriate drainage feature design. Topography here does not promote drainage shadow. Addressed in Sections 8.4.1 and 8.4.4 (Surface water) and Section 9.4.4 (Flora and vegetation).
		Loss of vegetation in WA due to mining and other developments.	Mining was not identified as a key threatening process in the Hamersley sub-region in the 2002 Biodiversity Audit of WA (Kendrick 2001).
		Rehabilitation trials should proceed as soon as practicable.	Rehabilitation trials at Yandi JC are already underway with regular monitoring – this will provide first tests on relevant substrates. Hamersley's rehabilitation program is discussed in Section 12.2.3.

Stakeholder	Consultation(s)	Key issues	Responses
		The length of time between mining and revegetation seems contrary to good industry practice.	Hamersley will endeavour to minimise the time between mining and revegetation as much as possible at Yandi JSE, however timing is largely controlled by the availability of space and material to backfill. Useful rehabilitation can only commence once final surfaces are in place. Rehabilitation is however able to commence earlier at Yandi JC so that results of monitoring at Yandi JC will be able to be used to amend rehabilitation strategies at Yandi JSE. Refer to Section 12.3.1
Gumala	Site inspection of project area and discussion of proposal	Disturbance of creek beds (principally due to bore construction).	Gumala have no objections to the construction of bores in creek beds so long as adequate consultation takes place. Hamersley also demarcates buffers/ mining exclusion zones adjacent to major creeks. Addressed in Section 11.4.1and 11.4.3.

The issues raised by stakeholders have been addressed in this EPS, and specifically, the following studies investigated key areas of concern:

- **Hydrogeological studies** to assess the influences of dewatering on surrounding groundwater systems, optimum methods of water discharge and actions required at mine closure to produce acceptable long-term outcomes (Liquid Earth 2005).
- **Vegetation, flora and fauna (terrestrial, short-range endemics and stygofauna) studies** to assess the potential impacts on the conservation status of those species known or likely to occur in the Yandi JSE project area (Biota 2004a, Biota 2004b, Biota 2005).
- **Aboriginal archaeological and ethnographic studies**, in close consultation with Gumala, investigating the presence and significance of Aboriginal heritage features of the project area (Day 2004, O'Reilly and Di Lello 2004).

5. ASSESSMENT OF ENVIRONMENTAL IMPACT

5.1 SCOPING OF RELEVANT FACTORS

The scoping process involved preliminary identification of environmental aspects and an environmental risk assessment to identify key environmental issues and factors. The scoping process utilised EPA guidelines and preliminary stakeholder consultation to identify those aspects that affect environmental factors. During this process the impacts on some factors warranted detailed assessment whereas other factors did not warrant such given existing or proposed environmental management and remoteness of the location.

5.2 KEY ENVIRONMENTAL FACTORS ADDRESSED

The following environmental factors relevant to this proposal were identified through the process described above as requiring detailed assessment:

- Landform
- Groundwater and surface water management
  - dewatering of CID to enable mining below the natural water table
  - disposal of excess dewater
  - drainage
  - closure
- Biodiversity
  - terrestrial vegetation and flora, including threatened species and water dependant vegetation
  - fauna, including subterranean biota and short range endemics
- Aboriginal heritage
- Closure

These factors have been addressed in detail in Sections 6 to 14.

5.3 OTHER ENVIRONMENTAL FACTORS ADEQUATELY ADDRESSED THROUGH EXISTING OR PLANNED MANAGEMENT REGIME

The following environmental factors have not been addressed in detail as they are considered to be minor factors for consideration given the remoteness of the location, Hamersley's experience at Yandicoogina and existing management measures or requirements in place:

- greenhouse gas emissions relating to power generation, fuel consumption and explosive usage
- dust emissions
- air quality (excluding dust)
- noise and vibration

- waste management
- hazardous materials.

These factors are addressed briefly below in Sections 5.3.1 to 5.3.6.

5.3.1 Greenhouse gases

The Greenhouse Effect is a natural phenomenon where light energy from the sun passes through the atmosphere and heats the earth's surface. Greenhouse gases in the atmosphere include carbon dioxide, water vapour, methane, nitrous oxide, non-methane volatile organic compounds, halocarbons, carbon monoxide and sulphur hexafluoride. These gases within the atmosphere trap heat reflected from the earth's surface maintaining temperatures at a level capable of supporting life.

The main anthropogenic greenhouse gas emission is carbon dioxide (CO_2), which has increased in concentration in the atmosphere by about 31% over the last 200 years. Other greenhouse gases include methane (CH_4) and nitrous oxide (N_2O) (EPA 2002).

Hamersley accepts that emissions of greenhouse gases resulting from human activities are contributing to climate change. Avoiding human caused changes to climate is an important international goal that requires reductions in emissions of greenhouse gases. Actions are required to improve understanding of the problem and provide solutions for both adaptation and greenhouse gas emissions abatement. Hamersley recognises that addressing the challenge of climate change will impose costs for greenhouse gas abatement and necessitate a change in the way energy is used.

Management of emissions of greenhouse gases from Rio Tinto operations is derived from the Rio Tinto Environment Standard – Greenhouse Gas Emissions, developed in 2004 and is due for full implementation across the Group in 2005 (Appendix 2). This document sets out the planning requirements, the implementation and operation measures and the performance monitoring for the mitigation of greenhouse gas emissions from Rio Tinto sites.

Rio Tinto has a current corporate target for a 4% reduction in total greenhouse gas emissions per tonne of product between 2003 and 2008.

To give a common base for considering the impact of various gases, greenhouse gases are usually expressed in terms of carbon dioxide equivalents (CO_2-e), where the potential of each to increase heating in the atmosphere is expressed as a multiple of the heating potential of CO_2 (EPA 2002). This is termed its "global warming potential" (GWP), for instance, methane has a GWP of 21 and nitrous oxide a GWP of 310.

The combustion of fossil fuels is the major source of anthropogenic CO_2 emissions.

Current Yandicoogina emissions

Current emissions from the Yandicoogina mining operation are shown in Table 3.

Emissions from the Yandicoogina operations include the emission due to fuel use, processing, land use change and electricity purchased. They do not include rail transportation to the port which is undertaken by a separate operation. Assessment of the total emissions from the combined Yandicoogina operation includes rail transportation.

Table 3 Annual greenhouse gas emissions for the Yandicoogina operation 2002-2004

Year	Annual Emissions (kt CO_2-e)	Production Rate (Mtpa)	Emissions per tonne of ore (kg CO_2-e/tonne)
2002	52.7	19.1	2.75
2003	60.4	20.2	2.99
2004	82.9	22.4	3.71[1]

[1] Rise in emissions rate in 2004 due to construction works and greater movement of waste material.

Future emissions

The major potential sources for the increase in the emission of greenhouse gases from the project are:

- fuel usage by mobile plant and equipment
- energy usage by processing plants for a higher iron ore production rate
- clearing of vegetation for the expanded mine envelope.

However, progressive rehabilitation of mined ground will restore a greenhouse gas "sink" over mine life.

Once the current Yandi JC operation (including the wet plant) and Yandi JSE are simultaneously fully operational, emissions (including rail emissions) are likely to be around 320,000 t CO_2-e/annum. Emissions will be approximately 192,000 t CO_2-e/annum not including those from rail movements. After closure of mining at Yandi JC, emissions will drop substantially. The component attributable to Yandi JSE ore would comprise approximately 48,000 tonnes CO_2-e/annum with an added 39 000 tonnes CO_2-e/annum from rail of the product. Port emissions are not accounted for here as a separate approval for port expansion has dealt with increased tonnage – once at port, the source of ore from within Hamersley's product stream is not relevant to emissions.

When the Yandicoogina mine reaches a full production rate of 52 Mtpa (40 Mtpa dry ore, 12 Mtpa wet ore) the emission rate per tonne onto rail is expected to drop from approximately 4.2 kg CO_2-e/tonne (24 Mtpa dry ore, 12 Mtpa wet ore) to 3.7 kg CO_2-e/tonne. The lower emission rate per tonne is a result of an increase in the proportion of dry iron ore processed by the operation compared to wet ore in the 36 Mtpa operations. Wet processing of the iron ore has a higher energy demand per tonne than dry ore. This will be an improvement of approximately 8% in the emission of CO_2-e per tonne of ore over current operations.

Table 4 shows a comparison of estimated greenhouse gas emissions per tonne of iron ore at Yandicoogina with recent comparable projects in the region. For benchmarking purposes, the emissions per tonne of ore shown in the table include emissions from rail transportation to the port.

The estimated low unit emission for the Yandicoogina project is due to the presence of existing infrastructure, which negates the need for further construction, and the relatively small amount of pre-strip required for mining.

Table 4 Comparison of greenhouse emissions per tonne of ore shipped

Project	Emissions per tonne of ore (kg CO_2-e/tonne) [c]
Hope Downs [a]	6.06
Fortescue Metals Group Limited - Stage A and B [b]	14.3
Yandicoogina	6.7

[a] Hope Downs Management Services (2002)

[b] Environ (2005)

[c] For benchmarking purposes emissions per tonne of ore include emissions from rail transportation to the port

In addition to the emission from the operation of plant and equipment, it is expected that there will be an emission of approximately 19,500 tonnes CO_2-e from the clearing of vegetation over the mine life, and an additional 6000 tonnes at closure due to clearing of the backfill hill. Hamersley is required to rehabilitate the area cleared and in the longer term the rehabilitated land is expected to sequester an equivalent amount of CO_2-e as released by clearing.

Hamersley has an existing EMP which addresses greenhouse gases. The EMP will be reviewed and revised to address greenhouse gas emission issues arising from the JSE project.

Hamersley will continue its involvement in the Greenhouse Challenge Plus program through Rio Tinto, which includes annual reporting of greenhouse emissions and abatement projects, and continue to examine greenhouse abatement strategies and where practical implement measures to reduce emissions and improve per tonne efficiency.

Proponent commitments

Issues relating to greenhouse gases at Yandi JSE will be covered by the following new proponent commitment (new proponent commitment number in parenthesis):

EMP

- Review and revise existing Yandicoogina EMP to incorporate greenhouse gas management at Yandi JSE (17).

This commitment is included in full in Table 13.

5.3.2 Air quality

Sources of nitrogen oxides (NO_x) and sulphur oxides (SO_x) are limited principally to emissions from vehicles and fixed plant that burn diesel as fuel. The on-site diesel-fired power station is currently operating to top up generating capacity in periods of peak load. The power station was initially decommissioned upon connection of the Yandicoogina operation to the 220 kVa grid supplied by the Hamersley gas-fired power station located at Dampier but recommissioned in 2004. The power station will continue to be used during the early stages of construction of the JSE mine to meet additional power supply needs, but is intended to be phased out after that once additional infrastructure has been installed to provide greater amounts of power from the Dampier grid.

Background air quality is generally good with no significant emitters of airborne contaminants, other than dust, adjacent to the operation. Other sources of emissions in the Yandicoogina airshed (a 10 km radius) include:

- BHPBIO Yandi operation (approximately 12 km west): dust, NO_x, and SO_x

- Lands of Marillana Creek Station (surrounding the mine): dust and occasional smoke emissions.

There are few topographic features that would constrain mixing within the Yandicoogina air shed and residence times would generally be short. As a consequence air quality is not considered to be a relevant environmental issue at Yandi, with the exception of dust.

5.3.3 Dust

Background dust levels at Yandicoogina are high relative to urban areas in the south west of Western Australia due to being located in an arid region where dust lift off occurs from sparsely vegetated landscapes.

Dust is not a significant environmental issue at the existing Yandi JC operation owing to its remote location. At Yandi JC, the principal risks of dust and drivers for dust control are safety and health for the workforce, consequently monitoring of dust is for occupational health reasons.

Aspects of the proposal that may potentially result in generation of dust/particulates impacts are:

- physical disturbance of the land surface during construction of infrastructure and mining (removal of vegetation, blasting, excavations)
- primary and secondary crushing of ore
- haulage and light traffic on unsealed roads
- conveying and transfer of ore between conveyor flights
- blasting.

A *National Environment Protection Measure (NEPM) for Ambient Air Quality* was endorsed by the National Environment Protection Council (NEPC) in June 1998. The desired environmental outcome of this Measure is ambient air quality that allows for the adequate protection of human health and well being. This outcome is to be achieved by meeting the National Environment Protection Standards (listed in Schedule 2 of the Measure, Table 5 below), as assessed in accordance with a prescribed monitoring protocol (Part 4 of the NEPM). This measure includes particulates, as listed in Schedule 1.

Table 5 NEPM standards and goals for ambient air quality

Pollutant	Averaging period	Maximum concentration	Goal within 10 years maximum allowable exceedances
Particulates (PM_{10})	1 day	50 μg/m3	5 days a year
Particulates ($PM_{2.5}$)	1 day	25 ug/m3	Goal is to gather sufficient data nationally to facilitate a review of the Advisory Reporting Standards.
	1 year	8 ug/m3	

The Yandicoogina operation is required to be consistent with Rio Tinto Environmental Standard: Air Quality Control (Appendix 2).

Hamersley will implement appropriate controls to manage dust emissions from aspects of the operation consistent with Rio Tinto Environmental Standard: Air Quality Control (Appendix 2). Hamersley currently controls dust at strategic locations throughout the current Yandi JC operations mainly through the application of water from water trucks or water sprays during ore processing.

As with the Yandi JC existing operation, dust generation minimisation and protection measures to be undertaken for Yandi JSE will include:

- water applied to haul roads and other unsealed surfaces and active work areas through the use of water trucks during dry conditions
- fitting of dust suppression systems to processing facility structures (e.g. water sprays and dry-type bag houses on the crushers)
- enclosing of dust generating processes (e.g. crushers, screenhouses, conveyor transfer points and train load out)
- scheduling blasting activities to coincide with favourable weather conditions
- house keeping practices to ensure no accumulation of waste materials around conveyor, transfer points and hardstand areas under crushers and associated plant
- control of vehicle speed on unsealed roads
- prompt rehabilitation of disturbed areas
- minimising areas to be disturbed.

The existing Yandicoogina EMP will be amended to address dust issues arising from the JSE project. The environmental conditions of the DoE licence to cover the entire Yandicoogina operation will also address dust control measures.

Proponent commitments

Issues relating to dust at Yandi JSE will be covered by the following new proponent commitments (new proponent commitment number in parenthesis):

General

- Dust suppression measures, including water application, will be implemented (13).

EMP

- Review and revise existing Yandicoogina EMP to incorporate dust management at Yandi JSE (17).

These commitments are included in full in Table 13.

5.3.4 Noise and vibration

Noise and vibration is generated from blasting, ore transport and handling activities and mining operations. Yandi JSE will increase the ambient noise levels in the vicinity of the operation, however due to the remoteness of the Yandicoogina operation noise and vibration impacts are restricted to health and safety of the workforce. Noise emissions from Yandi JSE may cause temporary and localised disruption to fauna in areas not affected by existing operations, however it is unlikely the behaviour of the wildlife will be disrupted in the long term.

In accordance with current management practices, Hamersley will ensure noise and vibration from Yandi JSE comply with the requirements of the Environmental Protection (Noise) Regulations, environmental licence and the Department of Industry and Resources (DoIR) (for mine safety and

health). Yandi JSE is located at a greater distance from the permanent village than the existing Yandi JC mine so noise and vibration impacts at the village from the JSE mine will be negligible.

Noise is managed under the Yandicoogina EMP, which will be reviewed and revised where relevant to incorporate management of noise from the proposed JSE project, and to the requirements of the Rio Tinto Environmental Standard: Noise and Vibration Control (Appendix 2).

Proponent commitments

Issues relating to noise and vibration at Yandi JSE will be covered by the following new proponent commitment (new proponent commitment number in parenthesis):

EMP

- Review and revise existing Yandicoogina EMP to incorporate noise and vibration management at Yandi JSE (17).

This commitment is included in full in Table 13.

5.3.5 Waste management

Wastes that will be generated as a result of the Yandi JSE project will be similar in composition to that already generated at the existing Yandi JC mine. Yandi JSE will result in an increase in volume of the following typical wastes:

- domestic solid and liquid wastes
- food scraps from the accommodation village and construction camp
- scrap metal/ drums
- rubber products (conveyor belt sections, tyres)
- batteries
- waste oils.

The licensed landfill will continue to be utilised for the disposal of general domestic solid wastes including putrescibles, biodegradables, inert substances and other general waste. Scrap metal and batteries will be stored and removed offsite by recycling contractors.

Domestic sewage is currently handled through a sewage treatment plant as prescribed in DoE licence number L7340/7. A new sewage treatment facility will be required for the administration and workshop buildings at Yandi JSE and will be appropriately licensed (if treating volumes greater than 10 m^3/d).

No separate waste fines management is required as part of the Yandi JSE proposal.

Waste management is controlled through licence conditions and addressed by the following plans and procedures for the existing Yandi JC operation, which will be reviewed and revised where relevant to incorporate waste management for the JSE project

- Yandicoogina EMP, which will be reviewed and revised where relevant to incorporate waste management for the JSE project.

- Waste Management Treatment, Storage and Disposal Guidelines – outlines the relevant disposal procedures, accountabilities and contacts as part of the Hamersley Iron Environmental Management System.
- Rio Tinto Environmental Standard: Waste Management – outlines the waste management practices for solid wastes at Rio Tinto sites (Appendix 2).

Proponent Commitments

Issues relating to waste management at Yandi JSE will be covered by the following new proponent commitments (new proponent commitment number in parenthesis):

General

- No burning of waste will be permitted and the onsite landfill will be used for the disposal of accepted wastes (13).
- Sewage treatment plants will be appropriately approved (10).

EMP

- Review and revise existing Yandicoogina EMP to incorporate waste management at Yandi JSE (17).

These commitments are included in full in Table 13.

5.3.6 Hazardous materials

A range of hazardous materials are required for the operation of the Yandi JSE mine, including hydrocarbons and explosives. A lube and fuelling facility will be constructed adjacent to the JSE mine pit with two large (110,000 L) diesel tanks, two oil tanks (10 kL each) and a waste oil storage tank (10 kL). The diesel tanks will be connected to the Yandi JC fuel facility by an above ground pipeline which will cross the Yandicoogina Creek.

Due to the environmentally sensitive nature of the Yandicoogina Creek crossing it will be necessary to ensure the integrity of the pipeline in this section. In accordance with Rio Tinto standards, this may require utilising:

- double-skinned pipe
- comparative metering at both sides of the creek
- auto-shut valving.

A formal risk assessment, in conformance with Rio Tinto standards, will also be undertaken to determine which areas of pipeline present a risk and what mitigation is required. A similar approach will also be adopted for the transportation, storage and handling of explosives materials.

Proponent commitments

General

- Bunding for hydrocarbon storage areas will be constructed in accordance with relevant Australian standards (11).
- Runoff from areas that may be contaminated with hydrocarbons will not enter natural drainage channels without prior treatment (12).

6. LANDFORMS

6.1 DESCRIPTION OF FACTOR

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

The surface topography has been shaped by alluvial processes with the existing streams winding between low lying mesas and hills. Three general landforms can be described for the project area:

- low stony hills
- valleys
- drainage lines.

There is a large active mine pit at Yandi JC that interrupts the valley landform to the immediate northwest of the proposed JSE operation. Further upstream along Marillana Creek, several large mine pits with associated stockpiles and infrastructure occur as part of BHPBIO's Yandi operations.

The natural appearance of the local landscape is also broken in parts by the appearance of existing mine infrastructure along and adjacent to the CID including waste rock dumps, administration buildings, conveyors, workshops, processing plant and the mine village.

6.2 POTENTIAL SOURCES OF IMPACT

Activities or aspects of the proposal that may potentially affect landform include:

- **Earthworks** removing topsoil, overburden and ore during mining will create a void in the landscape.
- **Placement of drainage levees and waste stockpile** will place new raised landforms on the alluvial plain.
- **Placement of infrastructure** temporally altering the appearance of the natural environment.
- **Rehabilitation and closure** – use of material from adjacent landforms to backfill mine pit will permanently change a local landform.

6.3 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA objectives

The EPA normally applies the following objectives to the assessment of proposals that may affect land. The objectives considered relevant to this assessment are:

- To maintain the integrity, ecological functions and environmental values of the soil and landform.
- To ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.

6.4 ASSESSMENT OF POTENTIAL IMPACT AND MITIGATION

6.4.1 Mining and backfill

Mining of the JSE pit will occur largely below the level of the surrounding land; with the exception of the removal of some existing mesas (CID outcrops). Thus the main alteration to the landform will be to produce an open depression in the shape of the CID. The projected waste:ore ratio is sufficiently low that replacing all waste rock and overburden in the pit would result in a backfill proportion of only 55% and not approach the pre-mining water level.

Best practice models of the evolution of water quality after closure have shown clearly that pit lakes with extensive evaporative surfaces will become saline. The only viable management approach to restrict this salinisation identified to date is to reduce the surface area of the waterbody exposed to evaporation by raising the level of the final pit floor through backfilling.

Hamersley's closure approach ranks the stabilisation of impacts on surface and groundwater above the need to minimise the disturbance footprint on landforms. During and post mining, all waste rock emanating from the pre-strip and initial mining that was not used in earthworks for construction will be reclaimed and subsequently used for backfill. Unlike the mine pit at Yandi JC, no waste fines from the wet processing of iron ore will be deposited within the mine void.

Additional material will be required to supplement waste rock sourced from pre-strip and initial mining to backfill the mine void because of the significant loss of material due to removal of the saleable ore. Consistent with the 1998 Yandicoogina Closure Plan (revised in 2003), additional rock fill could potentially be sourced from one or both of:

- an above watertable nearby borrow pit or hill
- areas abutting the mine void, but above the watertable.

In the case of the Yandi JSE pit, a large amount of material is required to raise the remaining pit floor to a level that allows adequate throughflow of groundwater to prevent salinity problems downstream. See Section 7 for further discussion.

Based on detailed mine plans, Hamersley has identified a hill adjacent to the CID which would be suitable for use as backfill for the JSE operation. The hill, referred to here as "Backfill Hill", would be progressively mined after closure and the material placed into the mine void to attain at least the critical elevation (490RL). The flora, fauna and heritage values of this hill had not been surveyed in detail at the time of the preparation of this EPS and are planned for survey during June 2005[5]. A similar hill to the south east of the JSE CID was however surveyed and has been used as an "analogue" site for which to provide indicative values.

The use of Backfill Hill will be subject to specific criteria for the protection of flora, fauna, and heritage values detailed in Sections 9.5, 10.5 and 11.5 respectively and approved through the Decommissioning and Rehabilitation Plan. This is discussed in more detail in Section 12.2.2.

[5] A vegetation and flora survey was undertaken on Backfill Hill between 31 May and 2 June 2005; refer to Appendix 5 for details and results.

The final elevation of the floor of the mined pit, even with the use of material from Backfill Hill, will still be lower than the pre-mining elevation. Because of this, drainage levees and embankments will remain in place along the edges of the mining area to prevent the depression becoming a preferred pathway for the adjacent stream and to continue to divert surface runoff around the CID so that flows continue to reach Marillana and Weeli Wolli Creeks. Retention of drains and levees will also form part of the protective bunding around the pit normally required by DoIR as a post closure safety measure.

6.4.2 Drainage levees

Most of the drainage around the Yandi JSE site occurs in defined channels and sheet drainage is rare or operates over very short distances. The following mine flood protection levees and diversion drains will be designed and constructed to protect the mining activities from being inundated as a result of flooding of the Yandicoogina, Marillana or Weeli Wolli creeks as well as diversion of minor water courses flowing into the JSE CID area (Figure 12):

- Yandicoogina Creek levees, northwest and northeast of the JSE deposit, this will consist of two separate levees approximately 400 m and 1600 m long
- eastern cut off drain approximately 2600 m long
- western cut off drains and levees approximately 5000 m long
- Weeli Wolli creek levee, south and southeast of the JSE deposit, approximately 2600 m long.

Levees will be constructed from overburden from the start up pit and revegetated as part of the rehabilitation of the disturbed areas during construction. The diversion drains will be formed and revegetated to resemble natural drainage lines of the area (Section 12.3.3).

As these drainage structures are to be left to prevent flooding of the pit area and maintain surface flow around the JSE area to the creek systems, there will be some permanent minor changes to surface topography from the remaining embankments and levees left around the JSE CID following closure.

6.4.3 Waste stockpile

A waste stockpile will be formed adjacent to the new pit during mining. The stockpile will be constructed in lifts to meet DoIR guidelines to avoid unacceptable slopes and to ensure that interim surfaces are stable and non-eroding. The ultimate height of the stockpile is not known at this stage however it will be approximate to the adjacent hill. The extent of the waste dump area required for the first five years operation is indicated in Figure 8. The area shown in Figure 8 will also contain a low-grade dump for ore which cannot meet current cut-off grades but may be later processed later with higher grade material.

During and following mining, overburden from the stockpile will be placed back into the mine pit as part of backfill, as mining schedules permit and rehabilitated once final surfaces are achieved. At the end of mine life all remaining waste and low-grade will be returned to the pit and the underlying landform will be rehabilitated to be similar to the original landform.

There will be no significant permanent change to local landscapes as a result of the waste stockpile development.

6.4.4 Infrastructure

All mine infrastructure will be removed from the landscape at closure and the land rehabilitated.

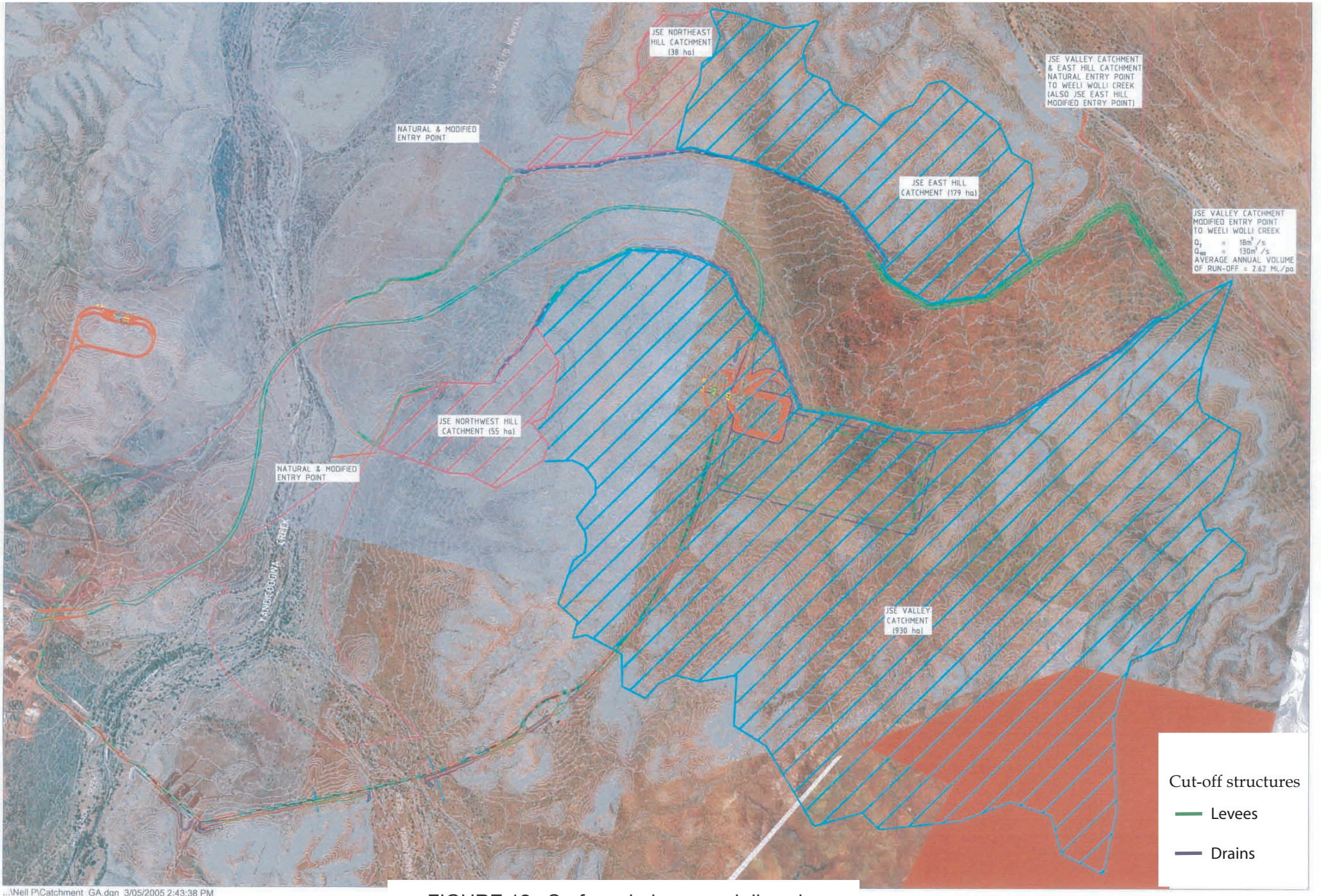


FIGURE 12. Surface drainage and diversions.

6.4.5 Visual aspects

The addition of the Yandi JSE operation to the area will change visual aspects of the local landscape. The addition of the mine infrastructure and open pit will not represent a significant change to visual amenity as the area is not accessible by the public and the operation will be adjacent to an existing mining operation. The area is not adjacent to any significant tourist attractions or access routes.

6.4.6 Rehabilitation

All areas disturbed during mining and construction of associated infrastructure will be rehabilitated following decommissioning prior to closure, once no longer required, in accordance with Hamersley's standard procedures described in the Yandicoogina EMP and the approach outlined in the Conceptual Decommissioning and Rehabilitation Plan (Section 12). Rehabilitation details, including timing and completion criteria, will be agreed prior to finalisation of the Decommissioning and Rehabilitation Plan.

Section 12.2.3 includes figures indicating the expected progress of mining and rehabilitation over the Yandi JSE mine life.

6.5 PROPONENTS COMMITMENTS

Issues relating to landform and restoration at Yandi JSE will be covered by the following new proponent commitments (new proponent commitment number in parenthesis):

General

- Ensure disturbed areas are progressively rehabilitated (15).

Use of Backfill Hill

- The use of adjacent landforms for the purpose of backfill will be subject to assessment of criteria for the protection of flora, fauna and heritage described in Section 9.5, 10.5 and 11.5 respectively. Removal of fill will be consistent with a final landform which sheds incident water from rainfall (16).

EMP

- Review and revise existing Yandicoogina EMP to incorporate rehabilitation at Yandi JSE (17).

Decommissioning and Rehabilitation Plan

The Decommissioning and Rehabilitation Plan will address closure issues such as removal of infrastructure, the source of backfill, rehabilitation and completion criteria. Hamersely will:

- Review and revise Conceptual Decommissioning and Rehabilitation Plan for the Yandicoogina Project within 12 months of commissioning the Yandi JSE project (18).
- Finalise Decommissioning and Rehabilitation Plan two years prior to decommissioning project (19).

These commitments are included in full in Table 13.

6.6 OUTCOME

The EPA objective to maintain the integrity, ecological functions and environmental values of soil and landform will generally be maintained for the Yandicoogina area through best practice topsoil handling and clearing procedures ensuring land disturbance is minimised. Topsoil will be replaced on restored landforms to ensure surface biological processes.

There will however be a change in landscape and disturbance to landforms as a result of mining. Most impacts will be temporary, but there will be some local long term changes in landform, following closure, primarily:

- modification to soil profile and lowering in elevation over the length of the mined CID
- permanent loss of at least part of low lying hill (Backfill Hill or other adjacent landform) from the local landscape
- minor changes to surface topography from remaining drainage embankments and levees.

Consistent with the EPA objective for landform, rehabilitation objectives are for a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.

7. GROUNDWATER

7.1 DESCRIPTION OF FACTOR

The CID aquifer exists in an ancient palaeochannel cut into the Weeli Wolli Formation basement rock and is recharged from the overlying alluvial sediments that occur in the creeks and drainage lines. In the vicinity of the Yandicoogina mine, the CID is generally about 70 m deep with the main ore zone occupying about 45 m of depth. Average hydraulic gradients within the aquifer are around 1.5 m/km with approximately 2500 to 3000 m^3/d (day) of groundwater flow down the CID. The CID is the most conductive aquifer in the area, providing a conduit for regional groundwater flow to the east.

The major aquifers in the CID are located in cavernous zones within the main ore zones. Some of the highest conductivities occur in secondary dissolution cavity structures within the deposits. The basement and boundary formations (Weeli Wolli Formation) are generally tight and groundwater contributions from the basement are minor. Wells in the basement rock yield little or no groundwater (Figure 13).

The CID generally comprises coarse sand to granule sized placer deposits that have subsequently been cemented in a goethite matrix. The porosity of the original sediments has largely been infilled by the goethite cementation and the primary porosity is now in solution features such as vugs and cavities, with the secondary porosity coming from extensive fracturing.

The palaeochannel deposits at Yandicoogina can be separated into four main hydrogeological units:

1. The shallowest hydrogeological unit consists of recent alluvial deposits and the Eastern Clay Conglomerate (ECC). This unit occupies the upper 15 m of the channel profile and is largely unsaturated but the low permeability ECC unit may support localised perched watertables. The alluvial aquifers associated with creeks are included in this unit.
2. The next hydrogeological unit consists of the upper weathered CID horizon (WCH) which contains the main ore zone and is largely unsaturated. The underlying ore body zone is divided into the Upper (GVU) and Lower (GVL) horizons. The two units are similar, although the GVL has generally been considered to be less competent and more fractured. They both generally lack the extensive high permeabilities required for dewatering purposes. The formation has an average porosity of around 25%, however the effective porosity is significantly less as not all of the void spaces are interconnected.
3. The third and most significant hydrogeological unit is the limonite-goethite clay unit (LGC) underlying the main ore zone. The LGC often has large clay filled or open cavities that yield high volumes of water. This unit is not continuous throughout the CID. Underlying the LGC is a basal clay conglomerate unit (BCC) that may have local limited secondary permeability.
4. The CID is deposited in a channel carved into the Weeli Wolli Formation, which in the study area is mostly comprised of banded iron formation. Permeability within the Weeli Wolli Formation is generally low, with some minor permeability resulting from fracturing. The Weeli Wolli Formation is considered the hydrogeological basement for the purposes of this report.

The southern end of the Marillana CID (referred to as JSE CID) joins the north flowing Billiards CID. The hydraulic connection between the JSE CID and Billiards CID is strongly restricted. This conclusion is based on the existence of a groundwater mound in the southern portion of the JSE (only partially due to high recharge rates), differences in water chemistry, a steep groundwater gradient

between the two aquifers and test pumping results. As a result, the throughflow of groundwater from the JSE to Billiards is limited.

Recharge

Recharge is expected to occur along the entire length of the CID and is associated with major rainfall events (Liquid Earth 2005). Most recharge occurs in the central to southern half of the CID where a large surface drainage system intercepts the CID before draining into the Weeli Wolli Creek (Figure 6). A groundwater mound exists in the southern portion of the JSE CID due to the higher recharge in the southern section and a restriction in the outflow area.

Local recharge is now influenced by releases from the Yandi JC operation, which provide almost constant flow within a small section of the Marillana Creek system and consequent recharge to the northern part of the JSE CID aquifer through the alluvial sediments overlying the CID.

CID relationship to alluvial aquifers

The role of groundwater in the CID in sustaining water levels in the main creek aquifers is limited. Drilling and pump tests show that the Weeli Wolli Creek alluvial/calcrete aquifer is perched 2-3 m above the underlying Billiards CID aquifer due to a heavy clay layer. The Weeli Wolli Creek and alluvial aquifers are unlikely to be impacted by groundwater drawdowns in the JSE CID.

The Marillana Creek and associated aquifers are partially connected to the CID and may be impacted by groundwater drawdown in the JSE CID.

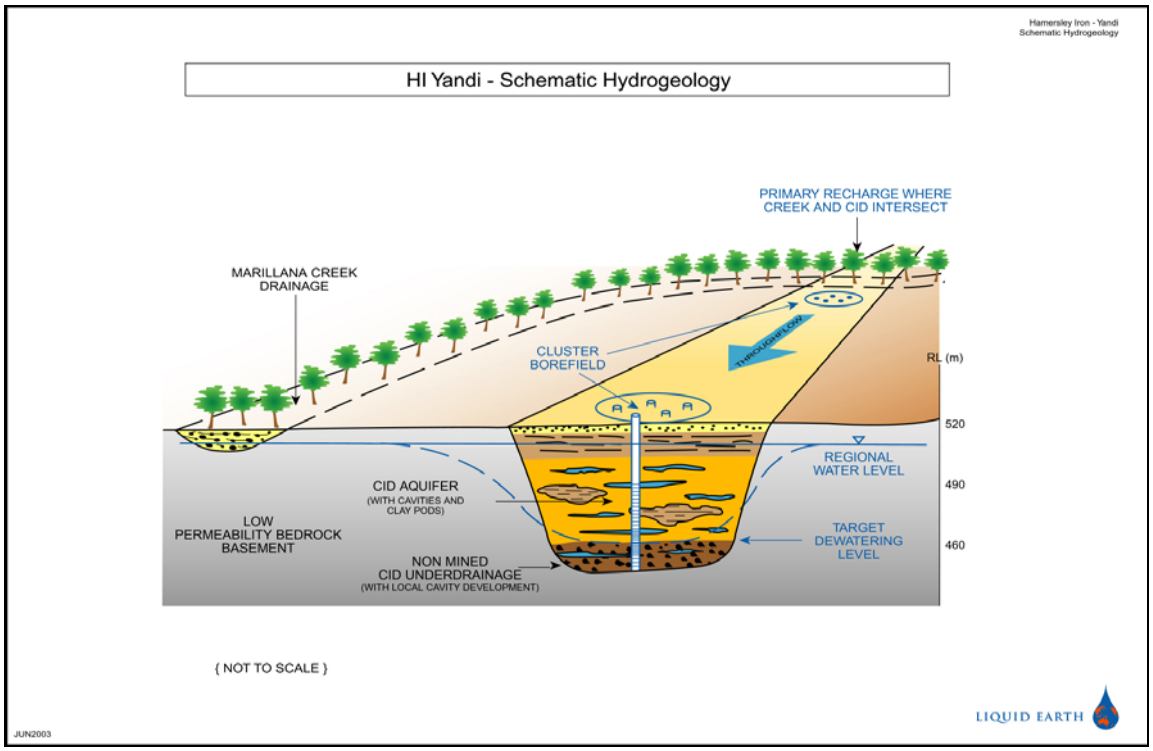


Figure 13 Schematic hydrogeology

Groundwater quality

Groundwater in the CID is fresh with salinities ranging from 150 to 600 mg/L. The water meets drinking water standards for inorganic chemicals.

Dewatering

Before dewatering commenced at Yandi JC, approximately 80% of the Yandicoogina ore body was below the water table (Liquid Earth 2005). The majority of the ore in the JSE CID is also below the watertable and dewatering will be necessary for mining. The impacts of dewatering activities at Yandi JC have so far been minor and affect only the northern part of the JSE deposit. Dewatering will be carried out as described in Section 3.2.1 and is similar to the current methodology used at Yandi JC. Current groundwater levels in the JSE CID are between 495 and 498 mRL.

Other activities

The BHPBIO Yandi mine, 12 km upstream of JSE operates a similar open cut mining operation with dewatering discharge to Marillana Creek. This discharge tops up the Creek alluvium and CID between BHPBIO and Yandi JC.

7.2 POTENTIAL SOURCES OF IMPACT

The following aspects of the proposal may temporarily impact on groundwater during mining:

- **Dewatering:** At the close of mining the JSE CID will have been dewatered to a level of 450 mRL. This dewatering will result in groundwater gradients towards the mine void and a cone of depression extending outwards from the CID into basement aquifers and along the CID.
- **Disposal of surplus water:** Surplus water will be discharged to the Marillana Creek system, recharging the alluvial aquifers during mining. The amount discharged to the surface may be reduced by reinjection (if feasible) to the Billiards CID.
- **Surface water flows:** A drainage system cuts across the southern area of the JSE deposit. Surface water management will be required to prevent the ingress of surface water into the mining operations. This will have the secondary impact of reducing recharge to the CID aquifer from this drainage system.
- **Hazardous materials or hydrocarbons:** The storage, handling or use of hazardous materials or hydrocarbons has the potential to contaminate groundwater.

The following aspect may cause long term impacts following mine closure:

- **Changed landform after closure:** The changed landform after mining has the potential to decrease throughflow in the CID aquifer through increased evaporation. This would concentrate the salts in the aquifer and result in local deterioration of water quality.

7.3 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA objective

The preliminary EPA objective, based on previous assessments for Hamersley and BHPBIO is:

- To ensure that alterations to groundwater flows or quality do not adversely impact on beneficial or environmental uses of the water and that the integrity, functions, and environmental values of watercourses are maintained.

Previous EPA advice in assessment reports on Hamersley operations at Yandicoogina have been incorporated into this EPS.

Regulatory framework

The abstraction of groundwater is subject to a licence issued by the DoE under the *Rights in Water and Irrigation Act 1914* that specifies the maximum abstraction rate and includes conditions for monitoring. Currently, the Junction Central mine operates with licences to take 10,000 Ml/a (GWL107422) and 150 ML/a (GWL153358).

Stormwater management, surface water discharges and potentially polluting activities are managed under a licence issued under the EP Act 1986. The Junction Central mine is currently operating under DOE licence L7340/7.

Water Resource Strategies

The Government of Western Australia developed the State Water Quality Management Strategy with the objective of "to achieve sustainable use of the Nation's water resources by protecting and enhancing their quality while maintaining economic and social development."

The State Water Quality Management Strategy requires that a Water Conservation Plan will be required before a water allocation licence is issued or renewed. The plan will outline water efficiency objectives and timeframes. Licence conditions will require implementation of the plan to an agreed schedule.

7.4 ASSESSMENT OF IMPACT AND MITIGATION

7.4.1 Dewatering

Dewatering of the mine pit will draw the watertable down resulting in a cone of depression around the mine pit. The dewatering will be carried out with cluster wellfields as described in Section 3.2.1. As the mining front progresses new cluster wellfields will be installed and previous wellfields mined through or decommissioned.

Figure 14 shows the predicted regional groundwater drawdown due to the proposed Yandi JSE mine at the end of mine life. The areas calculated by the model were based on the above average rainfall period from July 1998 to June 2004. This rainfall sequence was selected for modelling as it represents a conservative approach to avoid underestimating the amount of dewatering required and reflect the maximum discharges volumes. It is the most recent data which is likely to represent wetter sequences in long term rainfall.

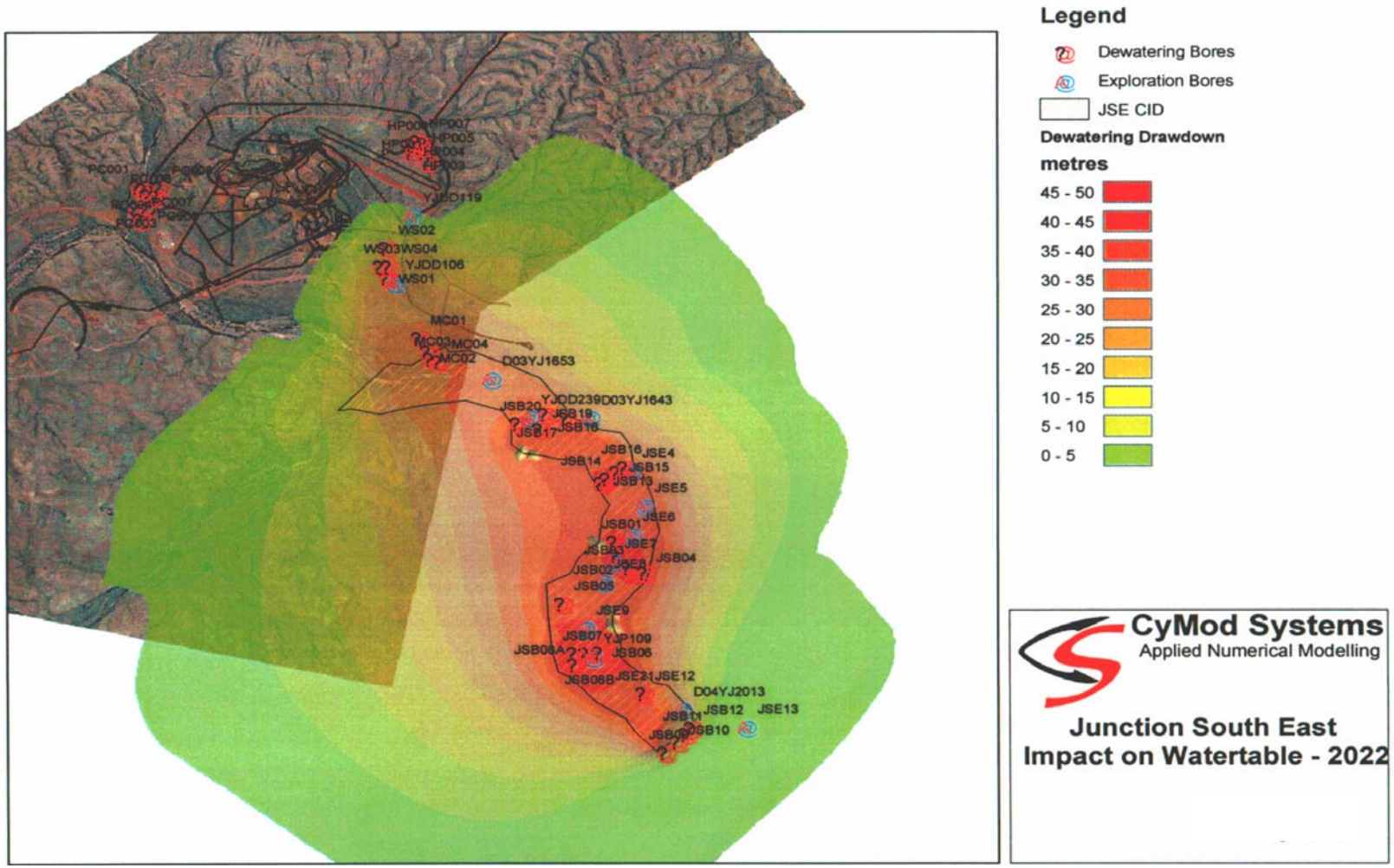


Figure 14 Local drawdown effect in CID in 2022 following mining

The model shows that drawdown will spread along the CID and to a lesser extent laterally into the basement Weeli Wolli Formation. The drawdown will not have a significant affect on the Billiards CID aquifer due to the poor hydraulic connection between the aquifers.

Dewatering in the JSE CID is not expected to influence watertables and associated groundwater dependent vegetation in the Weeli Wolli Creek as the alluvial aquifer in this area is perched with very limited hydraulic connection to the underlying CID aquifer (Liquid Earth 2005). Mining will be offset from the edge of the Marillana and Weeli Wolli Creeks by 200 m so will not have direct interference with the Creek and alluvials.

Marillana Creek alluvium between the JC and JSE CID and downstream may be impacted. Studies to date (Liquid Earth 2005) suggest that there is some hydraulic isolation between the alluvium and the CID but drawdown effects may occur over time as a result of both the approved JC CID dewatering and the proposed JSE CID dewatering. Disposal of dewatering water in Marillana Creek (Section 7.4.2) could be used to offset any unacceptable impacts of drawdown.

The monitoring program within the EMP will include monitoring of water levels in the Marillana Creek alluvium and underlying aquifer (Figure 9). Tree health in the adjacent Marillana-Yandicoogina Creeks may be affected and will also be monitored and contingency plans developed. See Section 9 for further discussion.

7.4.2 Disposal of surplus water

The predicted total water surplus from Hamersley's Yandicoogina mining is shown in Figure 11, assuming wet processing is operating at Yandi JC throughout this period and total use is approximately 18 ML/d. The surplus peaks at 30 ML/d in 2009 but the average for 2006 to 2010 is approximately 10 ML/d and decreases after that. There may be periods of water shortage after 2015 depending on rainfall patterns. The discharge peaks are caused by modelled high rainfall periods. A whole of site water balance for the Hamersley Yandicoogina mining operations will be included in the Water Management Plan included in the EMP.

Sump drainage and pumping will be required in addition to wellfield dewatering to "mop up" seepage into the pit and rain water inflows. Sump drainage is expected to be approximately 1-2 ML/d. The sump drainage water is generally slightly turbid and may have elevated nutrient levels. It will not be discharged to the environment but will be used preferentially and entirely in processing or dust suppression at Yandi JSE or JC (Figure 10).

Most dewatering will be carried out by clusters of wells. Dewatering water is of high quality and is suitable for discharge to the environment. The dewatering program will commence one year in advance of mining so that the initial dewatering volumes can be lower and more easily managed both in terms of infrastructure requirements and the environmental impacts of discharge, while still providing a dry mining surface within the required timeframe.

Surplus water from Yandi JC operations is currently discharged to the Marillana Creek system, predominantly downstream of the Marillana-Yandicoogina junction. Surplus water from Yandi JSE will be discharged to a similar location. The discharge would occur through new licensed and approved discharge outlets within the same area as the current discharge outlets. Surface impacts are discussed in Section 8.4.2. The current discharge sites for Yandi JC surplus water would be unsuitable as they are on the opposite side of the creeks.

The surface discharge will saturate a section of the Marillana alluvial aquifer and contribute some recharge to the CID. Recirculation of the discharge into the mine pit will be minimised by the location of the discharge.

Hamersley is investigating the potential to reinject a component of the dewatering discharge into the Billiards CID, down gradient of the JSE near the Weeli Wolli Creek (Figure 9). Reinjection would decrease the amount of water discharged down the Marillana and Yandicoogina Creeks. Reinjection would have no impact on the Weeli Wolli Creek system as the alluvial aquifer is perched and not connected to the Billiards CID.

Dewatering pipeline 1998

Preliminary investigations indicate that the Billiards CID aquifer may be suitable for reinjection. The aquifer is highly permeable, close to the mining operations and has a depth to water of 12m which is adequate for reinjection. The groundwater chemistry of the Billiards CID and the JSE CID are compatible. There is no apparent hydraulic connection between the two, thus eliminating the potential for recirculation of water back into the mining area. A comprehensive trial is planned in 2005[6] to confirm whether substantial reinjection rates are practical and sustainable in the long term. Results of that trial will be used to configure discharge strategies to be approved in groundwater licensing.

The proposed Hope Downs mine is located just over 20 km upstream of the JSE CID and has approval under Part IV of the EP Act to discharge its surplus water to the Weeli Wolli Creek. If this development proposal proceeds, there will be a significant (>30ML/d) discharge of water to Weeli Wolli Creek a few kilometres upstream of the JSE-Weeli Wolli CID junction. Under that scenario there would be little environmental benefit in pursuing reinjection of surplus JSE dewater (average of 10 ML/d) to the creek. These considerations will form part of the Water Management Plan in the EMP to be approved prior to groundwater licencing.

7.4.3 Surface water management

Surface water management will include levee and drain structures to prevent the ingress of surface water into the mining operations. These structures will also be used to catch the runoff water from around the plant and other infrastructure. Water from surfaces which may be contaminated by hydrocarbons will be processed through oil-water separators before entering any unlined drainage (Figure 10).

Redirection of surface drainage will have the secondary impact of reducing recharge to the JSE CID aquifer from this drainage system. During the life of the mine, this may reduce the amount of dewatering required by a small amount. After closure, the increased infiltration rates in the backfilled mine will counteract any reduced recharge from surface water diversions. Potential impacts of reduced recharge on groundwater dependent vegetation are discussed in Section 9.4.2.

[6] The trial pumping of groundwater from a test well situated within the JSE CID to a trial reinjection well situated within the Billards CID on the opposite side of Weeli Wolli Creek commenced on 17 August 2005; refer to Appendix 5 for more details.

7.4.4 Changed landform after closure

At the time of closure, the mine pit will have been dewatered to a level of 450 mRL. The water level will recover gradually after pumping ceases and within a few years a new equilibrium will be established. If the level of the backfilled pit was substantially lower than the original water table, a pit lake would form. In that situation the high evaporation rates and relatively small volumes of groundwater throughflow would cause the lake to become saline.

Groundwater throughflow is crucial to prevent the build up of salts caused by evaporation. Hamersley propose to backfill the JSE mine pit to 490 mRL, as this is the minimum level that will allow sufficient throughflow. This level is equivalent to groundwater levels in the Billiards CID aquifer at or near the confluence with JSE CID.

There will be insufficient waste rock from mining to backfill the pit to 490 mRL. Adjacent landforms are being assessed as potential sources of fill (Section 6.4.1). Use of such landforms for the purpose of backfill will be subject to the condition that removal of fill will be consistent with a final landform which sheds incident water from rainfall.

The long term cumulative impacts of mining and backfill of Yandi JSE and JC to 490 mRL have been modelled (Liquid Earth 2005). Results indicate that the permanent drawdown around the JSE would be 4-6 m. The highest drawdown would be associated with the Yandi JC operations with a drawdown near Phil's Creek of 14-16 m (Figure 15). This is due to the relatively higher original groundwater level of approximately 506 mAHD in that area.

Changes in water quality were also modelled and showed that the impact on water salinity of the partially backfilled pit was generally minor (from approximately 800 mg/L to 2000 mg/L) except in areas where the water level was close to the ground surface. There is a very small area near Weeli Wolli Creek where flow would be towards the backfill area allowing increased evapotranspiration and causing increased groundwater salinities. This would not affect regional water quality due to the very small area affected. Water quality in the alluvial aquifer would not be affected as it is not connected to the CID aquifers.

The highest concentration of salts would be associated with the approved Yandi JC mining operations near Phil's Creek as there would be a steep gradient from the CID into the backfill resulting in high evaporation and concentration of groundwater salts up to 10,000 mg/L (Figure 16).

Near the Weeli Wolli Creek, the modelled salinity reaches up to 5000 mg/L in a very small area at the edge of the backfilled pit where the groundwater flow is towards the pit from the south east.

Until equilibrium is reached there will be a hydraulic gradient from the Billiards CID to the mine pit. Very little throughflow will occur during this time and salinity will increase at the southern edge of the JSE CID (Figure 16). When equilibrium is reached there will be a slow groundwater throughflow from the JSE CID to the Billiards CID through the partial hydraulic barrier that exists between the two. This will export the saline water into the large high flow Billiards CID where it will be diluted and prevent further accumulation of salts at the interface between the two aquifers.

7.4.5 Hazardous materials and hydrocarbons

Groundwater contamination from hazardous materials or hydrocarbons will continue to be managed under the current mine EMS and through the Water Management Plan and other sections of the EMP.

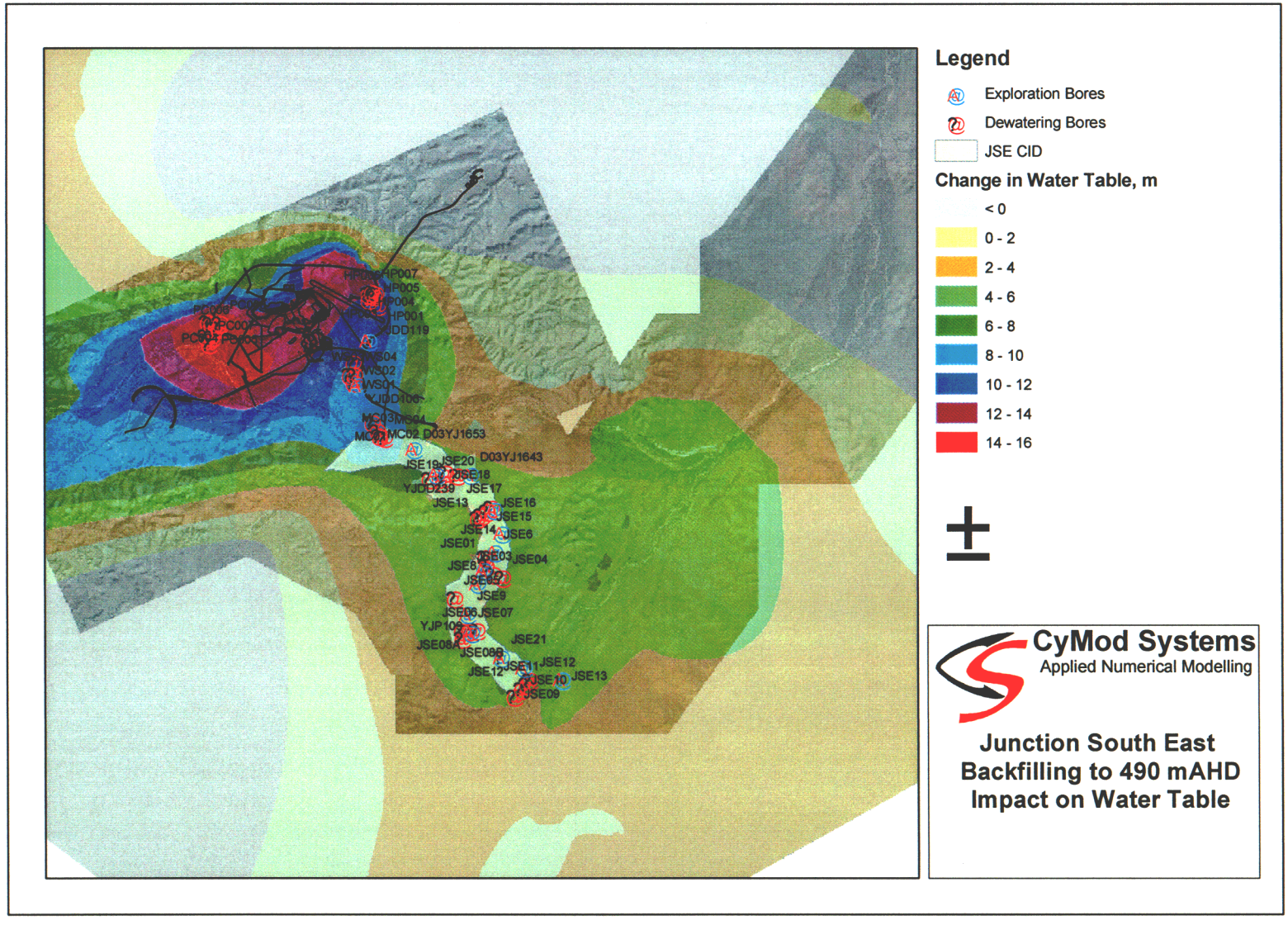


Figure 15 Long term water level impacts after mine void backfilling to 490 mRL

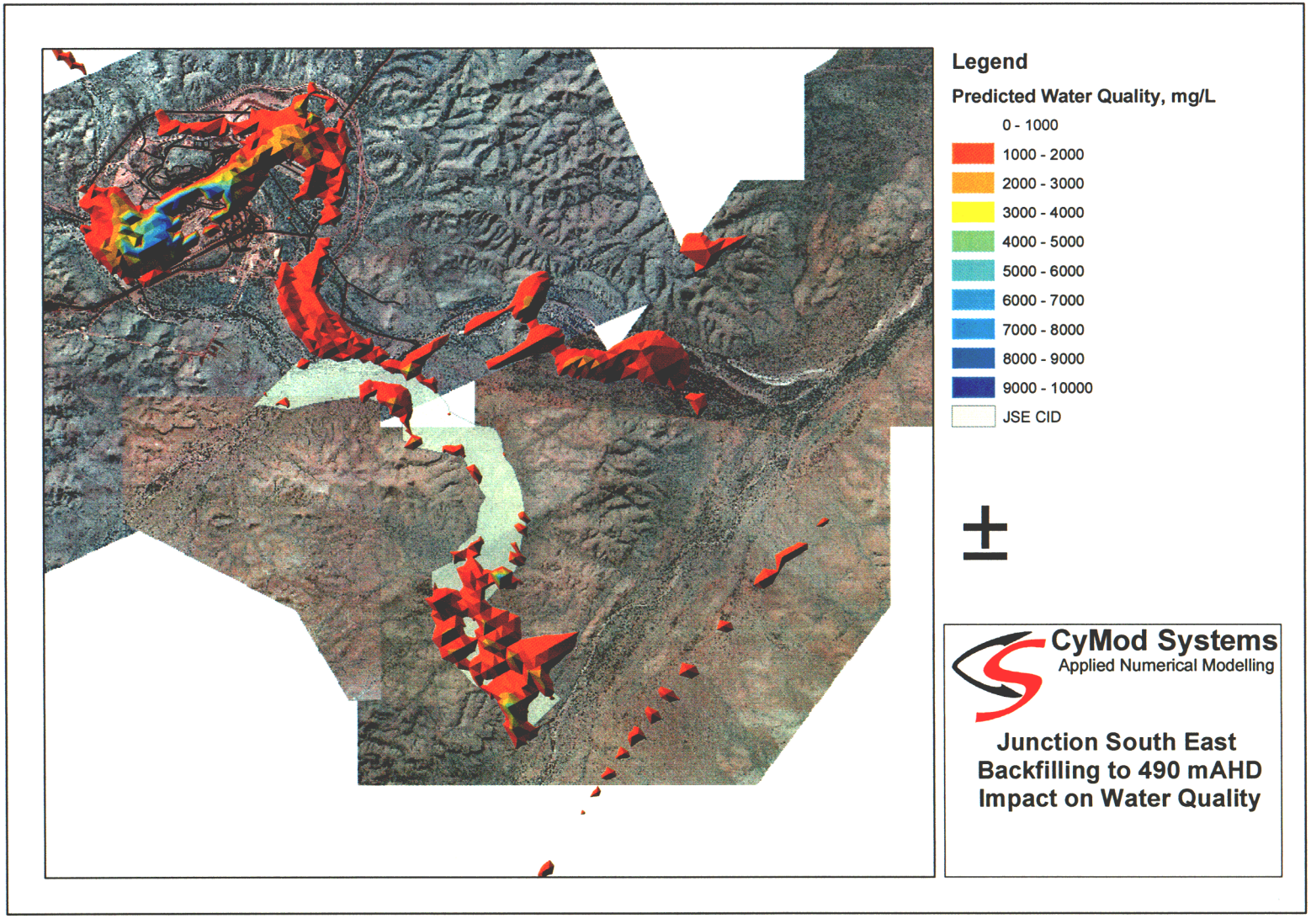


Figure 16 Long term water quality impacts after mine void backfilling to 490 mRL

7.4.6 Monitoring and adaptive management

A schedule of groundwater level and quality monitoring will be prepared as part of the Water Management Plan in the EMP which will be submitted to the DoE prior to the commencement of dewatering as part of the Licence to Take Water application. The proposed cluster wellfield and monitoring wells are shown in Figure 9.

Baseline

Monthly monitoring of water levels and regular water quality monitoring will be conducted prior to dewatering operation commencing.

Dewatering monitoring

The dewatering program will include:

- measurement of abstraction rates and discharge (both cumulative and instantaneous)
- monitoring water levels in production and monitoring wells
- monitoring water quality in production wells, sump discharge and any disposal discharge locations. Field measurements of EC, pH and temperature monthly and detailed water chemistry analysis annually.

A detailed monitoring schedule will be prepared after the production wells have been drilled, constructed and test pumped.

Closure

Groundwater level and quality monitoring continue for a number of years after closure to confirm the predictions of the closure model. The details of the monitoring program and contingencies plans should the predictions not be met will be included in the Closure Plan, which is to be revised to incorporate Yandi JSE, and incorporated into the Decommissioning and Rehabilitation Plan (Section 12).

Adaptive management

Groundwater monitoring will be part of an adaptive management framework for wellfield operation described in the Water Management Plan in the EMP. The framework includes contingency planning for unexpected changes or rates of change of groundwater levels and response to results of creekline tree monitoring (Section 9.5).

7.4.7 Water use efficiency

As a subsidiary of Rio Tinto, Hamersley is required to comply with the Rio Tinto Environment Standard on Water Use and Quality Control (Appendix 2). This standard includes minimising usage of fresh water and maximising water reuse and recycling. The Water Management Plan in the EMP will include measures to comply with this standard.

A preliminary whole of site water balance model for the entire Yandicoogina operation (including Yandi JSE) has been developed using the *Goldsim* model package (Section 3.3), which will be refined as part of the preparation of the Water Management Plan in the EMP.

7.5 PROPONENT COMMITMENTS

Issues relating to groundwater at Yandi JSE will be covered by the following new proponent commitments (new proponent commitment number in parenthesis):

General

- Comply with relevant legislation (1).
- Refer significant amendments to project for assessment (2).
- Continue to:
    - evaluate options for long term management of hydrogeological issues, including re-injection (3)
    - monitor surface and groundwater levels in the Weeli Wolli Creek system (4)
    - collect necessary hydrogeological data for the refinement of the model used to predict long term water levels and quality in the final void (5).
- Environmental audits and reporting (6, 7).

Use of Backfill Hill

- The use of adjacent landforms for the purpose of backfill will be subject to the criterion that removal of fill will be consistent with a final landform which sheds incident water from rainfall (16).

EMP

- Review and revise existing Yandicoogina EMP to include a full Water Management Plan that addresses groundwater management issues arising from Yandi JSE, including (17):
    - investigation of the feasibility of re injecting surplus water from dewatering to the Billiards aquifer
    - dewatering and discharge monitoring program for both Yandi JC and JSE
    - a full whole of site water balance for the Yandicoogina mining operations
    - a water conservation strategy for the entire operation
    - use of any poor quality water onsite.

Decommissioning and Rehabilitation Plan

- Hamersley will revise its approved Closure Plan to address the strategy for management of long term hydrogeological consequences of mining for both Yandi JC and JSE. The plan will be incorporated into the Conceptual Decommissioning and Rehabilitation Plan to be revised every five years. The strategy will be fully detailed in a Final Decommissioning and Rehabilitation Plan due two years prior to decommissioning of the project (18, 19).

CEMP

- A Construction Environmental Management Plan (CEMP) (Section 13.4) will include provisions for groundwater protection during construction (20).

These commitments are included in full in Table 13.

7.6 OUTCOME

The water levels in the creek alluvium near the discharge outlets will be higher throughout the year. This will have no significant impact on the regional hydrology. If reinjection proceeds, the water levels and throughflow in the Billiards CID near the reinjection point will be slightly higher but will not affect the overlying perched aquifers hence not affecting use of the superficial watertable.

There will be a cone of depression around the mine pit during dewatering but this will have only a limited and localised affect on the Billiards CID due to a hydraulic barrier at its junction with the JSE CID. The Weeli Wolli Creek alluvial aquifer is not likely to be impacted due to the distinct hydraulic separation from the underlying Billiards CID and hence there is little potential for the integrity, functions, and environmental values of Weeli Wolli Creek to be affected, consistent with the EPA objective for groundwater.

It is possible that the Marillana Creek alluvium between the JC and JSE CID and downstream may be impacted by groundwater drawdown during mining. If monitoring indicates that a drawdown of water levels in the alluvium is occurring, disposal of dewatering water in Marillana Creek will be used to offset any unacceptable impacts of drawdown.

After closure and backfilling to 490 mRL there will be localised changes to CID flows and an increase in salinity due to evaporation near the JSE junction with Billiards and near Phil's Creek to the north (part of the existing Yandi JC operation). These isolated changes will not have a significant impact on regional groundwater flow or quality and hence will not adversely impact on beneficial or environmental uses of the water, consistent with the EPA objective for groundwater.

8. SURFACE WATER

8.1 DESCRIPTION OF FACTOR

The creeks in the Pilbara are naturally ephemeral and streamflow around Yandi JSE is completely dependent on rainfall. In normal circumstances, streams are dry for most of the year (flow occurs about 30 to 60 days/yr) except for occasional pools. Streamflow after a rain event generally peaks within 24 hours, however minor stream flow can continue for days after the peak has passed.

Water samples collected from the DoE Flat Rocks gauging station on the Marillana Creek have been fresh and slightly acidic to slightly alkaline. Salinities range from 100 to 700 mg/L with an average of about 430 mg/L.

The Marillana Creek system is naturally ephemeral but discharges of surplus water from both BHPBIO and Hamersley mining operations have created permanent flow conditions in some sections (Figure 17). Discharges create surface flow for a short distance downstream before infiltrating into the alluvial sediments. Currently, about 10-15 ML/d is discharged from the Yandi JC operation to the Marillana and Yandicoogina Creeks resulting in minor surface flow in Yandicoogina Creek down to the road crossing approximately 1 km down stream, but only rare surface flows downstream of that. However, saturated conditions are maintained in much of the creek alluvial aquifer for several kilometres down stream of the outlets.

Surplus water from Yandi JC is discharged through four outlets designed to minimise impacts on vegetation and to contribute to aquifer recharge in the downstream CID. Wet processing at Yandi JC will utilise surplus water from the existing operation and discharges are expected to decline significantly or cease when this facility is commissioned until dewatering for the Yandi JSE project begins. The quality of surplus water discharge is monitored on a quarterly basis and is reported to DoE in the Annual Environmental Report. The concentration of total dissolved solids ranges from 400 to 550 mg/L and the pH ranges from 6.8 to 7.1 in discharged water.

BHPBIO currently discharges around 10 ML/d of mine dewatering water to the Marillana Creek further upstream. This water creates permanent flow in the creek for a short period before infiltrating into the underlying alluvial aquifer where it flows as far downstream as the Yandi JC operation.

1998

2000

Figure 17 Site of outflow site into Marillana Creek from dewatering at Yandi JC

8.2 POTENTIAL SOURCES OF IMPACT

The following aspects of the proposal may impact on groundwater:

- **Drainage management** will alter flow paths with:
  - permanent diversion structures around mine pits (Section 6.4.2)
  - temporary infrastructure such as roads.
- **Disposal of surplus water:** Surplus water from mining operations to be discharged to the Marillana / Yandicoogina Creek system through appropriate outlet structures (Section 7.4.2).
- **Creek crossings:** There will be two additional creek crossings required across Yandicoogina Creek.
- **Changed landform after closure**.

8.3 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA objective

The preliminary EPA objective, based on previous assessments for Hamersley and BHPBIO is:

- To ensure that alterations to surface water flows or quality do not adversely impact on beneficial or environmental uses of the water and that the integrity, functions, and environmental values of watercourses are maintained.

Regulatory framework

Stormwater management, surface water discharges and activities that emit to the environment are managed under a licence issued under the EP Act 1986. Yandi JC is currently operating under licence number 7340/7.

ANZECC/ARMCANZ

The Australian and New Zealand Environment and Conservation Council (ANZECC) together with the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) have released a set of water quality guidelines for the protection of marine and freshwater ecosystems (ANZECC/ARMCANZ 2000).

The ANZECC/ARMCANZ guidelines provide a comprehensive list of recommended low-risk trigger values for physical and chemical stressors in water bodies, broken down into five geographical regions across Australia and New Zealand. The guidelines and their application to mining are discussed in Batley *et al*. (2003).

Water Resource Strategies

The Government of Western Australia developed the State Water Quality Management Strategy with the objective "to achieve sustainable use of the Nation's water resources by protecting and enhancing their quality while maintaining economic and social development."

8.4 ASSESSMENT OF IMPACT AND MITIGATION

8.4.1 Drainage management

Existing drainage patterns will be altered to prevent surface water flowing into the mining area. A major diversion structure will be installed across the southern area of the JSE deposit and at the northern end of the JSE near Marillana Creek. In addition, a series of drains and levee banks will be constructed to divert surface water around the mining operations. The diversion structures will detour flows that intersect the mining operations but the destination of flows (Section 6.4.2, Figure 12) and their volumes will remain the same.

All diversion structures and drains will be stabilised and revegetated with local creek plant species to prevent erosion and associated water quality impacts.

8.4.2 Disposal of surplus water

The proposed discharges from the combined Hamersley Yandicoogina operations will occur around the current discharge sites in the Marillana Creek system (Figure 9), which has the following advantages:

- surplus water is already being discharged to this creek system
- the Yandi JC discharges will reduce when wet processing begins and the JSE discharges will replace those flows.

The water quality of the discharged dewatering is very high, sometimes with lower levels of dissolved salts than surface waters. Thus any impacts will be from water quantity and flow issues rather than any potential to degrade surface water quality. Sump water, which may be high in suspended sediments or nutrients will be retained and used on site (Figure 10).

The discharge design, monitoring and reporting will be subject to the environmental licence issued under the EP Act for Yandi JC and JSE and will be managed in a similar way to existing discharges. The discharge will infiltrate the alluvial sediments and create a continuous surface flow for possibly 1 to 2 km downstream in Marillana Creek in the first half of mine life. There will be no significant change in flood flows in the creek system attributable to Yandi JSE discharge.

Reinjection to the Billiards CID could reduce the discharge of surplus water but it is anticipated that some surface discharge will be required even if reinjection is proven feasible, especially during the early stages of dewatering[7].

8.4.3 Creek crossings

Two new ford style creek crossings will be installed on Yandicoogina Creek (Figure 8):

- one will be required for heavy vehicles to the north of the orebody with realignment of the existing unsealed road to Newman
- one will be required for a light vehicle crossing of Yandicoogina Creek to the west of the orebody alongside the conveyor bridge crossing.

[7] The trial pumping of groundwater from a test well situated within the JSE CID to a trial reinjection well situated within the Billards CID on the opposite side of Weeli Wolli Creek commenced on 17 August 2005; refer to Appendix 5 for details.

These crossings will be installed in the ford style of construction that is currently in use elsewhere by Hamersley and BHPBIO on the Marillana Creek. The ford crossings will be temporary structures and designed to be overtopped by most floods; rip rap may be placed on the upstream and downstream batters to provide some protection. The fords will likely need to be repaired after each major flood. Ford crossings may empound surface water upstream during periods of low flow, although the creek alluvials under the crossing should continue to allow subsurface flows.

A conveyor and light vehicle bridge will be constructed across Yandicoogina Creek to the west of the orebody where the floodplain of the creek is approximately 500m wide (Figure 8). The bridge will be designed to support a conveyor and a single traffic lane across the floodplain, and will be of similar construction to the existing conveyor bridge crossing of Marillana Creek. This design includes upstream guide banks to direct flow through the bridge waterway. A flood model has been used to design an appropriate bridge waterway opening taking into account bridge afflux (rise in water level due to the bridge) and flow velocities.

Hamersley will also ensure construction of creek crossings is managed under an 11/17/21A permit to modify bed and banks.

8.4.4 Changed landform after closure

After closure of mining operations, the mine pit will be backfilled to at least 490 mRL forming a "U" shaped channel depression with a base 10 to 15 m lower than the surrounding landscape, which may support surface expression of groundwaters at some times. This water may have salinities to 2000 mg/L. Diversion structures (drains, levees) would remain in place to prevent flow from surrounding areas accumulating in the depression. New minor drainage lines are likely to form down the slopes of the new landform. The depression is separated from the creek systems by a 200 m setback and bunding and external drainage will be permanently diverted around the depression. Closure is discussed further in Section 12.

8.4.5 Management plans

A revised Water Management Plan is being prepared as part of an updated EMP and will provide detail on the management of surface water issues of the combined Yandi JC and JSE projects.

The Water Management Plan will include monitoring creek levels, water quality and discharge water quality and establish management goals under the State Water Quality Management Strategy.

A CEMP (Section 13.4) and the Works Approval application for construction of the plant will include provisions for surface water management during construction.

8.5 PROPONENT COMMITMENTS

Surface water issues at Yandi JSE will be covered by the following new proponent commitments (new proponent commitment number in parenthesis):

General

- Comply with relevant legislation (1).
- Refer significant amendments to project for assessment (2).

- Continue to:
  - evaluate options for long term management of hydrogeological issues, imcluding re-injection (3)
  - monitoring surface and groundwater levels in the Marillana Creek system (4)
  - collect necessary hydrogeological data for the refinement of the model used to predict long term water levels and quality in the final void (5).
- Environmental audits and reporting (6, 7).

EMP

- Review and revise existing Yandicoogina EMP to include a full Water Management Plan that addresses surface water management issues arising from the mining area extension (17).

CEMP

- A CEMP (Section 13.4) and the Works Approval application for construction of the plant will include provisions for surface management during construction (20).

These commitments are included in full in Table 13.

8.6 OUTCOME

The discharge of surplus water from Yandi JC operations to the Marillana Creek system has resulted previously in small, localised impacts on the creek system. The proposed discharges from the combined Hamersley Yandicoogina operations will occur around the current discharge sites and result in continued minor flows to creeks. Continuous flows will occur for a short distance downstream of the discharge sites before infiltrating into the alluvial aquifer. Consistent with the EPA objective for surface water, these temporary alterations to surface water flows should not adversely impact on identified beneficial or environmental uses of the water providing they are managed carefully under the EMP. The general integrity, functions, and environmental values of the Marillana Creek system will be maintained through regular monitoring and control of discharges.

Reinjection might further reduce the surplus water discharge but would be of little environmental benefit if the approved discharges into Weeli Wolli Creek from Hope Downs were to occur.

Minor changes in drainage flows associated with earthworks will not impact the quality or quantity of water in the creeks.

9. VEGETATION AND FLORA

9.1 DESCRIPTION OF FACTOR

The project area is within the Fortescue Botanical District of the Eremaean Botanical Province as defined by Beard (1975) and is located near the boundary of the Hamersley and Fortescue sub-regions of the Pilbara Biogeographic Region as defined by the Interim Biogeographic Regionalisation for Australia (Environment Australia 2000). The majority of the project area is typical of the Hamersley sub-region and the major creek systems (Marillana, Yandicoogina and Weeli Wolli Creek) forming part of the Fortescue sub-region (Biota 2004a).

Various biological studies have been undertaken in the Yandicoogina area as part of the environmental impact assessment process for both BHPBIO and Hamersley. In addition, Hamersley botanists conduct ongoing targeted surveys for rare and priority plants in areas nominated for disturbance across Hamersley's leases. Most recently, Biota Environmental Sciences conducted a flora and vegetation survey of the Yandi JSE area in accordance with EPA Guidance Statement 51 (Biota 2004a). The following description of vegetation and flora for the Yandi JSE area is from the Biota (2004a) survey, unless otherwise stated.

Pilbara Region Biological Survey

The Pilbara Region Biological Survey, a five year investigation by CALM and the WA Museum (2002-2007), is underway to provide an improved understanding of Pilbara biodiversity and its conservation needs. Hamersley is assisting the study through the provision of relevant data and logistic support. Results from the Survey will provide for the:

- development of a framework to guide sustainable land-use and conservation planning in the Pilbara
- appraisal of the region's conservation reserve system
- improvement of the environmental impact assessment of developments
- verification of the distributional information for threatened species and ecological communities
- provision of detailed information on stygofauna
- documentation of new information about flora and fauna.

9.1.1 Vegetation

Biota (2004a) identified 20 vegetation types within the Yandi JSE area. These are listed and described in Appendix 3 and mapped in Figure 18.

The vegetation types fall into three main vegetation groups, related to topography. These vegetation groups are described in Table 6 and examples of each shown in Figure 19.

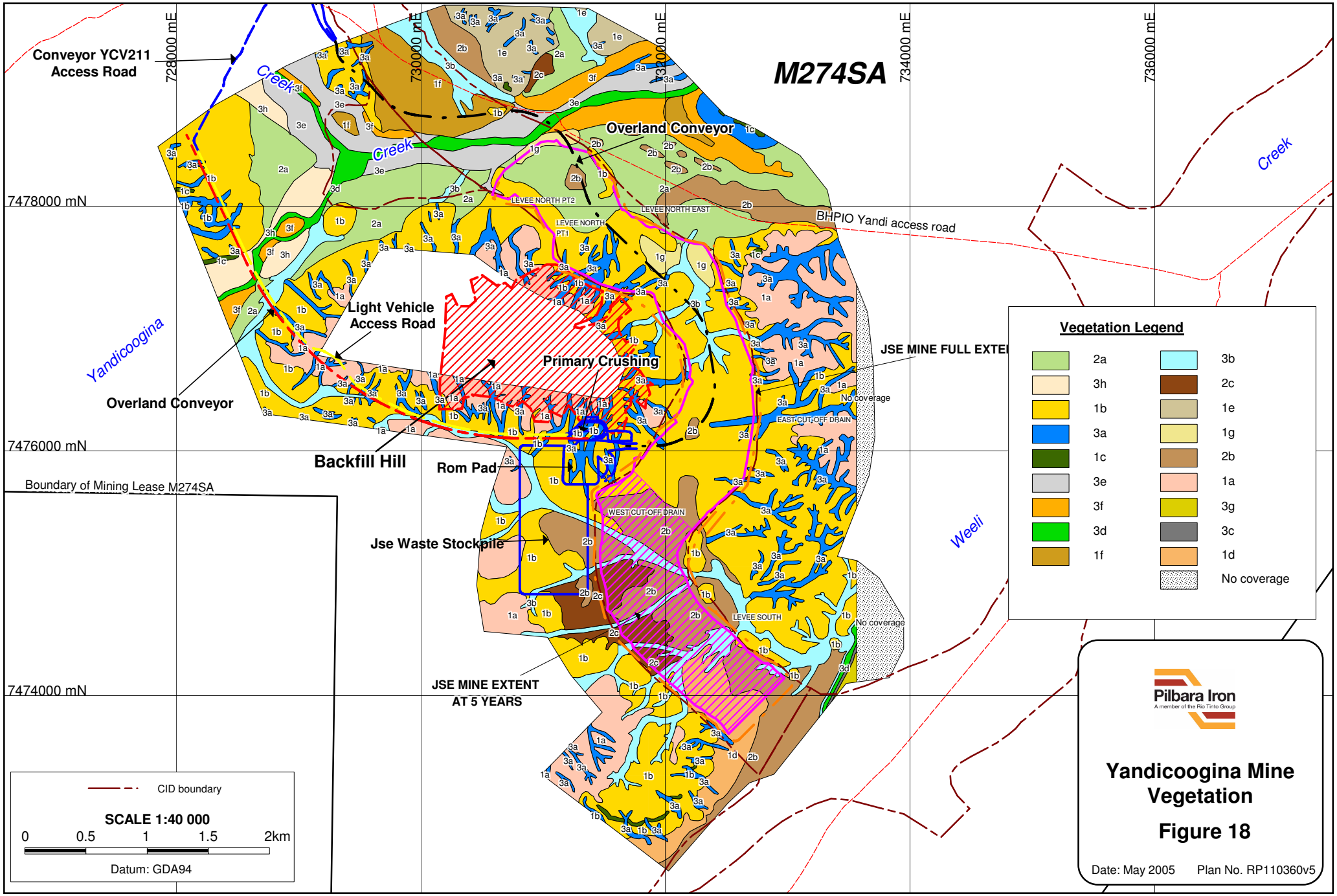

M274SA
728000 mE
730000 mE
732000 mE
734000 mE
736000 mE
7478000 mN
7476000 mN
7474000 mN
Conveyor YCV211 Access Road
Creek
Creek
Creek
Creek
Overland Conveyor
LEVEE NORTH PT2
LEVEE NORTH EAST
LEVEE NORTH PT1
BHPIO Yandi access road
Yandicoogina
Light Vehicle Access Road
Primary Crushing
JSE MINE FULL EXTE
Overland Conveyor
No coverage
EAST CUT-OFF DRAIN
Backfill Hill
Rom Pad
Boundary of Mining Lease M274SA
WEST CUT-OFF DRAIN
Jse Waste Stockpile
Weeli
LEVEE SOUTH
No coverage
JSE MINE EXTENT AT 5 YEARS
Vegetation Legend
2a
3h
1b
3a
1c
3e
3f
3d
1f
3b
2c
1e
1g
2b
1a
3g
3c
1d
No coverage
CID boundary
SCALE 1:40 000
0 0.5 1 1.5 2km
Datum: GDA94
Pilbara Iron
A member of the Rio Tinto Group
Yandicoogina Mine Vegetation
Figure 18
Date: May 2005
Plan No. RP110360v5

Table 6 Description of vegetation groups

Vegetation group	Vegetation types*	Description
Low stony hills	1a to 1g	Low stony hills generally with a scattered overstorey of *Eucalyptus leucophloia* (Snappy Gum), *Corymbia hamersleyana* (Bloodwood), *Acacia inaequilatera* (Kanji) and/or Hakea *chordophylla* over moderately dense spinifex, predominantly *Triodia* aff. *basedowii*, with some *Triodia wiseana* on slopes.
Valleys (Mosaic communities)	2a to 2c	Undulating, low stony plains in valleys generally comprising of *Corymbia hamersleyana* (Bloodwood) over sparse mixed shrubs and various species of spinifex. Alluvial flats are dominated by *Acacia aneura* (Mulga) and other *Acacia* communities over moderately rich assemblages of shrubs, herbs and tussock grasses, as well as spinifex, *Triodia wiseana* and *T. pungens*.
Creeks	3a to 3h	Drainage lines vary from small gullies in upper hills to more major creeklines in the Hamersley Ranges (Weeli Wolli, Yandicoogina and Marillana Creeks). Small, stony creeks in hills differ very little from the vegetation type surrounding them, and are usually species poor with occasional Eucalypts over *Triodia* aff. *basedowii* and *T. wiseana*. Lower in the landscape, they become more densely vegetated and species rich, including Eucalypt and Bloodwood species, shrubs, annual and perennial tussock grasses and herbs. Major creeklines comprise of woodlands and forests of *Eucalyptus camaldulensis* (River Red Gum), *E.* victrix (Coolibah) and other tree species over mixed shrublands, grasslands and herbs. Spinifex (usually *Triodia pungens* or *T. longiceps*) is comparatively sparse in drainage lines. Typical shrubs in drainage lines include *Acacia coriacea* subsp. *pendens* (major creeks only), *A. ancistrocarpa* (mainly in minor creeks), *A. bivenosa*, *A. pyrifolia*, *A. tumida* var. *pilbarensis*, *Gossypium robinsonii* and *Petalostylis labicheoides*. Major creeks sometimes have areas of apparent permanent or persistent water, that support specialised water plants.

* Refer to Appendix 3 for full descriptions.

Based on the vegetation mapping undertaken by Biota (2004a), the vegetation of Backfill Hill is expected to comprise of vegetation types 1a and 1b, associated with the hills, and vegetation type 3a, associated with minor creeks[8].

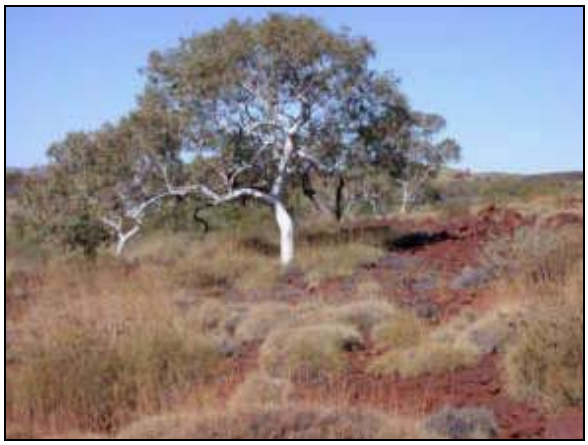
No Threatened Ecological Communities (TECs) listed under the *Environment Protection and Biodiversity Conservation Act 1999* or by CALM are known from the Yandi JSE area.

Vegetation condition

Biota (2004a) found that the main signs of disturbance to vegetation resulting from human activities are land clearing and dust associated with mining activities, fire and the presence of weeds (see Section 9.1.3 for more details pertaining to weeds). Clearing is limited to the network of vehicle tracks and drill pads associated with exploration and development. Although dust is evident on vegetation along main tracks this does not appear to have had any obvious effect on vegetation condition.

Approximately one third of the area surveyed by Biota (2004a) for the JSE project had been burnt (for pastoral purposes) two weeks prior to the survey being undertaken. As fire is a regular part of the landscape here, this area is expected to regenerate fully and the vegetation condition is not considered to have declined.

[8] A vegetation and flora survey of Backfill Hill was undertaken between 31 May and 2 June 2005; refer to Appendix 5 for details and results.



Low stony hills (vegetation type 1b): Low open woodland (*Eucalyptus leucophloia*) over *Acacia* shrubland and tussock grassland

Low stony hills (vegetation type 1e): Scatted *Acacia* shrubland over tussock grassland

Valleys (vegetation type 2a): Scattered *Corymbia hamersleyana* over tussock grassland

Valleys (vegetation type 2b): Low *Acacia* woodland over tussock grassland

Creeks (vegetation type 3c): Major creek bank (Weeli Wolli Creek) – *Eucalyptus camaldulensis* over exotic grasses

Creeks (vegetation type 3d): Major creek bed (Yandicoogina Creek) – *Eucalyptus camaldulensis* over scoured river bed

Figure 19 Examples of the major vegetation groups and associated vegetation types (Photos: Biota 2004a)

Increase in creek vegetation due to discharges

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

9.1.2 Flora

A total of 319 taxa of native vascular flora from 150 genera belonging to 53 families were recorded in the Yandi JSE area during the recent survey (Biota 2004a). The dominant families being Poaceae (grass family), Malvaceae (hibiscus family), Mimosaceae (wattle family), Papillonaceae (pea family), Asteraceae (daisy family) and Amaranthaceae (mulla-mulla family). These families are typically predominant in the vegetation of the central Pilbara.

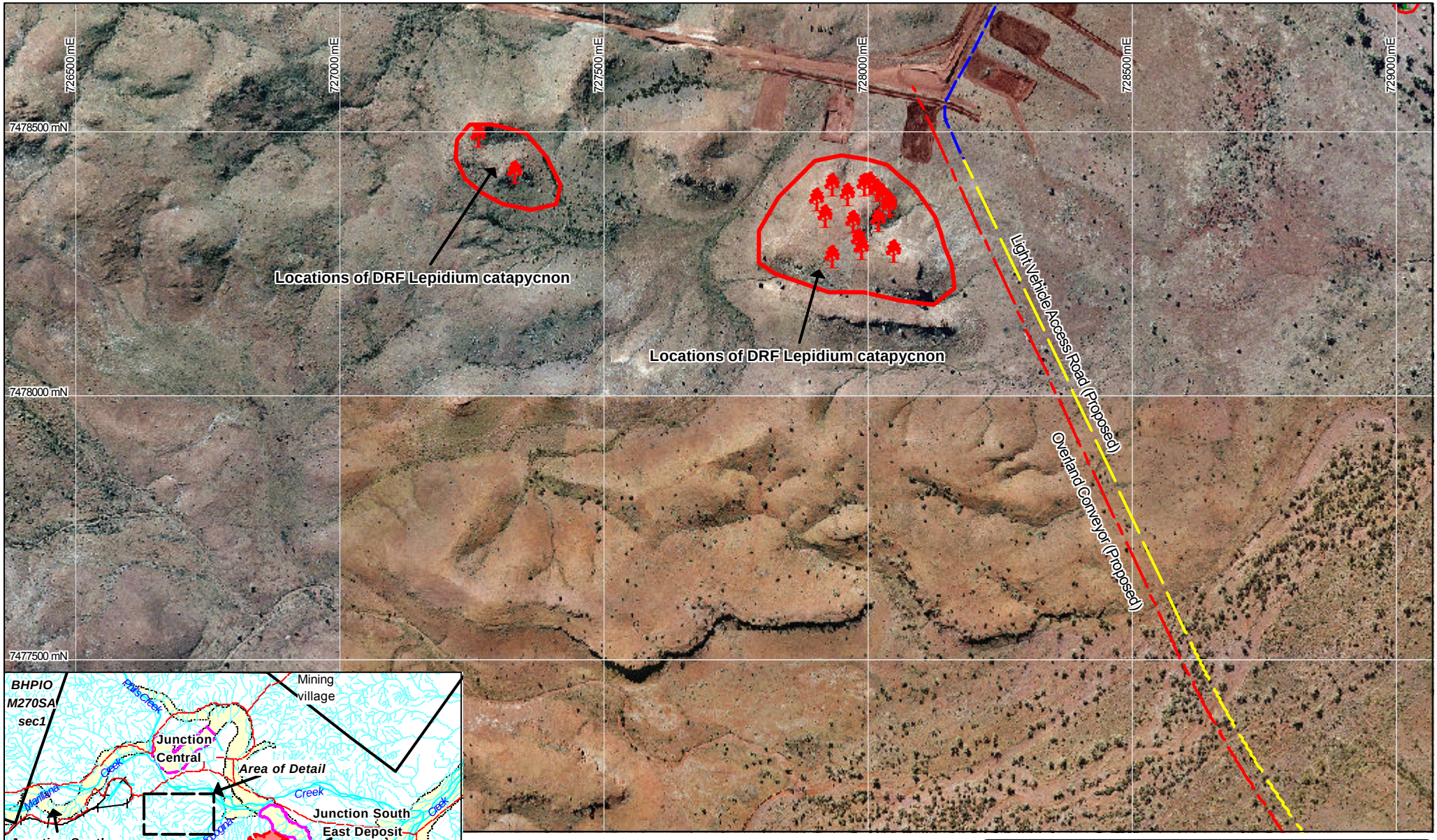
The only Declared Rare Flora (DRF) recorded from the JSE area are a small number of *Lepidium catapycnon* found by Hamersley surveys within a restricted area around the junction of the proposed new conveyor with the existing Yandi JC conveyor (Figure 20).

No DRF were recorded in the Biota (2004a) survey, however several species of Priority Flora were found:

- *Olearia fluvialis* (Priority 2): perennial, low-shrub that appears to be quite uncommon, rather than rare, and is restricted to sporadic populations in creek habitats.
- *Sida* sp. Barlee Range (S van Leeuwen 1642) (Priority 2): low shrub recorded from a single site on the bank of Yandicoogina Creek.
- *Themeda* sp. Hamersley Station (M. E. Trudgen 11431) (Priority 3): perennial tussock grass and, although only recorded from one site in the Yandi JSE area, has been recorded from other sites within the region.
- *Abutilon trudgenii* ms. (Priority 3): low shrub that is poorly collected rather than rare.
- *Goodenia stellata* (Priority 4): small rhizomatous perennial herb and, although only recorded from one site in the Yandi JSE area, has been recorded from other sites within the region.

Most of these species were recorded in association with creek vegetation communities and are expected to have a low probability of occurring on the low stony hills, such as Backfill Hill.

Biota (2004a) also identified several species of flora, not listed as DRF or Priority species, but that may be of some conservation interest due to being poorly collected or undescribed. These include, apparently undescribed species of *Malvaceae*, *Euphorbia*, *Tephrosia, Polymeria* aff. *ambigua* and forms of *Indigofera monophylla*. All these species have been recorded previously in the region and are not restricted to the Yandi JSE area.



Nominal Scale: 1:10,000

0.1 0 0.1 0.2 0.3 0.4 0.5km

MGA Zone 50, GDA94

HAMERSLEY IRON PTY. LIMITED

Figure 20

Locations of DRF Lepidium catapycnon near western end of new conveyor from Yandi JSE.

9.1.3 Introduced flora

Biota (2004a) recorded 13 weed species within the Yandi JSE area, with the following species being the most widespread in the JSE area:

- *Cenchrus ciliaris* (Buffel grass)
- *Malvastrum americanum* (Spiked malvastrum)
- *Setaria verticillata* (Whorled pigeon grass)
- *Argemone ochroleuca* subsp. *ochroleuca* (Mexican poppy).

These weed species are also widespread in the Pilbara region.

9.1.4 Conservation significance of vegetation and flora

National and State level

Aside from the few *Lepidium catapycnon*, there are no features of national conservation significance (e.g. species or TECs listed under the EPBC Act) within the Yandi JSE project area. As DRF, *L. catapycnon* is listed under Schedule 1 of the *Wildlife Conservation (Rare Flora) Notice 2005* and listed under the *EPBC Act 1999* as Vulnerable. Five Priority Flora are known to occur, but are not abundant. No TEC's are listed by CALM for the area.

Pilbara bioregion level

At the Pilbara bioregion level, the vegetation types recorded from the area do not appear to be restricted in the region in terms of their floristic composition. With the exception of the Priority Flora (particularly *Olearia fluvialis* and *Sida* sp. Barlee Range), the flora species recorded are relatively common and widespread in the Pilbara bioregion.

Hamersley Ranges sub-region level

The suite of flora species recorded from the Yandi JSE area is largely typical of that expected for this part of the Hamersley Ranges and the area has moderate conservation value for both general flora and significant flora species.

The vegetation types occurring in the major creeks in the JSE area are of conservation interest at the scale of the Hamersley Ranges as large creek systems that have persistent or available water do not occur extensively within the Hamersley Ranges. These typically have high relative species richness and support numerous flora (and fauna) species that are restricted to and reliant on such habitat. All ephemeral watercourses of the Hamersley sub-region are considered to be at risk, as they are frequently subject to threatening processes, particularly heavy grazing pressure and weed infestation (Kendrick 2001).

Biota (2004a) also identified the vegetation of the breakaways as being of high conservation interest at the Hamersley Range scale. Although breakaways are widespread through the Hamersley Ranges, they comprise only a small proportion of the area, and typically support restricted flora species.

9.1.5 Survey limitations

Biota (2004a) did not survey the hill preferred to be mined for sourcing the backfill required for mine closure, 'Backfill Hill' (Figure 18). That area is scheduled for survey in June 2005[9]. However, Biota (2004a) surveyed a similar hill to the south of the CID that was originally proposed to be mined for backfill. This hill was used as an analogue for describing the vegetation of Backfill Hill in this description of flora and vegetation. The use of Backfill Hill will be subject to specific environmental and heritage criteria. The surveyed hill will be used if these criteria are not met (Section 6).

Other limitations of the Biota (2004a) survey include:

- The field work was undertaken in spring which means summer peak species such as herbs and grasses may have been dormant at the time of the survey.
- Fungi and nonvascular flora were not specifically sampled.
- Approximately one third of the study area had been burnt two weeks prior to the survey. These areas were mapped from aerial photography as ground truthing was not possible. These areas could not be surveyed for rare flora.
- The flora recorded is unlikely to be a complete representation of the species in the area due to the study area being visited only once and conditions being quite dry at the time.

9.2 POTENTIAL SOURCES OF IMPACT

The following aspects of the proposal may potentially impact on vegetation and flora values:

- **Vegetation clearing** for the mine pit area, waste dump and for establishment of infrastructure such as physical plant, conveyor, access track and haul road, will lead to the direct disturbance of vegetation communities and potentially Priority Flora species.
- **Groundwater drawdown** as a result of mine dewatering could impact on creekline trees accessing this groundwater sources.
- **Disposal of excess mine dewater** to existing creek systems can lead to changes in the composition of plant communities, including the establishment of creek vegetation that may not be sustained post-closure.
- **Disruption of surface hydrology** may impact on those vegetation communities that rely on surface flows.
- **Vehicle movements** could potentially introduce and/or spread weed species.
- **Dust generation** could potentially smother vegetation retarding growth.

Increased fire frequency/intensity may favour the establishment of weeds and could also prevent the regeneration of native vegetation. However, it is pastoral activities, as opposed to mining activities, that are expected to exacerbate fire regimes in the Pilbara.

[9] A vegetation and flora survey of Backfill Hill was undertaken between 31 May and 2 June 2005; refer to Appendix 5 for details and results.

9.3 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICYAND GUIDANCE

EPA objectives

The preliminary EPA objective, based on previous assessments for Hamersley and BHPBIO is:

- Maintain the abundance, species diversity, geographic distribution and productivity of flora and fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

The following overriding EPA objective addressing biodiversity is also relevant to this factor:

- Maintain biological diversity where that represents the different plants, animals and micro-organism, the genes they contain and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.

National Strategy for Conservation of Australian Biodiversity

The State and Commonwealth Governments have endorsed the National Strategy for Conservation of Australia Biodiversity and the National Strategy for Ecologically Sustainable Development that protects biodiversity. The strategies address the conservation of Australia's biological diversity by defining guiding principles.

EPA Position Statement No 2

EPA Position Statement No 2, "*Environmental Protection of Native Vegetation in Western Australia*", provides an overview of the EPA's position on the clearing of native vegetation in Western Australia. Principles and related objectives and actions have been adopted from the above mentioned national strategies in the formation of this Position Statement. In assessing a proposal, the EPA's consideration of biological diversity will include the following basic elements:

- comparison of development scenarios or options of biodiversity at the species and ecosystems level
- no known species of plant or animal is caused to become extinct as a consequence of the development and the risks to threatened species are considered to be acceptable
- no association or community of indigenous plants or animals ceases to exist as a result of the proposal
- there is a comprehensive, adequate and secure representation of scarce or endangered habitats within the project area and/or in areas which are biologically comparable to the project area, protected in secure reserves
- if the project is large (in the order of 10 ha to 100 ha or more, depending on where in the State) the project area itself should include a comprehensive and adequate network of conservation areas and linking corridors whose integrity and biodiversity are secure and protected
- the on-site and off-site impacts of the project are identified and the proponent demonstrates that these impacts can be managed.

EPA Position Statement No 3

EPA Position Statement No 3, "*Terrestrial Biological Surveys as an Element of Biodiversity Protection*", discusses the principles which the EPA would apply when assessing proposals which may impact on biodiversity values in Western Australia. The outcomes sought by this Position Statement are intended to:

- promote and encourage all proponents and their consultants to focus their attention on the significance of biodiversity and therefore the need to develop and implement best practice in terrestrial biological surveys
- enable greater certainty for proponents in the EIA process by defining the principles the EPA will use when assessing proposals which may impact on biodiversity values.

EPA Guidance Statement No 51

EPA Guidance Statement No. 51, "*Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*", provides guidance on standards and protocols for terrestrial flora and vegetation surveys, particularly those undertaken for the environmental impact assessment of proposals.

Significance of vegetation and flora

The assessment framework for assessing the significance of vegetation and flora are shown in Appendix 4.

9.4 ASSESSMENT OF POTENTIAL IMPACT AND MITIGATION

9.4.1 Vegetation clearing

In total, approximately 670 ha of vegetation will be cleared for the Yandi JSE development. This includes 510 ha for the mine pit, waste dump and other infrastructure (such as physical plant, conveyor, access tracks and haul road) and a further 160 ha cleared as a result of the use of Backfill Hill, or the alternative backfill source (nearby surveyed hill) (Section 12.2.2). The approximate area of each vegetation type, as mapped by Biota (2004a), required to be cleared for the proposed project is shown in Table 7, excluding that expected on Backfill Hill.

The present survey did not include Backfill Hill. Consequently, Table 7 only provides an indication of the vegetation types likely to be affected by the clearing of 160 ha on Backfill Hill using a similar hill, which was surveyed, to the south-west of the CID as a comparison.

The vegetation types mapped for the expansion area are not restricted in their distribution regionally (Section 9.1.4). As a consequence, the clearing required for the expansion will only have a local impact on the vegetation types present and will not have regional implications. Within the Pilbara bioregion (Hamersley sub-region), Kendrick (2001) only identified broadscale vegetation clearing as being a key threatening process for the West Angelas Cracking-clays community. This community does not occur within Hamersley's Yandicoogina operational area.

Table 7 Area of each vegetation type within the Yandi JSE area

Vegetation type	Total area within the Yandi JSE area (ha)	Area to be cleared (ha)*
Low stony hills		
1a	221	11
1b	743	214
1c	5	<1
1d	50	27
1e	44	-
1f	64	1
1g	17	12
Valley floors		
2a	217	27
2b	199	98
2c	44	35
Creeks		
3a	208	23
3b	157	53
3c	1	-
3d	37	<1
3e	84	2
3f	66	1
3g	2	-
3h	36	1
Total mapped	**2,192**	**507**
Unmapped (outside of study area)**	5	5
Unmapped (Backfill Hill) **	160	160
Total	**2,357**	**670**

Source: Biota (2004a).

* A nominal 10 m buffer was placed around the proposed routes for the conveyor, access and haul roads and drains.

** Likely to comprise vegetation types 1a, 1b and 3a.

The identified *Lepidium catapycnon* individuals are sufficiently far from the proposed construction to be outside any disturbance envelope if construction is managed carefully (Figure 20). An exclusion zone around the plants will be clearly marked prior to construction and there should be no detrimental effect on any DRF. Other populations of *L. catapycnon* are known from the Yandicoogina area and the species occurs widely throughout the Hamersley Ranges (Kendrick 2001). As has been done previously for other construction projects and despite no direct impact on the DRF, Hamersley will apply to CALM for a permit to take Declared Rare Flora (*L. catapycnon*) under s23F of the *Wildlife Conservation Act 1950*.

With the exception of the recorded DRF and Priority Flora (particularly *Olearia fluvialis* and *Sida* sp.), the other flora species of the JSE area are relatively common and widespread in the Pilbara bioregion. Current mine plans indicate that of the five Priority Flora species present, only two species, *Abutilon trudgenii* (P3) and *Goodenia stellata* (P4), will be directly affected by the Yandi JSE development. Both species are known from numerous other sites in the Pilbara. The other three Priority Flora

species have been previously recorded from other sites within the Pilbara. *Olearia fluvialis* is mostly found in creek habitats; these habitats are afforded protection by Hamersley through the demarcation of buffers (mining exclusion zones). Therefore, the loss of flora from disturbance to the JSE area is not expected to affect the conservation status of the five Priority Flora species known to occur in this area.

Creek vegetation will be directly affected by the construction of a crossing over the Yandicoogina Creek for the mining fleet (to access the heavy vehicle workshop) and for the light vehicle road to Newman. Creek vegetation is considered of conservation significance at the scale of the Hamersley Ranges (Section 9.1.4) however, as noted by the EPA in its assessment of BHPBIO's Marillana Creek (Yandi) Life of Mine Proposal (EPA 2005), these vegetation communities are widespread (EPA 2005). Based on the current mine plan approximately four hectares of creek vegetation may be disturbed (site vegetation types 3d, 3e, 3f and 3h), which is not expected to significantly affect abundance or distribution of these habitats in the locality or region.

9.4.2 Groundwater drawdown

Within the JSE area, phreatophytic (groundwater dependent) vegetation is restricted to the major creek systems of Yandicoogina, Marillana and Weeli Wolli Creeks. These creek systems support various combinations of *Melaleuca argentea*, *Eucalyptus camaldulensis* and *E. victrix*, all of which are or can be reliant on either surface or groundwater. Drawdown of groundwater levels in the CID as a result of dewatering (Section 7) could affect these species if they are accessing deep groundwater. The nature of the impact depends on the:

- location, depth and extent of any drawdown cone
- rate of drawdown
- period of the drawdown.

It is likely that during some periods in the future, phreatophytic trees in creeklines adjacent to the mine will experience some degree of water stress. Experience from Yandi JC suggests that the exact timing, extent and result of such stress cannot be predicted on the basis of current knowledge. To ensure that significant impacts can be avoided, Hamersley propose to undertake a comprehensive monitoring program to provide as much early warning as practical.

Monitoring and adaptive management

In partnership with the University of Western Australia and relevant government agencies, Hamersley has developed a phreatophytic tree health monitoring program for the Yandicoogina operation. The aim of the program is to monitor the impact of groundwater drawdown on the health of phreatophytic vegetation to provide a trigger for staged management responses.

The program is adaptive as the current state of scientific knowledge is insufficient to accurately predict the responses of these trees to changing water level. The program uses techniques that are the best available at the present time.

Monitoring strategies

Five major strategies for monitoring tree health are proposed:

1. Collection and interpretation of remote sensing data.

2. Routine analysis of groundwater quality.
3. Establishment of tree health monitoring sites and the regular measurement of tree leaf index, shoot water potential, leaf osmotic potential and isotopic abundance.
4. Visual inspection of riparian trees.
5. Detailed analysis of tree water use and root growth.

Where monitoring indicates unacceptable dewatering impacts on phreatophytic vegetation, Hamersley's contingency measures include providing water to affected areas through localised recharge and shallow irrigation. Details of monitoring triggers and management have been developed and will be formalised in the EMP.

9.4.3 Disposal of surplus water

As described in Section 8.1, there will be periods when some dewatering will be discharged to local creek lines.

Following the period of high discharge rates experienced during the initial dewatering period, discharges should infiltrate the alluvial sediments quickly and permanent surface flows only cover a small distance (<1 km). Consequently, although vegetation may adapt to the increase in permanent flow over the first four years of operation, equally, it should adapt back to drier conditions once the flow is reduced. The tree monitoring program described above will also examine whether root systems in large trees have become adapted to high water flows and may suffer in times of reduced discharge, and require additional management.

To further reduce the volume of water discharged at peak surplus, Hamersley is undertaking investigations into the feasibility of re-injection of the dewater water into the downstream Billiards CID aquifer (Section 8).

9.4.4 Disruption to surface hydrology

Two crossings of Yandicoogina creek are required to be constructed (Section 3.3). These crossings are not expected to impede surface water flow through the creek system and will therefore, only impact creek vegetation due to clearing required for construction.

Sheet flow is limited around the Yandi JSE area and the principal disruption to surface flows will be the levees and cut-off drains directing water around the pit (Section 6.4.2). There may be also be some long term changes in the composition of vegetation downstream of where the mining area intercepts drainage lines, however, most of the areas downstream of drainage lines exist within the proposed mining area Impacts outside the mining area will be limited to a very small area and unlikely to be of local significance. Surface water management will be addressed in the Water Management Plan as part of the amended Yandicoogina EMP.

9.4.5 Weeds

Movement of vehicles has the potential to introduce weeds and/or spread existing populations of weeds within the development areas as does the presence of cattle. Mesic habitats, such as creeklines and floodplains, are particularly susceptible to weed invasion, however, within the Yandi JSE area sections of the Weeli Wolli, Marillana and Yandicoogina Creeks are already infested with weeds.

Implementation of Hamersley's hygiene and control measures, as detailed in the Yandicoogina EMP, will reduce the potential for the introduction and spread of weeds.

As part of implementing the JSE Project, Hamersley will implement a weed control program along the creeklines of the Marillana Creek system focussing on Hamersley's operational area.

9.4.6 Dust

Dust may have physical effects on plants such as blockage and damage to stomata, shading, abrasion of leaf surface or cuticle, and cumulative effects (e.g. drought stress on already stressed species). Vegetation located close to roads and other sources of dust is more likely to be subject to such impacts. As a result of Yandi JSE, areas along new roads not currently affected by dust will be temporarily affected.

9.4.7 Management measures

Hamersley's management of flora and vegetation is in accordance with Rio Tinto's 'Land-use Stewardship' Environmental Standard. Management measures are detailed in Hamersley's site EMP which provides for the management for flora and fauna. Measures include:

- minimising area to be cleared
- minimising disturbance of significant vegetation types (e.g. creek vegetation) and significant flora (e.g. Priority Flora species) – areas of *L. catapycnon* to be clearly marked and avoided
- rehabilitating disturbed areas with minimal delay (Section 6)
- promoting establishment of Priority Flora species in rehabilitation
- implementing hygiene measures for vehicles and machinery to prevent introduction and spread of weeds
- undertaking weed control.

A Construction Environmental Management Plan (CEMP) would be prepared for Hamersley's environmental management of construction, which will include provision for a further DRF and Priority Flora search prior to clearing and DRF locations to be marked and avoided during construction.

9.5 PROPONENTS COMMITMENTS

Vegetation and flora issues at Yandi JSE will be covered by the following new proponent commitments (new proponent commitment number in parenthesis):

General

- Comply with relevant legislation (1).
- Refer significant amendments to project for assessment (2).
- Environmental audits and reporting (6, 7).

Research

- The proponent will continue to support research programs by the Ecosystems Research Group of the University of Western Australia in assessing plant-water relationships and developing better predictive models of drawdown impacts in the Pilbara by developing a tree health research and monitoring program to assess impacts of dewatering on riverine vegetation (8).

Use of Backfill Hill

- The use of adjacent landforms for the purpose of backfill will be subject to the criterion that there is no loss of DRF populations or TECs or a substantial proportion of other flora and vegetation considered to be of state or regional conservation significance (16).

EMP

- Review and revise existing Yandicoogina EMP to address issues arising from the JSE project, including (17):
    - a conservation significant flora survey of the areas affected by fire in the JSE project area and Backfill Hill
    - a weed control program along the creeklines of the Marillana Creek system focussing on Hamersley's operational area
    - general flora protection measures around Yandi JSE
    - revegetation of the areas affected by the JSE project.

CEMP

- A CEMP (Section 13.4) and the Works Approval application for construction of the plant will include provisions for flora and fauna management during construction (20).

These commitments are included in full in Table 13.

9.6 OUTCOME

The Yandi JSE project will result in the progressive removal and rehabilitation of approximately 670 ha of native vegetation over the life of the project. The development may result in some long term changes in composition of vegetation due to altered drainage patterns. However this will not significantly affect local or regional conservation values of flora or vegetation. There is an increased risk of the spread of weeds, however this will be minimised through Hamersley's weed control and hygiene procedures.

A weed control program will be carried out along the creeklines of the Marillana Creek, focussing on Hamersley's operational area, to improve creek condition and may provide a net decrease in weeds over this area. In addition, knowledge of plant ecology and function in the region will be increased from flora surveys, revegetation and propagation trials, and associated research.

The Yandi JSE proposal is not expected to have any significant effect on regional flora and vegetation values due to the wide distribution of the vegetation types and flora species found in the project footprint and the control measures that will be implemented to minimise impacts on flora and vegetation values. No recorded DRF populations will be affected by mining. Consistent with EPA objectives, the abundance, species diversity, geographic distribution and productivity of flora at

species and ecosystem levels will be maintained conserving regional biological diversity. The breadth of botanical studies undertaken by Hamersley has ensured that highly significant floristic areas have been avoided and the implementation of an EMP addressing vegetation protection will further ensure impacts are minimised. There will be an increased knowledge of plant-water relationships due to ongoing surveys and research. This will improve Hamersley's ability to manage riparian areas.

10. FAUNA

10.1 DESCRIPTION OF FACTOR

10.1.1 Terrestrial vertebrate fauna

Numerous fauna surveys have been undertaken in proximity to the Yandicoogina area in accordance with EPA Guidance Statement 56. These surveys were in relation to existing and proposed mining operations and in association with the Pilbara Region Biological Survey (Section 9.1). Given the extensive coverage and results from these previous surveys it was considered that a systematic trapping exercise for terrestrial vertebrate fauna would not have added significantly to the knowledge of fauna in the Yandi JSE area. Following discussions with regional CALM staff to confirm this view, Biota Environmental Sciences undertook a desktop vertebrate fauna assessment of the Yandi JSE area (Biota 2004b).

Vertebrate fauna occurrence was predicted on the basis of vegetation associations found in the vegetation and flora survey, and is thus subject to similar limitations as that work (Section 9.1.5).

A total of 70 species of birds, three species of amphibians, 56 species of reptiles, and 13 native mammals are expected to occur within the general area of the Yandi JSE project. Several species that have been recorded from or are likely to occur in the Yandi JSE area are declared as Rare, Threatened or Vulnerable in State and/or Commonwealth legislation (Table 8). None of these species are restricted to the Yandi JSE area and most are found outside of the Pilbara.

10.1.2 Invertebrate fauna

Biota Environmental Sciences undertook a targeted invertebrate survey (short-range endemics) of the Yandi JSE area (Biota 2004b).

The intent of the short-range endemic invertebrate fauna survey was to provide further information to the knowledge base of these species, as agreed with CALM and EPA Services Unit officers. This was based on an agreed position that there is insufficient information at present to allow any conclusive assessment of conservation significance for these species within most of Western Australia. It is envisaged that further research by government agencies and private industry will eventually provide the taxonomic and distributional information required to allow such assessments.

The Biota (2004b) survey of the Yandi JSE area identified numerous invertebrates including spiders, pseudoscorpions, scorpions, millipedes and snails. However most of the specimens were not identified beyond family level. All invertebrate specimens collected have been lodged with the WA Museum where detailed identifications will occur as part of the ongoing taxonomic research in the groups collected. Furthermore, the lack of rainfall during the short-range endemic survey discouraged activity in some invertebrate groups (Biota 2004b).

Of the invertebrate species identified, only the genus *Synsphyronus* (pseudoscorpion) is known to contain short range endemic taxa (naturally small distributions less than 10,000 km^2). There is currently little information on the habitat preferences of the *Synsphyronus* species collected, however, the spatially restricted species belonging to this genus from elsewhere are rock-inhabiting. The bark-inhabiting pseudoscorpion species found elsewhere in Australia are known to have a distribution that

coincides with the Murray-Darling catchment. It is plausible that the distribution of pseudoscorpions collected at Yandi JSE may also be confined to individual catchments though a broader distribution is possible.

Three species of freshwater fish have been recorded in pools along Marillana Creek, these being the Common Eel-tail Catfish, Western Rainbowfish and Spangled Perch.

Table 8 Species of State and Federal conservation significance recorded from or likely to occur in the Yandi JSE area

Species	State level	Federal level	Distribution	Likely presence
Liasis olivaceus barroni (Pilbara Olive Python)	Schedule 1	Vulnerable	Regarded as a Pilbara endemic. Its known distribution coincides roughly with the Pilbara bioregion	Likely to occur particularly in rock pools along Marillana Creek and adjacent rocky areas.
Falco peregrinus (Peregrine Falcon)	Schedule 4	-	Has an almost cosmopolitan distribution and is widespread throughout mainland Australia and Tasmania.	Likely to be a resident as suitable prey species are present.
Ardeotis australis (Australian Bustard)	Priority 4	-	Occurs over much of WA with the exception of the more heavily wooded southern portions of the state. Its wider distribution includes eastern Australia and New Guinea.	Likely to be present.
Burhinus grallarius (Bush Stonecurlew)	Priority 4	-	Widespread in Australia and New Guinea. Remains common in tropical Australia but has declined in temperate Australia and has disappeared from many regions. Populations are apparently secure in the Pilbara.	Has been sighted close to the Yandi JSE area however, thought to be more common to the north and in coastal parts.
Neochmia ruficauda subclarescens (Star Finch)	Priority 4	-	Endemic to Australia where it occurs from the Pilbara to south-eastern Australia. It is most common in the tropics.	Unlikely in the Yandi JSE area. May occur in reedbeds along Weeli Wolli Creek where an absence of grazing pressure allows them to develop.
Pseudomys chapmani (Western Pebble-mound Mouse)	Priority 4	-	Common to very common in suitable habitat within the Hamersley and Chichester sub-regions.	Likely to be present. Previously recorded around Yandi JC.

10.1.3 Introduced fauna

Several species of introduced fauna are known to inhabit the Yandicoogina area including the house mouse, feral cat, wild dogs, horse, donkey, one-humped camel and domestic cattle.

10.1.4 Terrestrial fauna habitat

Biota (2004b) identified six major habitat types for the Yandi JSE area, based on topography and vegetation types:

- low stony hills
- Mulga on low stony hills
- exposed ridges and breakaways

- valley floors
- major creeks
- secondary creeks.

The habitat types do not appear to be unique or significant at the bioregion scale, although the creek habitat is significant on a sub-region scale as it would support a range of species not typically recorded from other habitats in the study area. This habitat type is also considered to be at risk in the Pilbara, as it is frequently subject to threatening processes, particularly heavy grazing pressure and weed infestation (Kendrick 2001).

10.1.5 Subterranean fauna

Biota Environmental Sciences undertook an assessment of stygofauna occurring in the Yandi JSE area (Biota 2005). This assessment was based on sampling results from Hamersley's ongoing stygofauna research (from November 2003) and work completed for Hope Downs Management Services (Biota in prep.). As these exercises had yielded good sample sizes, representatives of most taxonomic groups and a spatial spread of sampling points across the Yandi JSE area and surrounds, no additional field collecting was undertaken for this assessment[10].

A total of 23 well holes were sampled by Biota in 2003; 17 of these wells contained stygofauna (five of these wells were in the groundwater drawdown impact zone of the Yandi JSE area and 12 serving as reference wells) (Figure 21). Seven major taxonomic groups were identified[11]. The distribution of these groups and the status of their identification are described in Table 9.

Biota (2005) consider the abundance and diversity of stygofauna collected from the Yandicoogina area to be considerable, exceeding yields from other Hamersley sites in the Pilbara, and being comparable with, or exceeding, other regional sites. The relatively high diversity is probably attributable to the extent of alluvial and calcrete aquifer habitats associated with the major drainages in the locality. Almost all stygofauna were collected from shallow wellholes that intersected superficial alluvials, consistent with findings from other similar sites in the region.

As part of a research project at the University of Western Australia supported in part by Hamersley, comparison of the genetic and morphological species determinations has shown a high degree of correlation providing confidence that a robust assessment of the collected material has been completed.

The genetic and morphological analysis showed one species of isopod and two species of amphipods were present in both the Marillana Creek and Weeli Wolli Springs aquifers. This may suggest a larger-scale connection of stygal populations than previous studies have demonstrated. These distribution patterns will be further investigated as part of Hamersley's ongoing stygofauna research program (Biota 2005).

[10] An additional round of stygofauna sampling was carried out in the Yandi JSE area in April 2005; refer to Appendix 5 for details and results.

[11] Based on morphological identifications.

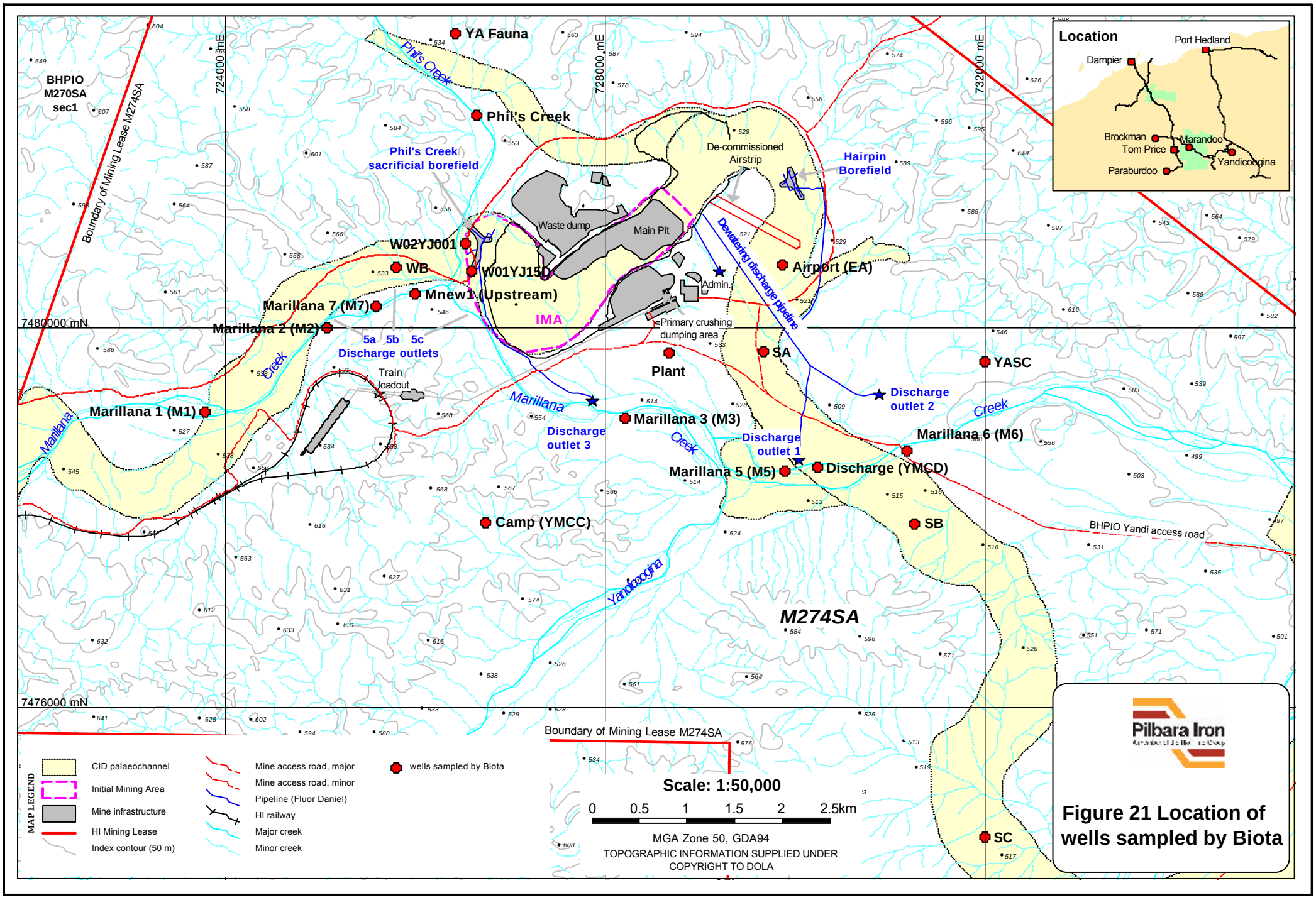
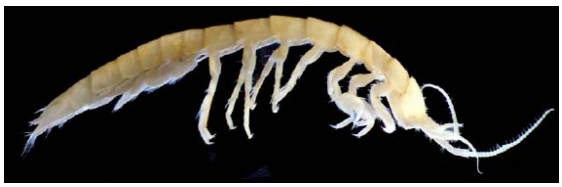


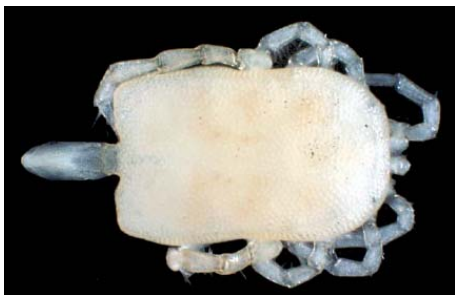
Figure 21 Location of wells sampled by Biota

Table 9 Distribution of main stygofauna taxonomic groups

Stygofauna	Location		Comments
	Impact well	Reference well	
Class Turbellaria (Stygal flatworms)	YMCD, M6	M1, M2, M7, Mnew1, W01YJ15D	The specimens collected do not resemble those collected elsewhere in the region. Species identification is currently being undertaken.
Class Oligochaeta (Oligochaeta worms)	M5	W02YJ001, M7, Plant	All species collected belonged to the family Tubificidae. Unfortunately, identification to species level was not possible as all species were immature.
Order Acarina (Hydracarina – water mites)	M6	Mnew1, Plant, M7	Identification work is incomplete on this group. Information to date suggests one specimen, belonging to the genus *Arrenurus* (Figure 22), is previously uncollected.
Class Ostracoda (crustacean)	Discharge, M5, M6	M1, M2, M7, Mnew1, Plant, W02YJ001	Most specimens belong to a species currently being described (identification yet to be confirmed). Specimens belonging to the genus *Gomphodella* belong to a species not represented amongst the taxa currently being described.
Class Copepoda (crustacean)	M6, SB	M7, Mnew1	Abundances generally low, with many juvenile specimens which limited species identification. Two species identified have been described from elsewhere in the region.
Order Amphipoda (crustacean)	All	All sampled except YASC, SB, W01YJ15D	Were collected from almost every well that stygofauna were recovered from.
Order Isopoda (crustacean)	M5, SB, Discharge	M3, M7, Mnew1, Plant	All isopods collected belonged to the genus *Pygolabis* (Figure 22). Morphological differences indicate that two species were present.



(a) *Pygolabis* sp. (Isopod)



(b) *Arrenurus* sp. (Hydracarine)

Figure 22 Examples of stygofauna collected from the Yandicoogina area (Photos: J McRae)

10.2 POTENTIAL SOURCES OF IMPACT

The following aspects of the proposal may potentially impact on fauna values:

- **Vegetation clearing** for mine pit and associated infrastructure will directly disturb terrestrial fauna habitat and potentially the direct mortality of individual terrestrial fauna species.
- **Vehicle movement** during construction and operation could potentially lead to the direct mortality of fauna species, particularly less mobile species.
- **Groundwater drawdown** from mine dewatering may lower the water table sufficiently in some areas to dry the zone in which some stygofauna species live.

10.3 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA objectives

The preliminary EPA objective, based on previous assessments for Hamersley and BHPBIO is:

- Maintain the abundance, species diversity, geographic distribution and productivity of flora and fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

The following overriding EPA objective addressing biodiversity is also relevant to this factor:

- To avoid adverse impacts on biological diversity, comprising the different plants and animals and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.

As with vegetation and flora (Section 9.3), the application of the principles of the National Strategy for Conservation of Australia Biodiversity, the National Strategy for Ecologically Sustainable Development and EPA Position Statement No. 3 also apply to the assessment of fauna.

EPA Guidance Statements No 54 and 56

EPA Guidance Statements No. 54, "*Sampling of Subterranean Fauna in Groundwater and Caves*", and No. 56, "*Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*", provide guidance on standards and protocols for subterranean and terrestrial fauna surveys, particularly those undertaken for the environmental impact assessment of proposals.

Significance of fauna

In Western Australia, rare or endangered species are protected by the *Wildlife Conservation (Specially Protected Fauna) Notice 2003*, under the *Wildlife Conservation Act 1950*. Schedules 1 and 4 in this notice are relevant to this assessment providing a listing of those species protected by this Notice. The EPA would also expect the proposal to have a low likelihood of impacting on fauna such that species would meet the criteria for special legal protection as a threatened species under the Act.

The Conservation and Land Management (CALM) Priority Fauna List also nominates conservation species from Priority level one to four as described for flora (Appendix 4). The Priority Fauna List does not confer any additional legal protection apart from the normal protection afforded to most native fauna. It is expected however, that the potential impacts from a proposal on these priority listed

species should be managed so that the species do not meet the International Union for Conservation of Nature and Natural Resources (IUCN) criteria for threatened species.

Commonwealth protection

In 1974, Australia signed the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). As a result, an official list of endangered species was constructed and is regularly updated. This listing is administered through the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The current list differs from the various State lists but there are some species that are common to both.

International agreements

A range of shorebirds is listed under the Japan-Australia (JAMBA) and China-Australia (CAMBA) Migratory Bird Agreements. Most of these are associated with saline wetlands or coastal shorelines and have little relevance to the proposal area. However, some migratory birds not associated with water are also listed on these international treaties.

10.4 ASSESSMENT OF POTENTIAL IMPACT AND MITIGATION

10.4.1 Terrestrial fauna

Biota (2004b) assessed the potential impacts of Yandi JSE on fauna habitat and fauna species. In general, the construction and operation of the mine will have some impact on fauna populations (e.g. direct mortality and removal/ disturbance of habitat), however this will be on a local rather than regional scale.

Fauna habitat

The clearing requirements will result in the removal or disturbance of approximately 670 ha of fauna habitat (Table 7 in Section 9.4). Floristic analysis showed that none of the vegetation types of the Yandi JSE area are restricted to the expansion area and although broadscale habitat categorisation is not available to compare with that undertaken by Biota (2004b), the representation of vegetation types outside of the Yandi JSE area suggests that the habitat types are not restricted.

Habitat adjacent to Yandi JSE may also be indirectly modified through the degradation of vegetation arising from the introduction or spread of weed species, or from increased fire frequency. These impacts are not expected to be significant (Section 9.4). Dewatering impacts on phreatophytic vegetation may also impact on creek habitat. Such impacts are difficult to quantify and are described in more detail in Section 9.4.

Fauna species

Fauna species known or expected to occur at Yandicoogina are widely distributed throughout the Pilbara and the Eyrean Subregion (including those species of conservation significance listed in Table 8). Of the invertebrate species identified, only those of the genus *Synsphyronus* (pseudoscorpion) may represent short-range endemic taxa, although little is known of the distribution of this genus. Given that fauna habitats are not restricted to the Yandi JSE area, it is unlikely that either the distribution or conservation status of any vertebrate or invertebrate species, including those listed as State or Federal conservation significance (Table 8), will change as a result of the Yandi JSE project.

There will be some localised loss of individual vertebrate fauna due to direct mortality arising from construction of the mine and infrastructure and occasional loss of fauna due to vehicle collisions. This is not expected to represent a significant impact.

Management measures

The management of impacts on terrestrial fauna has a large degree of overlap with native flora and vegetation protection initiatives for the Yandi JSE area (Section 9.4). Hamersley's management of fauna is in accordance with Rio Tinto's 'Land-use Stewardship' Environmental Standard. Management measures are detailed in Hamersley's site EMP which provides for the management for flora and fauna. Measures include:

- minimising the area to be cleared and siting infrastructure so as to avoid habitat fragmentation as far as practicable
- rehabilitating disturbed areas with minimal delay
- maintaining buffer distances between mining activities and watercourses
- mine planning to consider local hydrological patterns that have perceived ecological significance and to minimise disturbance to such systems
- restricting vehicle access to designated roads
- undertaking feral animal control
- environmental inductions for all staff that contains fauna protection responsibilities
- prohibition of firearms, traps and domestic pets.

A CEMP (Section 13.4) and the Works Approval application for construction of the plant will include provisions for fauna management during construction.

10.4.2 Stygofauna

Biota (2005) assessed the potential impacts on stygofauna based on modelled groundwater drawdown contours. The assessment focused on identifying the presence of any stygal species that may be restricted to the drawdown impact area. For some groups, the nature of the specimens and the limits of current taxonomy do not permit this species level analysis to be completed.

Almost all of the stygal taxa recorded from the Yandi JSE drawdown impact area were also recorded from reference wells or previously from elsewhere in the region (Table 10). These species are therefore unlikely to be at risk of extinction or significant change in conservation status due to the development of the Yandi JSE project.

Only one of the 14 stygal taxa identified in this study is known from the impact area alone, based on current sampling data. This is the ostracod *Gomphodella* sp., which does not match any specimens collected previously from the region. These specimens were collected from well M5 in the northern part of the impact area; an alluvial location within the dewatering influence of the already approved Yandi JC operation (Figure 21). As all other stygal taxa collected from the same sample occur more widely, it is possible that this apparent restricted distribution is due to sampling effects. The distribution of the other constituents of the stygal community at Yandicoogina (and the apparent close connections with the fauna of Weeli Wolli Creek), suggests that the risk of *Gomphodella* sp. being truly restricted to vicinity of M5 is likely to be low. The species is probably distributed at least locally

along the alluvial aquifer of Marillana Creek. Hamersley will undertake additional sampling in the Yandicoogina area during 2005 in an attempt to better document the distribution of this species[12].

Hydrogeology studies (Section 7) show that the CID of theYandi JSE deposit is not well connected to the Billiards CID and modelling suggests that dewatering influence will be spatially confined (Figure 14 and Figure 15). Those studies also showed that the superficial alluvial aquifer (where most stygofauna were collected) is effectively isolated from the deeper underlying CID aquifer along Weeli Wolli Creek immediately downstream of the JSE CID junction. While the dewatering will impact this deeper structure, the perched nature of the superficial aquifer will reduce hydrological impacts on local stygal communities. Within the JSE CID, there will be a shortage in supply of water to only a small portion of the aquifer in the lowest strata of the CID.

Table 10 Status and wider distribution of stygal taxa collected from within the Yandi JSE groundwater drawdown impact area

Taxa	Impact well	Status and wider distribution
Ostracoda		
Pilbaracandona sp.	Discharge	Previously described from specimens collected elsewhere in the region. Not restricted to JSE impact area.
Meridiescandona sp.	Discharge, M5-6	Also recorded locally from four reference wells. Previously described from specimen collected elsewhere in the region. Not restricted to JSE impact area.
Gomphodella sp.	M5	Specimens belong to a species not represented amongst known taxa currently being described. Only collected from JSE impact area.
Copepoda		
Mesocyclops darwini	M6	Previously described from specimens collected elsewhere in the region. Not restricted to JSE impact area.
Amphipoda		
Chydaekata sp.	M5	Also recorded locally from four reference wells. The same species also occurs in Weeli Wolli Creek. Not restricted to JSE impact area.
Paramelitidae sp. 2	M6	Also recorded locally from two reference wells. The same species has been recorded during the CALM regional survey. Not restricted to JSE impact area.
Isopoda		
Pygolabis sp. 3	M5, SB	The same species also occurs in Weeli Wolli Creek. Not restricted to JSE impact area.
Pygolabis sp. 1	Discharge	Also recorded locally from one reference well. Not restricted to JSE impact area.

[12] The ostracod *Gomphodella* sp. was collected from six wells during the second phase of sampling in April 2005, including two wells outside of the project drawdown; refer to Appendix 5 for details and results of the second phase of stygofauna sampling.

Management measures

Hamersley already has an established stygofauna research program. The aim of this program is to:

- Improve knowledge of the taxonomy, distribution and ecology of stygofauna within the Pilbara Region.

The program involves the ongoing support of research programs at the University of Western Australia (in collaboration with BHPBIO and Hope Downs) on the taxonomy and genetics of key taxa and the continuance of field programs sampling Pilbara alluvial and groundwater aquifers. Hamersley will also continue to liaise and share data with other mining companies and the CALM/ WA Museum Pilbara Region Biological Survey.

10.5 PROPONENTS COMMITMENTS

Fauna issues at Yandi JSE will be covered by the following new proponent commitments (new proponent commitment number in parenthesis):

General

- Comply with relevant legislation (1).
- Refer significant amendments for assessment (2).
- Environmental audits and reporting (6, 7).

Use of Backfill Hill

- The use of adjacent landforms for the purpose of backfill will be subject to the criterion that there is no impact on Threatened Fauna or substantial impacts on other fauna species of state or regional conservation significance (16).

EMP

- Review and revise existing Yandicoogina EMP to address issues arising from the JSE project, including (17):
    - undertaking a fauna survey of Backfill Hill
    - general fauna protection measures around Yandi JSE
    - continuing to support research to improve knowledge of the taxonomy, distribution and ecology of stygofauna within the Pilbara Region.

CEMP

- A CEMP (Section 13.4) will include provisions for fauna protection during construction (20).

These commitments are included in full in Table 13.

10.6 OUTCOME

The Yandi JSE project will result in the progressive loss and subsequent restoration of fauna habitat over the life of the project and as a result will potentially affect the local abundance of fauna

populations (terrestrial and subterranean). There will be no impacts on fauna which are of conservation significance at a regional, state or national level. Consistent with EPA objectives, the abundance, species diversity, geographic distribution and productivity of fauna at species and ecosystem level will be maintained conserving regional biological diversity. The breadth of fauna studies undertaken by Hamersley has ensured that highly significant habitats have been avoided and the implementation of an EMP addressing fauna protection will further ensure impacts are minimised.

Control of feral animals within and surrounding the mining area will have positive benefits to fauna values in areas beyond the mining area. The ongoing fauna surveys and associated research will also increase the knowledge of faunal ecology in the region.

11. ABORIGINAL HERITAGE

11.1 DESCRIPTION OF FACTOR

Extensive archaeological and ethnographic surveys have been undertaken within Hamersley's Yandicoogina operational area since 1995. Most recent surveys covering the Yandi JSE area include:

- Day (2004) and McDonald (2003): Ethnographic heritage surveys.
- O'Reilly and Di Lello (2004) and Archae-aus (2001, 2003): Archaeological heritage surveys.
- Campbell (2004): Ground penetrating radar survey of possible burial site.

These surveys do not cover Backfill Hill, which is proposed to be mined for backfill of the mine void. Hamersley will commission archaeological and ethnographic surveys of this area and the use of this hill will be subject to criteria for the protection of Aboriginal heritage (Section 11.5).

11.1.1 Ethnographic heritage

The most recent ethnographic heritage survey (Day 2004) involved the participation of five Aboriginal elders who were authorised to speak for the area. The Aboriginal Elders were shown around the JSE project area whilst also receiving a commentary on the main aspects of the proposal.

The Aboriginal Elders present for this survey confirmed the results of previous ethnographic surveys in the area, that there are no ethnographic values associated with the JSE area (McDonald 2003). Whilst they expressed 'sorrow' for the disturbance of the country, they were in agreement that they had no knowledge of any sites, mythologies or other ethnographic obstacles to the Yandi JSE project.

The Aboriginal Elders consulted indicated the importance of several archaeological sites within the JSE area, including the probable grave site and the rockshelters (Section 11.1.2). They also requested that no drilling be undertaken in the creeks without their agreement as has been requested in previous consultations. Whilst many of the creeks in the Yandicoogina project area and the wider region have not been formally identified as sites *per se*, they are considered to represent foci for camping, ceremonies and other activities. There is a general perception amongst the Aboriginal Elders that drilling within the creekbed may significantly alter local hydrology, which in turn may negatively impact other water sources as well as flora and fauna (Day 2004).

11.1.2 Archaeological heritage

Archaeological surveys have identified several archaeological sites within and in the near vicinity of the Yandi JSE area (Table 11). Most of the sites are artefact scatters that have a low archaeological significance. The possible burial site (P02175b) has been fenced and signed and further assessed using a ground penetrating radar survey. The survey indicated that it is highly likely that the site is a grave, however, this would only be confirmed with some form of excavation (Campbell 2004). Due to the sensitivity of the site, excavation is not appropriate and the site will be treated as a grave site.

Table 11 Archaeological heritage sites within and in the near vicinity of the Yandi JSE area

Site number	Site type	Degree of archaeological significance	Ethnographic significance
P02175a	Artefact scatter	Low to medium: relatively high artefact density and a variety of lithic types, therefore, this site is somewhat less common in the region.	Low
P02175b	Probable burial area	Very high	Yes
Y00-02	Artefact scatter	Low: artefact assemblage is typical of those found in the region, a large number of which have been recorded in detail.	Low
Y00-03	Artefact scatter	Low	Low
Y00-04	Artefact scatter	Low	Low
Y00-05	Manuports*	Not stated in survey report (Archae-aus 2001).	Yes
Y00-06	Artefact scatter, scar tree	Low	Low
Y03-12	Artefact scatter	Low	Low
Y03-13	Artefact scatter	Low	Low
Y03-25	Artefact scatter	Low	Low
Y03-26	Artefact scatter	Low	Low
Y03-30	Artefact scatter	Low	Low
Y03-26	Artefact scatter	Low	Low
Y04-01	Rockshelter	Not stated in survey report (O'Reilly & Di Lello 2004).	Yes
Y04-02	Rockshelter	As above	Yes
Y04-03	Rockshelter	As above	Yes

* A manuport is a term given by archaeologists and anthropologists to a natural object which has been moved from its original context by human agency but otherwise remains unmodified.

11.2 POTENTIAL SOURCES OF IMPACT

Aspects of the proposal that may potentially impact on Aboriginal heritage values are:

- **Physical disturbance of the land surface** during construction and operation of the mine and associated infrastructure has the potential to disturb archaeological sites.
- **Physical disturbance of the creek beds** during construction and operation of wells (dewatering and monitoring wells), construction of creek crossing and dewater disposal has the potential to interfere with ethnographic associations with the creek systems.

11.3 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA Objectives

The EPA normally applies the following objectives in its assessment of proposals that may affect heritage and culture values. These objectives are considered relevant to this proposal.

- To ensure that the development complies with the requirements of the *Aboriginal Heritage Act 1972* (WA).
- To ensure that changes to the biological and physical environment resulting from the proposal development do not adversely affect historical and cultural associations of the area.

Statutory requirements

The Minister for Indigenous Affairs is responsible for the administration of the *Aboriginal Heritage Act 1972*. Under section 17 of the Aboriginal Heritage Act, it is an offence to disturb any Aboriginal site without consent under section 18 of that Act.

The Minister considers recommendations from the Aboriginal Cultural Material Committee (ACMC) and the general interests of the community when making a decision on disturbance to a site and may also impose conditions on the approval.

The Registrar of Aboriginal Sites is responsible for maintaining the Register of Aboriginal Sites. The Department of Indigenous Affairs (DIA) has a database of all recorded sites.

EPA Guidance Statement No 41

EPA Guidance Statement No. 41, "*Assessment of Aboriginal Heritage*", provides guidance on the process for the assessment of Aboriginal heritage as an environmental factor. This guidance statement also details those actions that may be pertinent to the factor of Aboriginal heritage, including:

- consultation with DIA staff and desktop review of sites
- undertaking an Aboriginal heritage and/or archaeological survey in consultation with relevant Aboriginal representatives
- inform relevant Aboriginal people of the proposal and conduct appropriate consultation
- demonstrate that any concerns raised by the Aboriginal people have been considered in the environmental management of the factor and that this is made known to the relevant Aboriginal people.

11.4 ASSESSMENT OF POTENTIAL IMPACT AND MITIGATION

11.4.1 Ethnographic values

Any ground disturbance activities have the potential to affect ethnographic values. Apart from ethnographic values identified for several archaeological sites, ethnographic values for the Yandi JSE area focus on the creek beds. Drilling activities in the creeks, surplus water discharge, and road and conveyor crossings have the potential to detract and/or impact on these values.

To protect the ethnographic values of the creeks in the project area, Hamersley maintains buffers or exclusion zones around the creek systems that preclude mining activities. These buffers have been determined and agreed in consultation with the Gumala Aboriginal Corporation (Gumala) and typically apply a 200 m exclusion zone either side of the watercourses. The Aboriginal elders consulted expressed no opposition to water monitoring wells being constructed within the creek buffers providing specific consultation is undertaken, as had previously occurred with previous Hamersley developments (Day 2004). Hamersley will also consult with Gumala on the discharge of surplus water to creeks and other disturbances that may be required, for example, during construction of creek crossings.

11.4.2 Archaeological sites

Several of the archaeological sites identified may be disturbed by activities associated with the Yandi JSE project. As some sites are located on the periphery of the CID, the extent and nature of the impact will not be known until final planning for mine development is complete. It may be practicable for development to avoid some sites on the periphery.

The majority of the archaeological sites identified are artefact scatters that have been assessed as being of low archaeological significance and as having no ethnographic significance (Table 11). Furthermore, four of the sites occurring within the Yandi JSE area already lie within the existing Hamersley Yandi section 18 (*Aboriginal Heritage Act 1972*) consent area; Y03-12, Y03-13, Y03-25 and Y03-30.

One site occurring on the periphery of the CID, site Y00-05, was identified as comprising of manuports. Disturbance of this site will be avoided if practicable, if not, the site will only be disturbed with the consent of Gumala and the Minister for Indigenous Affairs (process described below). Detailed recording and salvaging of this site will mitigate against its loss.

Hamersley has committed to avoid any disturbance of the probable burial site, P02175b, unless otherwise agreed in writing by Gumala. The site has been demarcated by Hamersley with fencing and signage and as the site occurs in proximity to Yandicoogina Creek, the site will be further protected by the buffer zone provided for this watercourse.

The rockshelter sites (JSE04-01 to JSE04-03) are potentially within the footprint of the Backfill Hill reclaim area. Whether these sites require disturbance will be determined during the detailed closure planning process.

11.4.3 Management measures

In accordance with Rio Tinto's 'Communities' Standard and Hamersley's site EMP, Hamersley will continue to implement the following management measures to ensure Aboriginal heritage values are not compromised by the Yandi JSE project:

- where an archaeological site cannot be avoided, Hamersley will seek consent to disturb the site(s) from the:
    - Minister for Indigenous Affairs through a section 18 application under the *Aboriginal Heritage Act 1972* (if that site is not within the current section 18 consent area).
    - Gumala Aboriginal Corporation (Gumala).
- Hamersley will undertake disturbance in accordance with the conditions of the section 18 consent and the *Site Protection Conditions* agreed with Gumala under the Yandicoogina Land Use Agreement.
- Hamersley will consult with and involve Gumala in mitigative heritage work prior to disturbance of the site. This will include detailed recording of sites and salvage of artefacts.
- Hamersley will consult with Gumala in the allocation of creek exclusion/buffer zones.

11.5 PROPONENTS COMMITMENTS

Aboriginal heritage issues at Yandi JSE will be covered by the following new proponent commitments (new proponent commitment number in parenthesis):

General

- Comply with relevant legislation (1).
- Refer significant amendments for assessment (2).
- Environmental audits and reporting (6, 7).
- Disturbance to Aboriginal sites – compliance with *Aboriginal Heritage Act 1972* (14).

Use of Backfill Hill

- The use of adjacent landforms for the purpose of backfill will be subject to the criterion that archaeological and ethnographic sites will be managed in accordance with the *Aboriginal Heritage Act 1972* and the Yandicoogina Landuse Agreement (16).

EMP

- Review and revise existing Yandicoogina EMP to address Aboriginal heritage issues arising from the JSE project, including (17):
    - undertaking of an Aboriginal archaeological and ethnographic survey of Backfill Hill.
    - general heritage site protection measures around Yandi JSE.

These commitments are included in full in Table 13.

11.6 OUTCOME

A number of recorded sites will be disturbed by mining, however based on the archaeological and ethnographic surveys of the Yandi JSE area, the proposal will avoid disturbance of those sites identified to be of significance. The alterations to the biological and physical environment resulting from the proposal development should not adversely affect historical and cultural associations of the area.

Hamersley will continue to consult and work with Gumala regarding management of Aboriginal archaeological and ethnographic sites and values and, consistent with the EPA objective for this factor, will manage Aboriginal heritage sites and associated issue such that it complies with the requirements of the Aboriginal Heritage Act. Hamersley's experience with managing these sites provides a high level of confidence that any Aboriginal heritage sites that may be present on Backfill Hill will be managed accordingly and in accordance with the agreement with Gumala and the Aboriginal Heritage Act.

12. REHABILITATION AND CLOSURE

Hamersley's approach to planning for closure at Yandicoogina has followed a strategy that seeks to resolve the major question of the long term hydrogeological status of the area's groundwater before developing the details around removal of infrastructure and return of vegetation. Following approval of the initial Yandi JC operation, a Conceptual Closure Plan was developed and agreed by government in 1998 on the basis of being updated every 5 years. An updated closure plan including aspects of waste fines containment structures and groundwater management at Yandi JC was developed in 2003 and approved by DoE in March 2005. In addition, Hamersley has prepared a Conceptual Decommissioning and Rehabilitation Plan for the Yandicoogina Project Area, which was originally cleared by the DoE in August 2000.

Hamersley intends to consolidate these documents and revise them to incorporate closure, decommissioning and rehabilitation issues for both the Yandi JC and JSE projects in a single Conceptual Decommissioning and Rehabilitation Plan to be revised every five years. The plan will include a revised Closure Plan addressing management of long term hydrogeological consequences of mining the CID for both Yandi JC and JSE.

12.1 CLOSURE OBJECTIVES

Broad-based objectives have been established to guide early stages of rehabilitation and closure planning. Current closure objectives for the mining operations are as follows:

- relinquishment to the community of a tidy, safe, and uncontaminated site
- construction of landforms that are stable, free draining, non-polluting and aesthetically compatible with the surrounding landscape
- establishment of sustainable endemic vegetation communities consistent with reconstructed landforms, surrounding vegetation and suitable for the support of pastoralism.

For each objective, targets have been established which are specific, measurable and achievable. These targets establish a standard or level of performance that can be used to demonstrate successful rehabilitation prior to closure. These targets have been identified from the specific statutory requirements or from best practice, as identified through regulatory and industry guidelines.

12.2 BACKFILL OF MINE PIT

12.2.1 Experience at Yandi JC

During the environmental approvals process for the existing Yandi JC operation, Hamersley recognised that leaving pit lakes open to evaporation in the Pilbara was likely to lead to unacceptable salinisation of groundwater. The EPA and the Minister for the Environment accepted that a strategic approach which ranked protection of groundwater quality in major aquifers above additional disruption to surface landforms was appropriate. The closure plan for the Yandi JC operation, as approved by the DoE, is based on a hydrogeology model that predicts water quality will not deteriorate to unacceptable levels if sufficient backfill is placed in the final pit to allow throughflow of water.

Pit floor requirements for Yandi JC are predicted to be no deeper than 490 mRL throughout the entire pit. For Yandi JC, this means placing all waste rock (estimated from the original mine plan) back in the pit and sourcing additional backfill (source never definitively identified) to supplement this waste. Under that plan, in-pit salinity is increased by a factor of five (to around 2,500 mg/L), but stabilises at that value and remains within acceptable limits for beneficial uses such as stock watering. Salinity in aquifers downstream of the pit was predicted to be around half that value.

12.2.2 Backfill option for Yandi JSE

Preliminary groundwater modelling has indicated the minimum backfill to 490 mRL level determined as critical for Yandi JC is likely to be a minimum height for the JSE pit floor to produce acceptable salinity downstream. That level is below the initial water table for the JSE orebody of 495-498 mRL, but is sufficiently high to permit water to flow out of the pit void into downstream aquifers. Below this level of backfill, the discharge (throughflow) from the JSE CID is unlikley to occur to the Billiards CID for substantial periods of time. Without some form of flushing, the groundwater system in the JSE area has the potential to accumulate salts and become increasingly saline (Section 7.4.4).

The Yandi JSE orebody has a lower waste:ore ratio than Yandi JC and estimates from the JSE mine plan suggest that all available waste (around 50 million cubic metres) will only provide sufficient backfill to lift the pit floor to 490 mRL over part of the pit floor. An additional 30 million cubic metres of fill is required to be sourced to raise the remaining part of the pit floor to 490 mRL.

Backfill Hill

As mining starts in the south of the deposit and works north progressively, most of the fill shortage will be in the northern sections of the pit. The most economic alternative is to source this fill from mining the hill at the north-west corner of the JSE pit, referred to in this EPS as “Backfill Hill”. Using a single source of backfill from a hill minimises the footprint of additional disturbance and would not produce a water-collecting structure that would be hard to rehabilitate. Current plans suggest that mining of backfill from this hill would continue for around four years after completion of mining within the JSE pit and be required to source 30 million cubic metres of swelled fill.

Present volume calculations suggest that Backfill Hill could provide that volume of waste without mining to below the surface of the surrounding land. Use of this hill would be subject to a number of environmental criteria in regard to flora, fauna and heritage values (Sections 9.5, 10.5 and 11.5 respectively) and approved formally as part of the Closure Plan.

If these criteria are not met, a proportion or none of Backfill Hill may be available for use as fill and an alternative hill to the south east of the JSE CID will be used. The environmental and heritage values of this hill are known and the use of it for fill would not compromise the EPA’s objectives for flora, fauna and heritage. The use of the alternative hill however represents significant additional haulage cost to the proponent and consequently is not the preferred choice for this purpose.

Alternative closure strategies considered

Consideration was given to the possibility of redirecting part or all of stream flows from the Marillana and Yandicoogina Creeks through the pit void of the Yandi JSE project. The concept was rejected for a number of reasons, primarily that saline lakes would form over time in the pit, creek vegetation in Marillana Creek downstream of the JSE CID would be affected, and the pit lake option does not meet the current commitment Hamersley has made in respect to closure for the existing Yandi JC operation.

12.2.3 Predicted life of mine landforms

Figure 23 through Figure 26 show the predicted progress of mining and landform restoration over the life of mining for Yandi JSE. This gives an indication of the timing of landform restoration and subsequent rehabilitation, with closure post 2025. The expected progress of mining and rehabilitation at Yandi JC for this period is also indicated on Figure 23 through Figure 26.

12.3 REHABILITATION

The following is a summary of an indicative rehabilitation strategy for the Yandi JSE project. The strategy will be expanded on in the Conceptual Decommissioning and Rehabilitation Plan for the Yandicoogina operation, to be revised to include both Yandi JC and JSE within 12 months of cessation of mining, and fully detailed in the Final Decommissioning and Rehabilitation Plan to be prepared at least two years prior to decommissioning.

12.3.1 Description

Mining and establishment of associated infrastructure will result in clearing of vegetation, disturbance of soil profiles and landforms. Rehabilitation aims to restore disturbed landforms as rapidly as practical such that they are sympathetic to surrounding undisturbed areas, resembling as much as possible the original topography, and revegetated with local species suited to the environmental conditions of the landscape. Areas disturbed during construction of mine infrastructure but not required for operation will be rehabilitated within the construction phase. During mining, once final landforms are achieved and stable they will be revegetated. Figures 23 to 26 show a likely progression of available final landforms governed by the progress of mining to final depth.

Out-of-pit waste dumps will be constructed as per DoIR guidelines to ensure that interim surfaces are stable and non-eroding. Should dusting become an issue on dumps some form of control via vegetative cover may be required (although final fate of waste dumps will eventually be that they are to be returned to the pit).

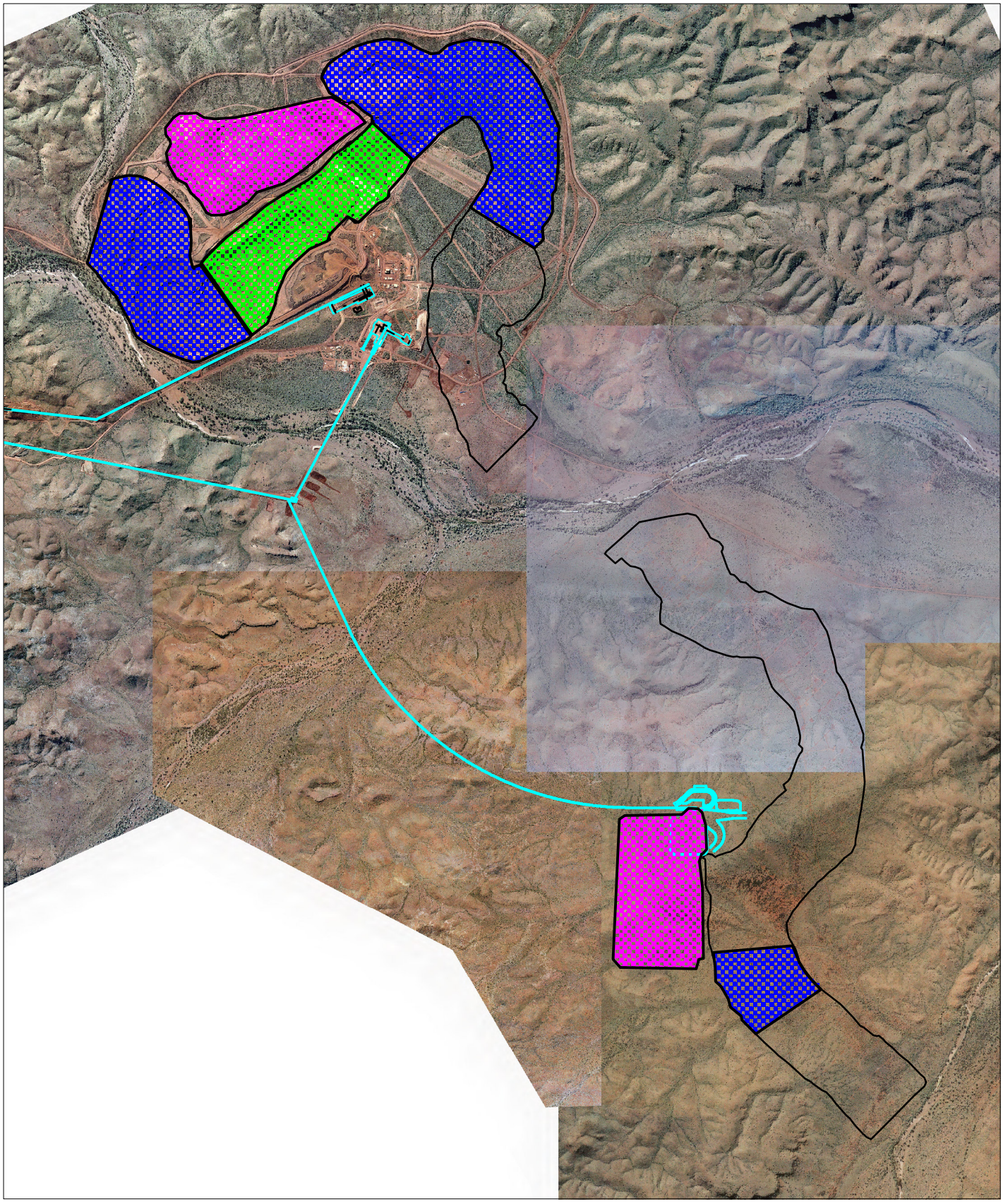
Experience with rehabilitation trials at the Yandi JC operation (which is scheduled to close well before Yandi JSE) will be used to direct revegetation efforts. Following mining, infrastructure that is no longer required will be removed and the land rehabilitated to blend in with the surrounding undisturbed areas.

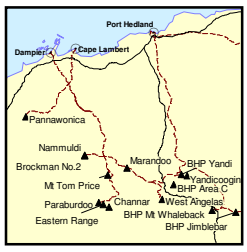
12.3.2 Objectives

For Yandi JSE, mining is a temporary land use and therefore rehabilitation objectives are to be consistent with the likely future land use for the land. The end use of the land will be pastoral grazing on native species, i.e. its original land use.

The broad objective of rehabilitation is to produce final landforms that are:

- safe
- stable
- support self-sustaining native vegetation
- free draining and non polluting
- visually compatible with surrounding landscape.





- Active Mining Area
- Backfilled Pit Area
- External Waste Dump
- Rehabilitated Waste Dump
- Rehabilitated Area Mined for Additional Fill

N

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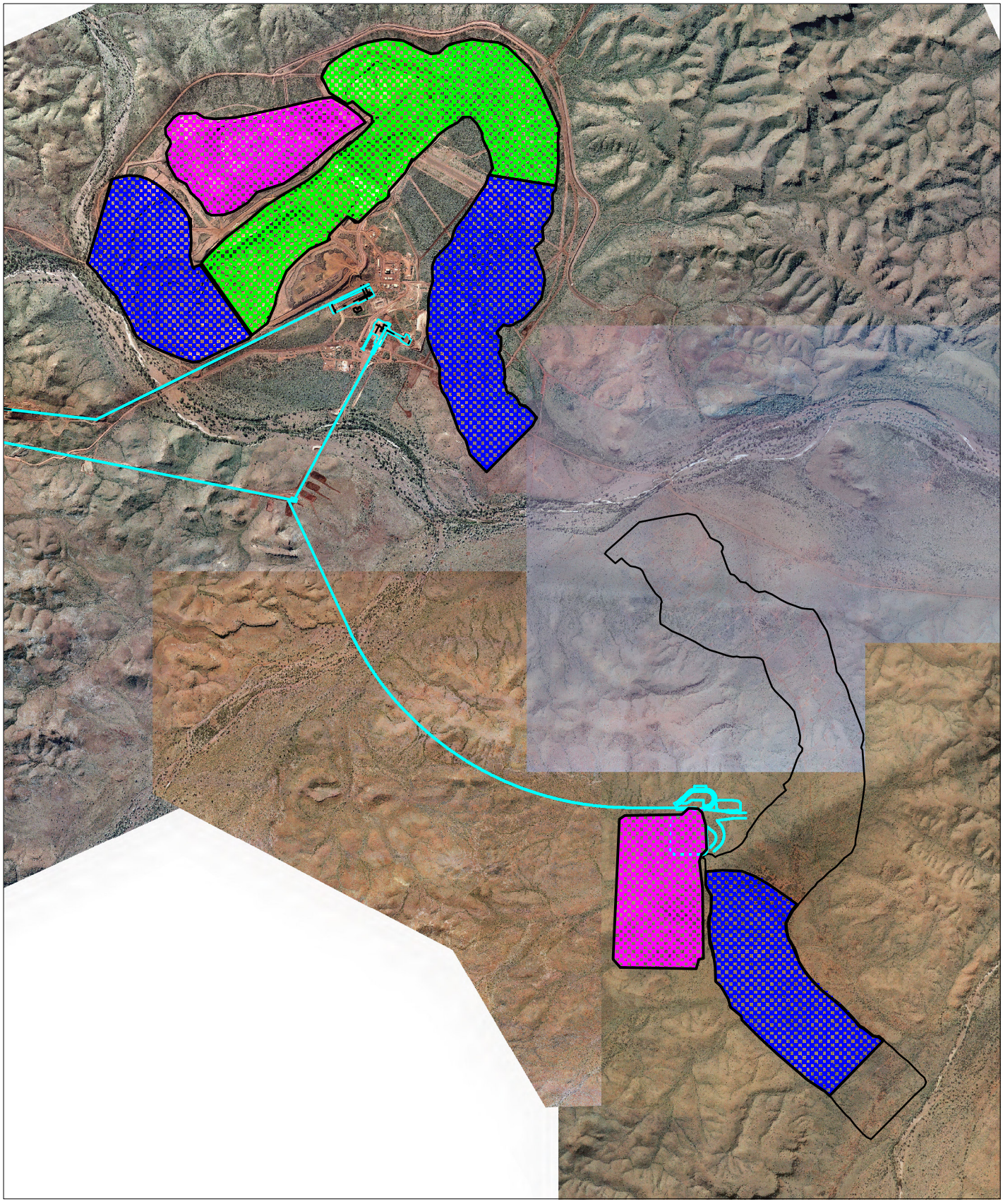
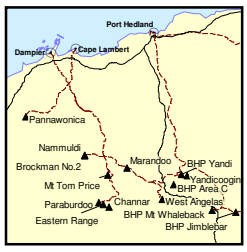
Figure 23 Yandi Conceptual Mine Progression Year 1 (2007)

Author: MAH	Date: 19-04-05
Drawn: MAH	Revised:
Dwg No.:	Report No.:
Projection	Scale:





- Active Mining Area
- Backfilled Pit Area
- External Waste Dump
- Rehabilitated Waste Dump
- Rehabilitated Area Mined for Additional Fill

N

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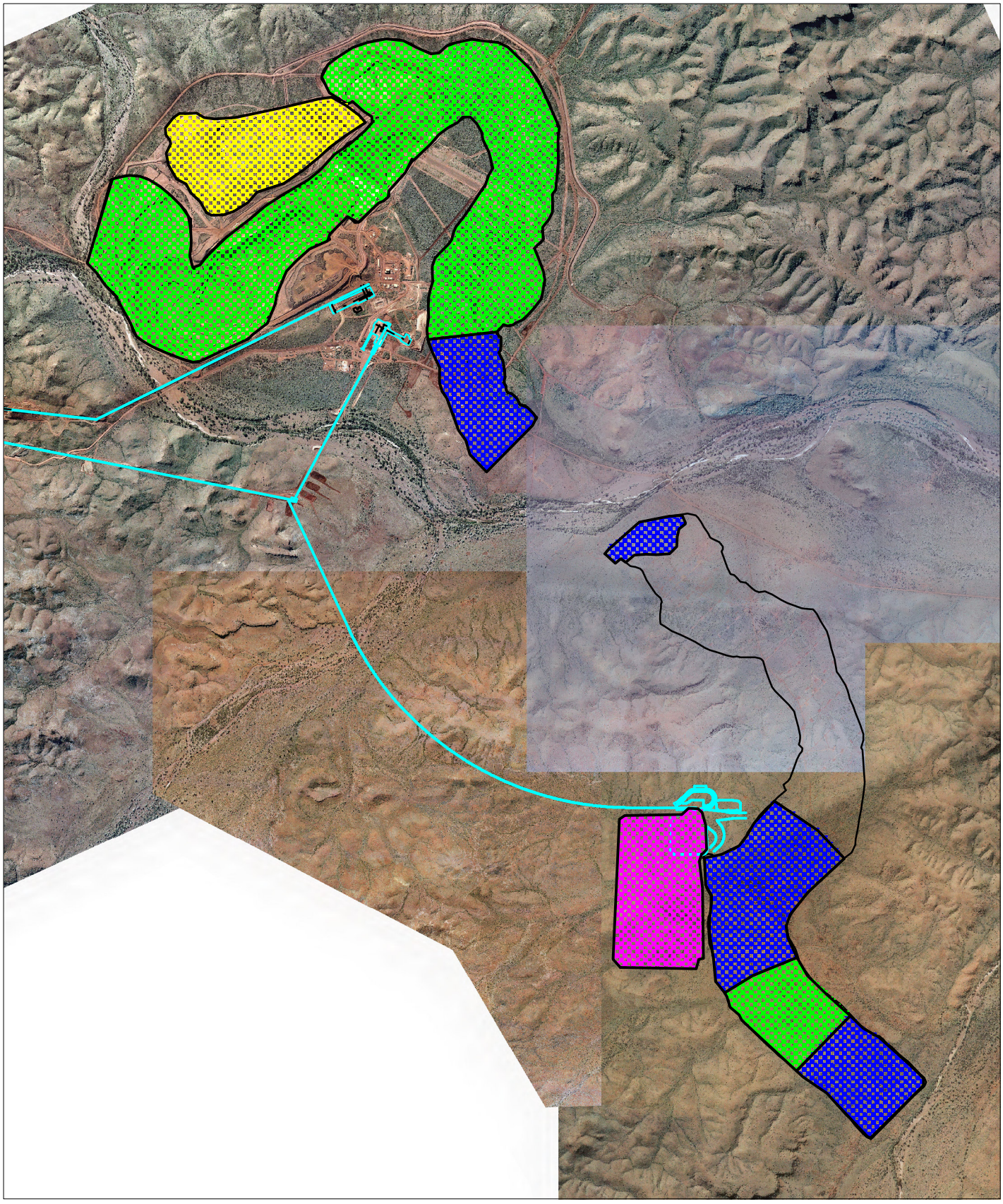
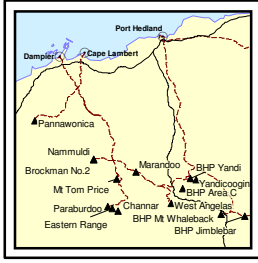
Figure 24 Yandi Conceptual Mine Progression Year 5 (2011)

Author: MAH	Date: 19-04-05
Drawn: MAH	Revised:
Dwg No.:	Report No.:
Projection	Scale:





- Active Mining Area
- Backfilled Pit Area
- External Waste Dump
- Rehabilitated Waste Dump
- Rehabilitated Area Mined for Additional Fill

N

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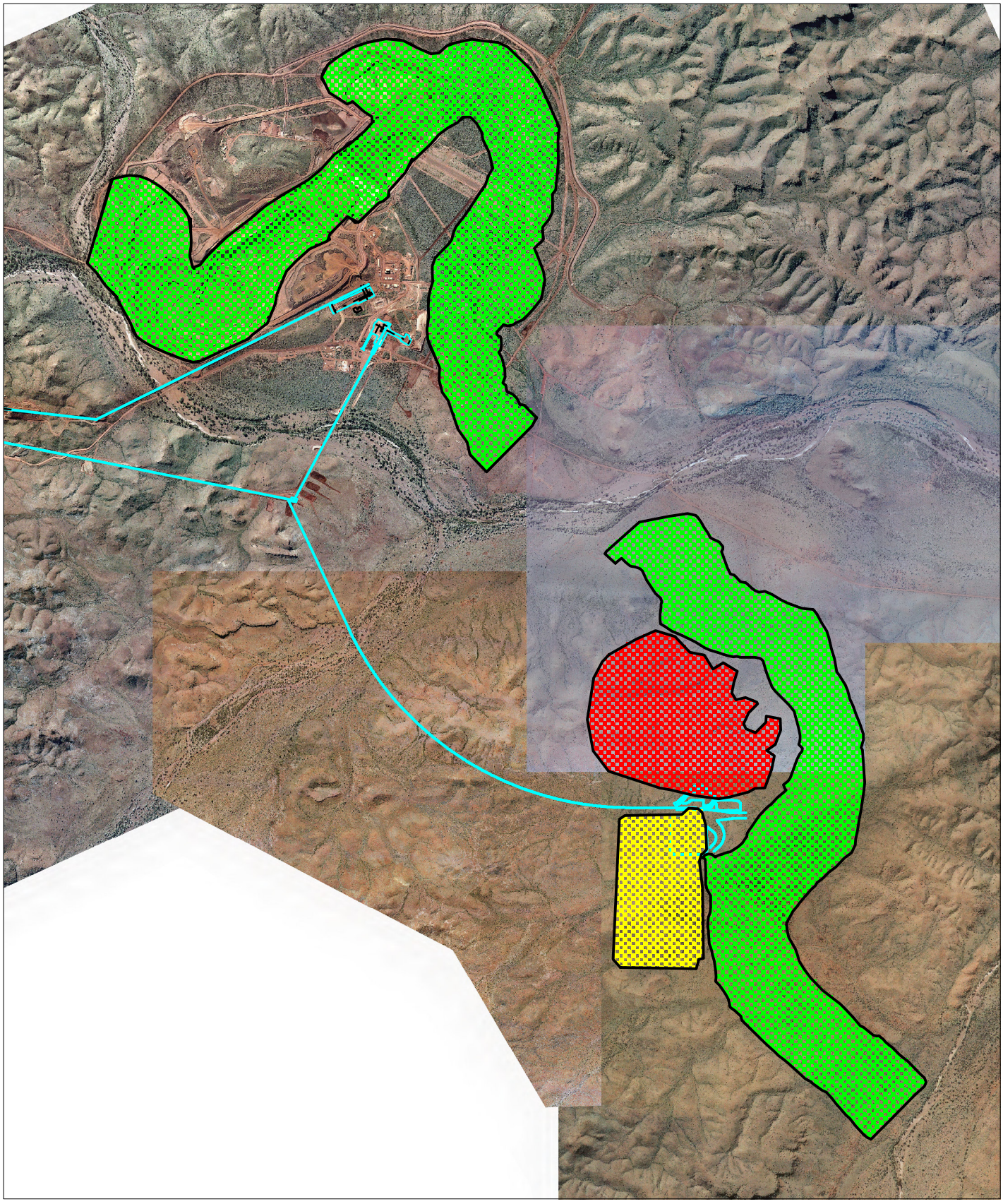
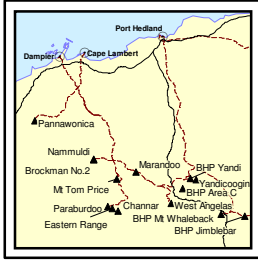
Figure 25 Yandi Conceptual Mine Progression Year 8 (2014)

Author: MAH	Date: 19-04-05
Drawn: MAH	Revised:
Dwg No.:	Report No.:
Projection	Scale:





- Active Mining Area
- Backfilled Pit Area
- External Waste Dump
- Rehabilitated Waste Dump
- Rehabilitated Area Mined for Additional Fill

N

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Figure 26 Yandi Conceptual Mine Progression Year 19 (2025)

Author: MAH	Date: 19-04-05
Drawn: MAH	Revised:
Dwg No.:	Report No.:
Projection	Scale:

12.3.3 Rehabilitation approach

The Final Decommissioning and Rehabilitation Plan will fully describe the planned rehabilitation works for the decommissioned operation, including proposed restored landforms, corresponding revegetation prescriptions, timing, and rehabilitation performance criteria (completion criteria) for final land use.

Rehabilitation of backfilled mine pit

Progressive rehabilitation of the mine pit (in the JSE CID) will be integrated into the mine operation activities. Following mining, the pit floor will be raised with overburden and waste rock material from the waste stockpile and material mined from the Backfill Hill, or the alternative backfill source (nearby hill).

The CID post mining landform, as a result of the net loss of material, will be worked to form a gradual sloping depression. The slopes will be reshaped so they are self draining and stable and topsoil and vegetative material either sourced from stockpiles or freshly removed from concurrent clearing operations (i.e. at the active mine face). Deep ripping will be conducted to remove compacted areas where appropriate.

New minor drainage lines are likely to form on the slopes with runoff directed towards the centre line of the channel depression. The revegetation prescription will incorporate opportunity for appropriate local species specialised for creek zones to establish.

The expected timing of mine pit rehabilitation at Yandi JSE is indicated on Figure 23 through Figure 26.

The remaining pit void will be decommissioned in accordance with DoIR requirements.

Planting of drainage levees and diversion drains

The CID rehabilitation area will be surrounded by the perimeter of embankments and drains constructed during mining, which will not be removed at closure. These drainage structures will be constructed to remain for as long as possible to ensure surrounding runoff is not prevented from reaching the Marillana and Weeli Wolli Creeks and will be revegetated.

Planting of embankments will be typical of restored slope rehabilitation but diversion drains will require specific rehabilitation procedures and prescriptions to provide opportunity for local species specialised for drainage zones to establish. The extensive baseline vegetation data collected in the area for the current and previous proposals provides Hamersley with detailed information on the suitability of species for drainage line conditions.

Particular attention will be paid to establishing vegetation resembling drainage line vegetation communities along the diverted significant drainage line near the south west end of the CID. The diversion represents a permanent change to the path of this drainage line and Hamersley intends to use this as a demonstration project for drainage line rehabilitation. Revegetation of permanent drainage lines and embankments can commence soon after construction and does not have to wait to closure.

Rehabilitation of decommissioned land

Decommissioning will involve the dismantling and removal of all building structures, equipment and pipelines not otherwise agreed to be retained. All compacted areas will be deep ripped and recontoured in order to restore normal drainage.

12.3.4 Rehabilitation procedures

Rehabilitation of the Yandi JSE area will be undertaken in accordance with the procedures described in the Hamersley Rehabilitation Handbook.

The procedures include instructions for:

- ground disturbance
- topsoil management
- waste stockpile design
- landforming
- revegetation, including ripping, mechanical seeding and fertiliser application
- rehabilitation monitoring
- erosion monitoring.

One of the keys to successful rehabilitation is topsoil management. Topsoil is critical for successful rehabilitation, particularly in arid environments such as the Pilbara. Topsoil will be obtained during all site clearing activities and used immediately on restored landforms or stored temporarily in low lying stockpiles (<2 m high). The long-term viability of topsoil stockpiles will be maintained through the use of Hamersely's standard prescriptions for topsoil management to be applied at initial construction and through mine life.

12.3.5 Completion criteria

Completion criteria will be developed in consultation with the Department of Industry and Resources (DoIR), Department of Environment (DoE) and Department of Conservation and Land Management (CALM). These criteria would be directed towards return of vegetation typical of the area, but recognising the in-pit ecosystems may not have analogues in the existing local vegetation communities. The specific criteria may include, but are not necessarily limited to, flora and fauna species abundance, diversity, community composition, and habitat characteristics.

The amended EMP and Conceptual Decommissioning and Rehabilitation Plan will describe the process and timing for developing specific rehabilitation objectives, performance indicators and completion criteria subject to review by the above authorities.

This approach is consistent with that outlined by EPA in their draft conditions (condition 6-1) contained in the EPA Report and Recommendations for the BHPBIO Marillana Creek Life of Mine Proposal (Bulletin 1166, EPA April 2005), which is adjacent to the Hamersley Yandicoogina Project.

12.3.6 Monitoring and performance indicators

Monitoring of revegetation will be conducted on a regular basis to assess the success of revegetation techniques and ensure that the vegetation communities are approaching the planned land use values and agreed completion criteria.

Performance indicators will be selected, typically related to specific completion criteria, for the purpose of monitoring. Results of monitoring will be used to further refine the rehabilitation strategy.

Monitoring rehabilitation

Control sites are selected to be permanent reference sites selected on the basis of representative landform and vegetation applicable to each of the land systems to be restored. These sites help to account for seasonal or interannual changes in ecosystem state.

The rehabilitation monitoring program will be described in the EMP developed in consultation with agencies referenced in Section 12.3.5.

12.3.7 Consideration of climate change

The effect of climate change on success of rehabilitation has been raised as an issue by some stakeholders during consultation for the EPS. However, long term climate change will equally affect rehabilitation areas and natural vegetation and occur at such a rate that a natural progression of species more suited to the changing conditions will occur. Additionally, assessed on current trends, the Central Pilbara is not expected to experience significant decreases in annual rainfall in the immediate long term, which would more likely affect rehabilitation than increases in rainfall. Unlike the south-west of Western Australia, the Central Pilbara has experienced a 30 to 50 mm increase in average annual rainfall (Bureau of Meteorology 2005).

The rehabilitation strategy incorporates the use of local species adapted to the existing conditions, in particular the dry environment and sporadic occurrence of rainfall. It is not considered appropriate to select plant species that may be better adapted to future climates at this stage, at the expense of creating an ecosystem which does not represent local vegetation types.

12.4 PROPONENT COMMITMENTS

Closure and rehabilitation issues at Yandi JSE will be covered by the following new proponent commitments (new proponent commitment number in parenthesis):

General

- Comply with relevant legislation (1).
- Refer significant amendments for assessment (2).
- Environmental audits and reporting (6, 7).
- Vegetation and topsoil removed during site preparation to be used for progressive rehabilitation (15).

EMP

- Review and revise the existing Yandicoogina EMP to address rehabilitation issues arising from the JSE project, including (17):
    - detailed strategy of the progressive rehabilitation program for disturbed areas including reference to procedures to undertake, and monitor and manage rehabilitation and a description of the process for establishment of rehabilitation completion criteria.

Decommissioning and Rehabilitation Plan

- Within 12 months of the Yandi JSE proposal being commissioned, a revised Conceptual Decommissioning and Rehabilitation Plan for the Yandicoogina Iron Ore Mine will be submitted to EPA for approval (18). The plan will now incorporate both the Yandi JC and JSE operations. It will be prepared, and reviewed every five years, in consultation with DoIR, DoE and CALM. The plan will address:
    - strategy for managing long term hydrogeological consequences of mining the CID
    - notional removal of infrastructure
    - indicative rehabilitation plan
    - source of backfill material and notional management of associated environmental issues
    - process for establishment of completion criteria.
- At least two years prior to the decommissioning of the project, the Decommissioning and Rehabilitation Plan for the Yandicoogina Iron Ore Mine will be finalised and submitted to the Government for approval and will fully detail (19):
    - management of long term hydrogeological consequences of mining the CID
    - removal of infrastructure
    - rehabilitation plan
    - backfilling of pit, sourcing backfill and management of associated environmental issues
    - completion criteria developed in consultation with the DoIR, DoE and CALM.

These commitments are included in full in Table 13.

13. ENVIRONMENTAL MANAGEMENT

In summary, the Yandicoogina Project currently operates under:

- The *Iron Ore (Yandicoogina) Agreement Act 1996* (WA), which requires amendments to Mining Proposals covering the any expansions to be submitted to the WA Government.
- Ministerial Conditions – Statement No. 417 (24 May 1996) and 523 (1 October 1999), which includes Environmental Conditions, Key Characteristics of the Proposal, and the Proponent's Environmental Management Commitments.
- An approved Environmental Management Program (EMP) (required by Ministerial Condition 4 and Proponent's Environmental Management Commitments 14 and 31).
- DoE Licence 7340/7 (current until 31 May 2005 – renewal application lodged March 2005).
- Licences to Take Water under the Rights in Water and Irrigation Act Groundwater Licence (primarily two (GWL 107422 –for purposes of mine dewatering wellfields, dust suppression, earthworks, construction and mineral ore processing; and GWL153358 – for purposes of earthwork and construction, mining camp) current until 30 June 2007.
- Hamersley Iron Yandicoogina Closure Plan (prepared in 2003) covering the hydrogeological aspects of mine void closure (recently approved (March 2005) following revision of the 1998 document).
- An approved Conceptual Decommissioning and Rehabilitation plan covering the remainder of the Yandicoogina mine and rail facilities.
- Annual environmental reporting requirements under the Agreement Act and EP Act.

Environmental protection principles

Hamersley acknowledges the environmental protection principles listed in s4a of the EP Act through its strong commitment to sustainable development and environmental management at Yandicoogina and other operations. These environmental protection principles being the:

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

These principles are clearly reflected in Hamersley's environmental policy (Section 13.1), Iron Environmental Management System (Section 13.2), Environmental Management Program (Section 13.3), and the Rio Tinto corporate environmental standards that are implemented across the Rio Tinto Group (Appendix 2).

13.1 PROPONENT'S ENVIRONMENTAL POLICY

The proponent aims to conduct business in an efficient and environmentally responsible manner that is compatible with the expectations of their shareholders, the government and the community. Hamersley also recognises that environmental responsibilities go beyond those required under statutory regulations and encompass social obligations, leadership in sustainable development and minimising environmental impacts.

To demonstrate this commitment, the Pilbara Iron and Robe River Joint Venture Environmental Policy was signed in August 2004 by the Managing Directors of Pilbara Iron, Expansion Projects and Robe River Joint Venture and the Chief Operating Officer of the Pilbara Rail Company. This new policy reflects the recent growth and structural changes in the business.

The Environmental Policy is the guiding document for driving environmental management and provides context and specific direction for continuous improvement. The signing of the new policy has renewed commitment to care for the environment using our well-established approach of '*Protect – Restore – Do it Better*'.

Environmental Policy

Our goal is to create long-term value as a responsible iron ore mining company. In doing this we need to care for the environment with our aims including:

- *efficient use of natural resources*
- *to meet our legal and other obligations along with the targets we set*
- *to minimise pollution and clean up any accidents quickly*
- *leaving areas as close as practical to how we found them*
- *to continually improve performance*
- *ensuring employees know their environmental accountabilities and act on them*
- *being proactive to better understand the impact of our operations now and for the future*
- *providing opportunities for communities and others to tell us what they think*

To achieve this, our actions will be:

- *managing our environmental issues through our EMS and business systems*
- *developing environmental improvement plans each year for priorities identified in review of systems and performance*
- *improving our ability to measure water, energy use and greenhouse gas emissions*
- *minimising waste and spills of hydrocarbons*
- *improving the efficiency of our use of natural resources*
- *updating plans for disturbance and closure, progressively rehabilitate and measure success*
- *recognising good environmental performance*
- *training staff and contractors in environmental requirements of their work*
- *that community views are sought, respected and considered*
- *reporting regularly to stakeholders on our performance*
- *aligning with the Rio Tinto Iron Ore Health, Safety and Environmental Policy*

13.2 HAMERSLEY IRON ENVIRONMENTAL MANAGEMENT SYSTEMS (HAMERSLEY IEMS)

Hamersley operates under an ISO14001 framework using its Iron Environmental Management System (or 'IEMS'). ISO14001 is an internationally recognised continuous improvement model that has been picked up, implemented and added value to thousands of organisations worldwide. Its basis lies in management commitment and the allocation of resources to establish systems based on reducing environmental risk. The key elements of ISO14001 include assessing environmental risk and legal requirements, developing objectives and targets for improvement, training, operational control, communication, emergency response, corrective actions, audits and review. Rio Tinto has mandated that all its global operations be certified to this standard by July 2005.

In 2005, the Hamersley sites successfully maintained their certification to ISO14001, first achieved in October 2003, through three external audits by NCS International Pty Ltd (NCSI).

One of the key components of IEMS is ensuring that environmental planning processes are integrated fully with the overall business planning process. This ensures that objectives and targets are both realistic and resourced. Environmental Improvement Plans (EIPs) are established annually and reflect how environmental objectives and targets are achieved. In 2004, over 330 EIPs were formally signed off and tracked throughout the year.

An improved system for tracking corrective actions has recently been developed with the Health, Safety, Environment and Community (HSEC) module. This has enabled all corrective actions from audits, inspections and incidents to be tracked and reported by sites on a regular basis. Phase II of this project will continue in 2005 with additional improvements to be implemented.

Each year management within Hamersley review IEMS to ensure its continuing suitability, adequacy and effectiveness.

13.3 ENVIRONMENTAL MANAGEMENT PROGRAM

It is intended that the Yandi JSE project will be managed under the same framework as the Yandi JC project, and be effectively managed as part of the same mining operation.

The Yandicoogina operation has an Environmental Management Program (EMP) in place developed as a condition of Ministerial Statement 417 and amended to incorporate management of the expanded mine as per Ministerial Statement 523. The EMP has been approved by the DoE and outlines plans for the following aspects:

- Groundwater management
- Surface water management — mining and railway operations
- Flora and fauna
- Waste management
- Hydrocarbon management
- Dust, noise and fire
- Environmental awareness and training
- Environmental incident response and preparedness
- Greenhouse gases

- Contaminated sites
- Aboriginal heritage
- Contractor management
- Change management
- Rehabilitation and decommissioning
- Monitoring and reporting
- Environmental auditing and reviews.

The EMP will be reviewed and revised where relevant for the purpose of extending the environmental management and monitoring to address all environmental issues arising from the development and operation of the Yandi JSE operation.

13.4 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

A Construction Environmental Management Plan (CEMP) will be prepared specifically to address management of environmental issues arising from construction activities, including those associated with the activities of a large construction workforce. This plan may form part of the Works Approval process covering plant construction. The plan would include a requirement for:

- all contractors with potential environmental aspects to receive an instruction package on legal and best practice requirements for minimising impacts
- an induction package for all staff and contractors outlining key project objectives and procedures and the need for compliance
- pre-construction permit requirements under Part V of the EP Act, including Works Approval, borefield licences and others
- pre-disturbance surveys for flora of conservation significance
- clearing and topsoil management procedures
- rehabilitation requirements
- incident reporting and emergency management procedures
- a schedule of internal audits to verify compliance.

13.5 DECOMMISSIONING AND REHABILITATION PLAN

Section 12 describes the management framework for closure, decommissioning and rehabilitation.

13.6 SUMMARY OF ENVIRONMENTAL CONTROLS

The existing Yandi JC mine and associated operations are managed in accordance with numerous regulatory and other management instruments to ensure an integrated environmental management approach.

Table 12 outlines the controls that exist or will be in place to ensure environmental compliance and appropriate management of the Yandi JSE operation in regard to each environmental factor and issue. These controls are primarily as follows:

- Compliance with Environmental Conditions, Key Characteristics or Proponent Commitments, including proposed new commitments (Section 13.7) in the Ministerial Statement.
- Relevant controls in Construction Environmental Management Program (CEMP), which includes all environmental aspects of construction and must be approved by DoE.
- Relevant controls in Environmental Management Program (EMP), which includes Water Management Plan for Yandicoogina operation, which must be approved by DoE.
- Final Decommissioning & Rehabilitation Plan to be prepared prior to closure and approved by DoIR and DoE in consultation with CALM.
- Conditions of the DoE Works Approval (under EP Act) for construction of prescribed premises.
- Conditions of the DoE Licence (under EP Act) for prescribed premises (Processing, Mine dewatering, Landfill and Sewage facility).
- Conditions of the Licences to Take Water (under Rights in Water & Irrigation Act).
- Relevant Rio Tinto Environmental standard (Appendix 2).

Other relevant controls include s18 approval to disturb Aboriginal heritage sites under the Aboriginal Heritage Act and annual environmental reporting requirements.

13.7 SUMMARY OF PROPONENT'S COMMITMENTS

The proponent (Hamersley) proposes the Environmental Management Commitments for the management of Yandi JSE as detailed in Table 13.

These commitments could be included in a new Ministerial Statement for the Yandicoogina Operation.

Table 12 Environmental compliance and management controls for Yandi JSE (as part of entire Yandicoogina operation)

Factor	Topic / aspect	Ministerial Conditions	CEMP	EMP	Decomm. & Rehab. Plan	Works Approval	DOE Licence	Licence to Take Water	Rio Tinto Standard
Landform	Extent of ground disturbance	✓							
	Mining of hill for backfill	✓			✓				
Water	Dewatering for mining	✓		✓				✓	
	Groundwater abstraction for administration, village supply			✓				✓	
	Further study of effects of mining on creeks and groundwater	✓		✓					
	Discharge of surplus water to creeks			✓			✓		
	Reinjection (potential)			✓			✓		
	Closure water issues	✓			✓				
	Monitoring of creek alluvium surface water and groundwater	✓	✓	✓				✓	
	Monitoring of groundwater in mining area	✓	✓	✓		✓		✓	
	Drainage management – mine		✓	✓		✓			
	Prevention of surface water contamination	✓	✓	✓		✓	✓		✓
	Drainage management – railway	✓		✓					
	Water use minimisation		✓	✓					✓
Flora and Fauna	Extent of clearing	✓	✓			✓			
	Protection of areas not approved to be cleared		✓	✓		✓			
	Protection of riverine habitat	✓	✓	✓					
	Weed management		✓	✓					
	Fire management		✓	✓					
	Flora and fauna survey of Backfill Hill	✓		✓					
	Use of Backfill Hill subject to criteria and satisfaction of DoE	✓			✓				
	Further study of short range endemics			✓					
	Further study on stygofauna			✓					
	Rehabilitation		✓	✓	✓				
Greenhouse Gases	Emission reductions		✓	✓					✓
	Reporting		✓	✓					

Factor	Topic / aspect	Ministerial Conditions	CEMP	EMP	Decomm. & Rehab. Plan	Works Approval	DOE Licence	Licence to Take Water	Rio Tinto Standard
Air Quality	Dust	✓	✓	✓		✓	✓		✓
	Other air quality issues		✓						✓
Noise	Noise management		✓	✓		✓			✓
Waste management	Overburden	✓	✓	✓	✓				
	Operational liquid wastes		✓	✓			✓		
	Solid waste disposal (landfill)	✓	✓	✓		✓	✓		
	Sewage (including treatment facility)	✓	✓	✓			✓		
Hazardous materials	Hydrocarbon management	✓	✓	✓		✓	✓		
	Hazardous substances / dangerous goods storage		✓	✓		✓	✓		✓
Aboriginal heritage	Disturbance of sites	✓	✓	✓					
	Protection of sites / heritage values	✓	✓	✓					✓
	Consultation with Gumala Aboriginal Corporation	✓	✓	✓					✓
	Archaeological and ethnographic survey of Backfill Hill	✓		✓					
	Use of Backfill Hill subject to criteria and satisfaction of DoE and DIA	✓			✓				
Closure	Decommissioning and Rehabilitation Plan (DRP) for entire Yandicoogina operation prepared to the satisfaction of DOE and DOIR.	✓			✓				✓
Rehabilitation	Rehabilitate disturbed areas	✓	✓			✓			
	Decommissioning and Rehabilitation Plan (DRP) for entire Yandicoogina operation prepared to the satisfaction of DOE and DOIR.	✓			✓				✓
EMPs	Environmental Management Program (EMP) for entire Yandicoogina operation prepared to the satisfaction of DOE and DOIR.	✓		✓					
	Construction Environmental Management Plan (CEMP) for new processing facilities.		✓			✓			

Table 13 Proponent's Environmental Management Commitments for the management of Yandi JSE

No	Issue	Objective	Action	Phase	Requirements (Advice)
1	Legislation	Comply with relevant legislation	The construction and operation of the project will be undertaken in accordance with the requirements of relevant Commonwealth and State legislation and regulation.	Pre-construction, construction and post-commissioning	
2	Amendments to the project	Refer significant project amendments for assessment	Details of any plan to alter the project from that outlined In the EPS that is likely to result in significant environmental impacts will be provided to the EPA for environmental assessment.	Pre-construction and post-commissioning	
3	Understand hydrogeological system	Understand hydrogeoological systems and develop and evaluate options for long term management	Hamersley will continue to evaluate the impacts of mining and decommissioning on the Marillana-Yandicoogina-Weeli Wolli Creek systems and the CID jointly with BHPBIO for the purposes of further understanding the hydrogeological system in order to develop and evaluate options for viable and compatible long term management strategies, including re-injection; results of evaluations will be reported to the Pilbara Iron Ore Environmental Management Committee.	Pre-commissioning and post-commissioning	DoE
4	Groundwater monitoring in the Weeli Wolli Creek system	Monitor groundwater in the Weeli Wolli Creek alluvium	Hamersley will establish groundwater monitoring bores in the alluvium to monitor surface and groundwater levels before dewatering commences; the results of this monitoring will be submitted to the State on an annual basis.	Pre-construction, construction and post-commissioning	DoE
5	Hydrogeological data collection	Collect further hydrogeological data to develop a model for the final void	Hamersley will continue to collect necessary hydrogeological data for the refinement of the model used to predict long term water levels and quality in the final void. This model will be applied to assist design of the final void to minimise long term impacts of mining on local and regional groundwater. A report on this model and the final void outcome will be prepared and submitted to the DoE before finalising the Decommissioning and Rehabilitation Plan.	Pre-construction, construction and post-commissioning	DoE
6	Environmental audits	Conduct regular environmental reviews	Hamersley will conduct internal environmental reviews during the construction (every 6 months) and operation (annually) of the project. These environmental reviews will assess compliance with project commitments, relevant Works Approval and Operating Licence conditions and any other environmental requirements.	Construction and post-commissioning	DoE
7	Environmental reporting	Prepare reports on environmental management and monitoring	Annual and triennial reports that describe the actions taken to comply with environmental management conditions and monitoring commitments will be prepared by Hamersley and issued to the State.	Post-commissioning	
8	Biological	Minimise impacts on riverine vegetation	During the project life, Hamersley will develop and formalise a tree health research and monitoring program to assess the impacts of dewatering on riverine vegetation. The monitoring program will include contingency actions if unacceptable impacts are detected. The results of the tree health monitoring program will be submitted to the State on a triennial basis.	Pre-commissioning, construction and post-commissioning	DoE, CALM
9	Waste disposal	Manage wastes in an appropriate manner	Waste will be managed in accordance with the following requirements: ▪ burning will not be permitted as a means of rubbish or other waste disposal within the project area ▪ all putrescible, biodegradable, inert substance and other general rubbish will be disposed of in a fenced, excavated waste pit that will be regularly backfilled to cover the waste material.	Construction and post-commissioning	DoE

No	Issue	Objective	Action	Phase	Requirements (Advice)
10	Sewage treatment plants	Ensure sewage treatment plants are approved	Plans for sewage treatment plants proposed at Yandicoogina will be submitted by Hamersley for approval by the Western Australian Department of Health.	Pre-construction	DoH, DoE
11	Hydrocarbons	Appropriate storage of hyrdocarbons	All bunding for hydrocarbon storage areas will be constructed in accordance with the requirements of AS1940-1993.	Construction and post-commissioning	DoIR, DoE
12	Contaminated surface runoff	Ensure that contaminated surface runoff does not enter natural drainage	The project will be designed, and management procedures put in place, to ensure that stormwater runoff from areas that may be contaminated by hydrocarbons does not enter natural drainage channels without prior treatment.	Pre-constrcution and post-commissioning	DoE
13	Dust	Minimise dust	Dust suppression measures, including application of water from tankers, will be implemented to minimise dust generation during site preparation and construction activities.	Construction and post-commissioning	DoE
14	Aboriginal heritage (archaeological) sites	To comply with *Aboriginal Heritage Act 1972*	If any Aboriginal site is required to be disturbed, Hamersley will seek consent to disturb the site from the Minister for Indigenous Affairs through a section 18 application under the *Aboriginal Heritage Act 1972*.	Pre-construction and construction	DIA, Gumala
15	Rehabilitation	Ensure disturbed areas are rehabilitated	Vegetation and topsoil removed during site preparation will be used to progressively rehabilitate disturbed areas.	Construction and post-construction	DoE, CALM
16	Backfilling of mine void	Minimise impact of use of hill for backfill on flora, fauna, surface drainage patterns and Aboriginal heritage sites	The use of adjacent landforms for the purpose of backfilling of the mine pit void at JSE will be subject to the following criteria for the protection of flora, fauna and heritage: ▪ no loss of DRF populations or TECs or a substantial proportion of other flora and vegetation considered to be of state or regional conservation significance ▪ no impact on Threatened Fauna or substantial impacts on other fauna species of state or regional conservation significance ▪ archaeological and ethnographic sites to be managed in accordance with the Aboriginal Heritage Act 1972 and the Yandicoogina Land Use Agreement. ▪ removal of fill and rehabilitation will be consistent with a final landform which sheds incident water from rainfall.	Decommissioning	DoE, DoIR, CALM, DIA, Gumala

No	Issue	Objective	Action	Phase	Requirements (Advice)
17	Environmental Management Program (EMP)	To manage environmental impacts of Yandi JSE	The Environmental Management Program (EMP) will be reviewed and revised where relevant for the purpose of extending the environmental management and monitoring to address all environmental issues arising from the development and operation of the Yandi JSE operation in consultation with DoE, DoIR and CALM. The revised EMP will include, but not be limited to, the following updated plans: i. water (groundwater and surface water) management plan, for both during and post-mining, incorporating the borefield operating strategy, whole of site water balance and discharge of surplus water, and drainage management measures for the altered drainage patterns ii. dust and noise emission management plans iii. greenhouse gases management plan iv. waste management plan v. flora and fauna protection plans, including monitoring and management of trees in creeklines and surveys for stygofauna vi. fire and weed management plans including a weed control program in the Marillana Creek system focusing on Hamersley's operational area vii. environmental induction program for personnel viii. progressive rehabilitation program for disturbed areas, consisting of a detailed strategy of the progressive rehabilitation program for disturbed areas including reference to procedures to undertake, and monitor and manage rehabilitation and a description of the process for establishment of rehabilitation completion criteria ix. summary of monitoring programs.	Pre-commissioning	DoE, DoIR, CALM
18	Decommissioning and rehabilitation plan	To satisfactorily decommission the mine site and rehabilitate the site and its environs.	Within 12 months of the Yandi JSE proposal being commissioned, a revised Conceptual Decommissioning and Rehabilitation Plan for the Yandicoogina Iron Ore Mine will be submitted to EPA for approval, which will address: ▪ strategy for managing long term hydrogeological consequences of mining the CID ▪ notional removal of infrastructure ▪ indicative rehabilitation plan ▪ source of backfill material and notional management of associated environmental issues ▪ process for establishment of completion criteria. The plan will now incorporate both the Yandi JC and JSE operations. It will be prepared, and reviewed every five years, in consultation with DoIR, DoE and CALM.	Post-commissioning	DoE, DoIR, CALM

No	Issue	Objective	Action	Phase	Requirements (Advice)
19	Decommissioning and rehabilitation plan	To satisfactorily decommission the mine site and rehabilitate the site and its environs.	At least two years prior to the decommissioning of the project, the Decommissioning and Rehabilitation Plan for the Yandicoogina Iron Ore Mine will be finalised and submitted to the Government for approval and will fully detail: ▪ management of long term hydrogeological consequences of mining the CID ▪ removal of infrastructure ▪ rehabilitation plan ▪ backfilling of pit, sourcing backfill and management of associated environmental issues ▪ completion criteria developed in consultation with the DoIR, DoE and CALM.	Post-commissioning	DoE, DoIR, CALM, Gumala
20	Construction Environmental Management Plan	Prepare plan for management of construction activities	Prepare a Construction Environmental Management Plan to cover all aspects of construction. This would include a requirement for surveys of rare and priority flora over all areas prior to any ground disturbance. It would also manage activities of the construction workforce including the requirement for an environmental induction program for construction personnel. The CEMP will include, but not be limited to, the following: i. all contractors with potential environmental aspects to receive an instruction package on legal and best practice requirements for minimising impacts ii. an induction package for all staff and contractors outlining key project objectives and procedures and the need for compliance iii. pre-construction permit requirements under Part V of the EP Act, including Works Approval, borefield licences and others iv. pre-disturbance surveys for flora of conservation significance v. clearing and topsoil management procedures vi. rehabilitation requirements vii. incident reporting and emergency management procedures viii. a schedule of internal audits to verify compliance.	Pre-construction	DoE, DoIR, CALM

Abbreviations:

DIA	Department of Indigenous Affairs
CALM	Department of Conservation and Land Management
DoE	Department of Environment
DoIR	Department of Industry and Resources
Gumala	Gumala Aboriginal Corporation

14. CONCLUSION

The key environmental factors identified by the proponent, government agencies and other key stakeholders in regard to the development and operation of the Yandi JSE project were:

- Groundwater – Impacts of dewatering, site water management and long term impacts of mining and closure on water quality of CID aquifer.
- Surface water – Protection of water quality of Marillana Creek system.
- Flora and Fauna – Conservation of regional biodiversity.
- Aboriginal heritage – Protection of significant Aboriginal sites and consultation with the Gumala Aboriginal Corporation in heritage investigations and works.

The targeted consultation program indicated that the most important issue regarding this proposal related to the water management issues, primarily impacts to groundwater during and following mining and protection of the creek system.

14.1 ENVIRONMENTAL COSTS

The environmental costs of the proposal are as follows:

- Changes in the immediate landscape primarily caused by the removal of material from the CID and resultant depression in the restored landform and the removal of the adjacent low lying hill from mining for the purpose of backfill (impact of local significance).
- Localised alterations to groundwater flow in CID and an increase in groundwater salinity in the restored landform due to evaporation of water near the surface (which will be 10 – 15 m lower than prior to mining in some areas). These isolated changes will not have a significant impact on regional groundwater flow or quality.
- Minor changes in surface drainage patterns over CID and diversion of minor drainage lines around CID, but which should not impact the quality or quantity of water in the creeks themselves.
- Progressive removal of approximately 670 ha of native vegetation over the life of the project, although with eventual rehabilitation to native vegetation.
- Potential changes in composition of vegetation down gradient of mine due to altered surface drainage; however this will not significantly affect local or regional flora and vegetation values.
- Increased risk of the spread of weeds, however this will be initially minimised through Hamersley's weed control and hygiene procedures and effective rehabilitation should negate risk.
- Reduction in local abundance of some fauna populations, however this will not have a significant effect representation of fauna at a regional (Central Pilbara) or sub-regional (Hamersley Ranges) level.
- A number of Aboriginal sites will be disturbed from mining, however based on the archaeological and ethnographic surveys of the Yandi JSE area, the proposal will avoid disturbance of those sites identified to be of significance.

14.2 ENVIRONMENTAL BENEFITS

A number of environmental benefits will arise from the implementation of this proposal and continued operation of the Yandicoogina Iron Ore Mine Operation:

- Weed control program in creek lines of the Marillana Creek system focussing on Hamersley's operational area.
- Continued support of research programs by the Ecosystems Research Group of the University of Western Australia in assessing plant-water relationships and developing better predictive models of drawdown impacts in the Pilbara.
- Continued support of research into the distribution and taxonomy of stygofauna in the Central Pilbara.

In addition, the ongoing activities of Hamersley will continue to support towns in the Pilbara region.

Hamersley will also continue to support a variety of community groups and public projects in WA through the WA Rio Tinto Future Fund, Partnership Programs and the Pilbara Donations Committees, and its Aboriginal Training and Liaison Unit (ATAL) in Dampier, responsible for helping Aboriginal communities maintain traditions and structures of cultural significance.

14.3 ENVIRONMENTAL RISKS AND MANAGEABILITY

The approach taken in this environmental review has been based on a risk assessment approach to characterise environmental factors, determine potential impacts and develop mitigation measures.

The proponent has extensive experience in managing the development, operation and environmental compliance of similar projects (including the existing Yandi JC operation) and this experience is anticipated to lead to a greater certainty in achieving desirable environmental outcomes.

The environmental aspects of the proposal will be primarily managed through the Yandicoogina EMP, which will be amended to incorporate all aspects of the Yandi JC project, the site EMS, relevant licences, the implementation of proposed environmental management commitments for Yandi JSE, and the continued implementation of environmental management commitments for the existing Yandicoogina Project. Hamersley will ensure an acceptable closure outcome through preparation of a Final Decommissioning and Rehabilitation Plan for the Yandicoogina Project to the satisfaction of stakeholders.

The proponent has consulted with stakeholders (including Government agencies) to scope the potential impacts of the proposal and to determine the significance of environmental issues and the acceptability of mitigation. This process substantially improves the likelihood that all significant environmental issues have been identified, investigated, mitigated and offset as far as practicable.

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Appendix 1
Ministerial Statements
417 and 523

Ass # 979
Bull # 809
State # 417

MINISTER FOR THE ENVIRONMENT WESTERN AUSTRALIA

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

YANDICOOGINA IRON ORE MINE & RAILWAY
90 KILOMETRES NORTH WEST OF NEWMAN
HAMERSLEY RANGE (979)

HAMERSLEY IRON PTY LIMITED

This proposal may be implemented subject to the following conditions:

1 **Proponent Commitments**
The proponent has made a number of environmental management commitments in order to protect the environment.

1-1 In implementing the proposal, the proponent shall fulfil the commitments made in the Consultative Environmental Review and in response to issues raised following public submissions; provided that the commitments are not inconsistent with the conditions or procedures contained in this statement.

The environmental management commitments were published in Environmental Protection Authority Bulletin 809 (Appendix 4) and a copy is attached.

2 **Implementation**
Changes to the proposal which are not substantial may be carried out with the approval of the Minister for the Environment.

2-1 Subject to these conditions, the manner of detailed implementation of the proposal shall conform in substance with that set out in any designs, specifications, plans or other technical material submitted by the proponent to the Environmental Protection Authority with the proposal.

2-2 Where, in the course of the detailed implementation referred to in condition 2-1, the proponent seeks to change the designs, specifications, plans or other technical material submitted to the Environmental Protection Authority in any way that the Minister for the Environment determines, on the advice of the Environmental Protection Authority, is not substantial, those changes may be effected.

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3 Proponent

These conditions legally apply to the nominated proponent.

3-1 No transfer of ownership, control or management of the project which would give rise to a need for the replacement of the proponent shall take place until the Minister for the Environment has advised the proponent that approval has been given for the nomination of a replacement proponent. Any request for the exercise of that power of the Minister shall be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement proponent to carry out the project in accordance with the conditions and procedures set out in the statement.

4 Environmental Management Programme

A detailed Environmental Management Programme should contribute to the development of long term management options through comprehensive monitoring and management practices.

4-1 Prior to construction, the proponent shall prepare an Environmental Management Programme to the requirements of the Environmental Protection Authority on advice of the Department of Environmental Protection.

This Programme shall detail the procedures and practices for protection of the environment during all phases of mining and include, but not be limited to the following:

1 groundwater monitoring and management;

2 surface water monitoring and management, including measures for the protection of the integrity of Marillana Creek;

3 sheet and gully drainage management along the railway;

4 pollution prevention measures, including noise and dust;

5 waste management, including overburden, liquid, solid and gaseous wastes;

6 protection of flora and fauna, including fire and weed management;

7 rehabilitation of disturbed areas; and

8 development of a comprehensive monitoring, management and reporting programme for the above.

The reporting programme shall provide for:

1 annual reports outlining implementation of the Environmental Management Programme;

2 triennial reports reviewing the implementation of the Environmental Management Programme; and

3 six yearly reports reviewing the environmental objectives and implementation of the Environmental Management Programme and its effectiveness in achieving those objectives,

to the requirements of the Environmental Protection Authority.

4-2 The proponent shall implement the Environmental Management Programme required by condition 4-1 to the requirements of the Environmental Protection Authority on advice of the Department of Environmental Protection, the Department of Minerals and Energy, the Water and Rivers Commission and the Department of Resources Development.

5 Decommissioning

The satisfactory decommissioning of the project, removal of the plant and installations and rehabilitation of the site and its environs to a sustainable condition in the long term, is the responsibility of the proponent.

5-1 Within five years following commissioning of the Yandicoogina mine, or at such later time considered appropriate by the Minister for the Environment acting on the advice of the Department of Environmental Protection, the proponent shall prepare a plan which:

1 describes the process for decommissioning and rehabilitation of the project area;

2 provides for the long term management of salinity in the mined-out pit;

3 provides for the long term management of any regional effects arising from mining the Channel Iron Deposit;

4 has the objective of protecting the water resources and phreatophytic vegetation of the area; and

5 provides for the development of a 'walk away' solution for the decommissioned mine,

to the requirements of the Environmental Protection Authority on advice of the Department of Minerals and Energy and the Water and Rivers Commission.

Note: A "walk away" solution means that the site shall either no longer require management at the time the proponent ceases mining operations, or if further management is deemed necessary, the proponent shall make adequate provision so that the required management is undertaken with no liability to the State.

5-2 The proponent shall implement the plan required by condition 5-1 to the requirements of the Environmental Protection Authority on advice of the Department of Environmental Protection, the Department of Minerals and Energy, the Water and Rivers Commission and the Department of Resources Development.

6 Time Limit on Approval

The environmental approval for the proposal is limited.

6-1 If the proponent has not substantially commenced the project within five years of the date of this statement, then the approval to implement the proposal as granted in this statement shall lapse and be void. The Minister for the Environment shall determine any question as to whether the project has been substantially commenced.

Any application to extend the period of five years referred to in this condition shall be made before the expiration of that period to the Minister for the Environment.

Where the proponent demonstrates to the requirements of the Minister for the Environment on advice of the Department of Environmental Protection that the environmental parameters of the proposal have not changed significantly, then the Minister may grant an extension not exceeding five years.

7 **Compliance Auditing**
To help determine environmental performance and compliance with the conditions, periodic reports on the implementation of the proposal are required.

7-1 The proponent shall submit periodic Performance and Compliance Reports, in accordance with an audit programme prepared by the Department of Environmental Protection in consultation with the proponent.

Procedure

1 Unless otherwise specified, the Department of Environmental Protection is responsible for assessing compliance with the conditions contained in this statement and for issuing formal clearance of conditions.

2 Where compliance with any condition is in dispute, the matter will be determined by the Minister for the Environment.

Note

The proponent is required to apply for a Works Approval and Licence for aspects of this project under the provisions of Part V of the Environmental Protection Act.

Hon Peter Foss QC MLC
MINISTER FOR THE ENVIRONMENT

24 MAY 1996

Proponent's Environmental Management Commitments

April 1996

YANDICOOGINA IRON ORE MINE & RAILWAY
90 KILOMETRES NORTH WEST OF NEWMAN
HAMERSLEY RANGE (979)

HAMERSLEY IRON PTY LIMITED

ISSUE	OBJECTIVE	COMMIT -MENT NUMBER	COMMITMENT	PHASE
Legislation	Comply with relevant legislation.	1	The construction and operation of the project will be undertaken in accordance with the requirements of relevant Commonwealth and State legislation and regulations.	Pre-construction and Post-commissioning.
Amendments to the project	Refer significant project amendments for assessment.	2	Details of any plan to alter the project from that outlined in the CER that is likely to result in significant environmental impacts will be provided to the EPA for environmental assessment.	Pre-construction and Post-commissioning.
Understanding hydrogeological system	Understand hydrogeological systems and develop and evaluate options for long term management.	3 4	Hamersley will continue to evaluate the impacts of mining and decommissioning on Marillana Creek and the CID jointly with BHPIO for the purposes of further understanding the hydrogeological system in order to develop and evaluate options for viable and compatible long term management strategies. Results of evaluations will be reported to the Pilbara Iron Ore Environmental Management Committee.	Pre-construction, Construction and Post-commissioning.
Groundwater monitoring in Marillana Creek	Monitor groundwater in the Marillana Creek alluvium.	5 6 7	Hamersley will establish groundwater monitoring bores in the alluvium to monitor surface and groundwater levels before dewatering commences. The results of this monitoring will be submitted to the State on an annual basis. The monitoring programme will be implemented to the satisfaction of the Minister for the Environment on advice from DEP.	Pre-construction, Construction and Post-commissioning.

Hydrogeological data collection	Collect further hydrogeological data to develop a model for the final void.	8 9 10	Hamersley will continue to collect necessary hydrogeological data for the development of a model to predict long term water levels and quality in the final void. This model will be applied to assist design the final void to minimize long term impacts of mining on local and regional groundwater resources to the satisfaction of the Minister for the Environment on advice of DEP. A report on this model and the final outcome will be prepared and submitted to the DEP before finalising the decommissioning plan.	Pre-construction, Construction and Post-commissioning.
Environmental Audits	Conduct regular environmental reviews.	11 12	Hamersley will conduct internal environmental reviews during the construction (every 6 months) and operation (annually) of the project. These environmental reviews will assess compliance with project commitments, relevant Works Approval and Operating Licence conditions and any other environmental requirements.	Pre-construction, Construction and Post-commissioning.
Environmental Reporting	Prepare reports on environmental management and monitoring.	13	Annual and triennial reports that describe the actions taken to comply with environmental management conditions and monitoring commitments will be prepared by Hamersley and issued to the State.	Post-commissioning.

Environmental Management Programme (EMP)	Prepare an EMP for the construction and operation of the project.	14	Hamersley will submit and implement an EMP for the project prior to the commencement of major construction activities. The EMP will be developed in consultation with the DEP, and to the satisfaction of the Minister for the Environment. The EMP will provide details on the following: 1 groundwater and surface water management during mining and post-mining 2 sheet and gully drainage management along the railway 3 dust and noise emissions 4 waste management 5 flora and fauna protection 6 fire and weed management 7 environmental inductions for construction and operation personnel 8 rehabilitation of disturbed areas, and 9 monitoring programmes.	Pre-construction and Post-commissioning.
Biological	Minimise impacts on riverine vegetation.	15 16 17	During the project life, Hamersley will undertake monitoring to assess the impacts of dewatering on riverine vegetation. If unacceptable impacts are detected, management strategies for the riverine vegetation will be implemented to the satisfaction of the Minister for the Environment on advice from DEP. The results of this monitoring and management will be submitted to the State on a triennial basis.	Pre-construction, Construction and Post-commissioning.
Waste Disposal	Manage wastes in an appropriate manner.	18 19	Burning will not be permitted as a means of rubbish or other waste disposal within the project area. All putrescible, biodegradable, inert substances and other general rubbish will be disposed of in a fenced, excavated waste pit that will be regularly backfilled to cover the waste material.	Post-commissioning.

Sewage Treatment Plants	Ensure sewage treatment plants are approved.	20	Plans for sewage treatment plants proposed at Yandicoogina will be submitted by Hamersley for approval by the Western Australian Department of Health.	Pre-construction.
Hydrocarbons	Appropriate storage of hydrocarbons.	21	All bunding for hydrocarbon storage areas will be constructed in accordance with the requirements of AS1940 - 1993.	Construction and Post-commissioning.
Contaminated Surface Runoff	Ensure that contaminated surface runoff does not enter natural drainage.	22	Management procedures will be put in place to ensure that stormwater runoff from areas that may result in contamination by hydrocarbons does not enter natural drainage channels without prior treatment.	Post-commissioning.
Dust	Minimise dust.	23	Dust suppression measures, including application of water from tankers, will be implemented to minimise dust generation during site preparation and construction activities.	Construction and Post-commissioning.
Pastoral Activities	Minimise potential disruption to pastoral activities.	24	Hamersley will enter into negotiations with the Marillana pastoral station manager on the issue of means of managing any potential disruptions to pastoral activities.	Pre-construction, Construction and Post-commissioning.
Archaeological and Ethnographic Sites in Railway Corridor	Obtain archaeological and ethnographic clearance for the railway corridor.	25	Once suitable access has been established, Aboriginal people involved in the earlier site survey process with Hamersley will be invited to inspect the route of the surveyed railway alignment to identify any significant archaeological or ethnographic sites.	Pre-construction.
Disturbance to Aboriginal Sites	Comply with *Aboriginal Heritage Act.*	26	If any Aboriginal site is required to be disturbed, a written application, as required under Section 18 of the *Aboriginal Heritage Act*, will be made to the Trustees of the Western Australian Museum for consent by the Minister for Aboriginal Affairs.	Pre-construction and Construction.
Rehabilitation	Ensure disturbed areas are rehabilitated.	27	Vegetation and topsoil removed during site preparation will be used to progressively rehabilitate disturbed areas.	Construction and Post-commissioning.

Decommissioning Plan	Prepare plan for decommissioning of the project.	28	A conceptual decommissioning plan will be prepared in consultation with DEP, DOME, and the Water and Rivers Commission to the satisfaction of the Minister for the Environment for subsequent implementation.	Post-commissioning.
		29	The plan will be submitted to Government at least two years prior to decommissioning of the project.	
		30	The plan will address post-mining water management issues giving due consideration to the known results of environmental management at other mines on the channel iron deposit.	

MINISTER FOR THE ENVIRONMENT;
LABOUR RELATIONS

Statement No.

000523

STATEMENT TO AMEND CONDITIONS APPLYING TO A PROPOSAL (PURSUANT TO THE PROVISIONS OF SECTION 46 OF THE ENVIRONMENTAL PROTECTION ACT 1986)

YANDICOOGINA IRON ORE MINE & RAILWAY
90 KILOMETRES NORTH-WEST OF NEWMAN
HAMERSLEY RANGE

Proposal: The Yandicoogina Iron Ore Mine and Railway is located approximately 90 kilometres north-west of the town of Newman.

The proposal involves the construction and operation of an open cut iron ore mine; facilities to crush and screen ore and convey it to the rail loadout facility; and a 90 kilometre rail section which connects the mine to the Central Pilbara Railway.

Proponent: Hamersley Iron Pty Limited

Proponent Address: 152-158 St George's Terrace, Perth WA 6000

Assessment Number: 1174

Previous Assessment Number: 979

Previous Statement Number: Statement No. 417 (published on 27 May 1996)

Report of the Environmental Protection Authority: Bulletin 946

Previous Reports of the Environmental Protection Authority: Bulletin 809, April 1996

The implementation of this proposal is subject to the conditions and procedures contained in Ministerial Statement No. 417 (May 1996), as amended by the following conditions and procedures:

Condition 1 of Statement No. 417 is deleted and the following conditions are inserted:

1 Proponent Commitments

1-1 The proponent shall implement the consolidated environmental management commitments of April 1996 as amended on 12 July 1999 and documented in schedules 2 and 3 of this statement.

1-2 The proponent shall implement environmental management commitments which the proponent makes or has made as part of the fulfilment of conditions and procedures in this and the previous statement issued for this proposal.

Published on

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Condition 2 of Statement No. 417 is deleted and the following conditions are inserted:

2 Implementation

2-1 Subject to these conditions and procedures, the proponent shall implement the proposal as documented in schedule 1 of this statement.

2-2 Where the proponent seeks to change any aspect of the proposal as documented in schedule 1 of this statement in any way that the Minister for the Environment determines, on advice of the Environmental Protection Authority, is substantial, the proponent shall refer the matter to the Environmental Protection Authority.

2-3 Where the proponent seeks to change any aspect of the proposal as documented in schedule 1 of this statement in any way that the Minister for the Environment determines, on advice of the Environmental Protection Authority, is not substantial, those changes may be effected.

The following conditions are inserted after Condition 7 of Statement No. 417:

8 Environmental Management System

8-1 In order to manage the environmental impacts of the project, and to fulfil the requirements of the conditions and procedures in this statement, prior to mining within the extended mining area, the proponent shall demonstrate to the requirements of the Environmental Protection Authority on advice of the Department of Environmental Protection that there is in place an environmental management system which includes the following elements:

1 An environmental policy and corporate commitment to it;

2 Mechanisms and processes to ensure:

(1) planning to meet environmental requirements;

(2) implementation and operation of actions to meet environmental requirements;

(3) measurement and evaluation of environmental performance; and

3 Review and improvement of environmental outcomes.

8-2 The proponent shall implement the environmental management system referred to in condition 8-1.

CHERYL EDWARDES (Mrs) MLA
MINISTER FOR THE ENVIRONMENT

- 1 OCT 1999

Schedule 1

Proposal (979/1174)

The Yandicoogina Iron Ore Mine and Railway (also known as "Yandi (HIY) Project") is located approximately 90 kilometres north-west of the town of Newman.

The proposal involves the construction and operation of:

- an open cut iron ore mine;
- facilities to crush and screen ore and convey it to the rail loadout facility; and
- a 90 kilometre rail section which connects the mine to the Central Pilbara Railway.

Table 1 summarises the key characteristics of the project - the initial mining area and the mining area extension.

Table 1: Key project characteristics

Aspect	Project (initial mining area)	Mining Area Extension	Variation from Project (initial mining area)
Length of CID to be mined	SL12.2km to SL15.0km	SL15.0km to a point 750m beyond SL19.0km (equivalent to 19.75km)	Additional 4.75km
Area of CID to be mined	300ha	300ha	Additional 300ha
Initial mining rate	About 8Mt/a, increasing to design capacity of 15Mt/a	About 15Mt/a, maintaining design capacity	No change
Ore reserve to be mined	140Mt	160Mt, bringing total to 300Mt	Additional 160Mt
Estimated mine life	15-20 years	25-30 years	Additional 10-15 years
Mine pit profile	About 65m deep; 40m below pre-mine watertable	About 65m deep; 40m below pre-mine watertable	No change
Dewatering requirements	Initial: 30ML/d Maintenance: 10-15ML/d	Initial: 15-20ML/d Maintenance: 10-15ML/d	Initial - lower Maintenance - same
Volume of dewatering used	5ML/d	5ML/d	No change
Number of dewatering borefields	Two: • a Permanent borefield • a Sacrificial borefield	Three: • an existing Permanent borefield • a new Permanent borefield on Phils Creek CID • a new Sacrificial borefield in the main CID	An additional Permanent borefield and a replacement Sacrificial borefield in the CID
Proportion of waste material backfilled (versus out-of-pit)	100% (after first three years, all waste reports as backfill, with out-of-pit waste used as backfill upon mine closure)	100% (waste reports as backfill from commencement of mining or is stockpiled and returned as backfill later)	No change
Proportion of mine void to be filled with overburden	About 50%	About 50%	No change
Mine infrastructure requirements	Refer CER (1995) and Section 1.2 and Figure 1.2 of the Section 46 Environmental Review document.	Utilise existing infrastructure until additional ore processing plant (or re-location of existing one) needed. Some new haul roads also.	Additional or re-located ore processing plant. More haul roads.

Abbreviations:

CID	Channel Iron Deposit
ha	hectares
ML/d	megalitres per day
Mt/a	million tonnes per annum
SL	drill Section Line

Figures

Figure 1 - Location plan.

Figure 2 - Project layout map.

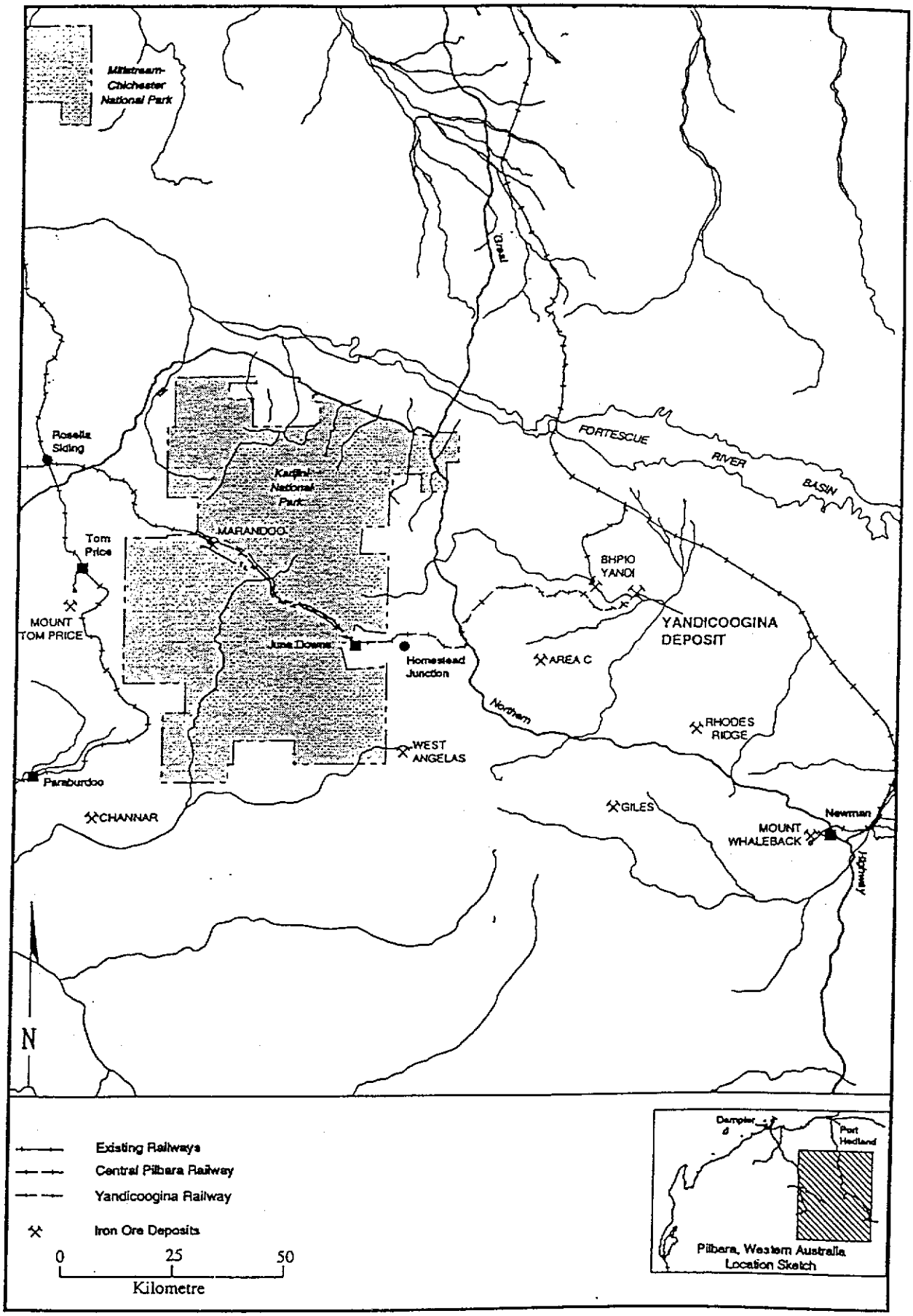
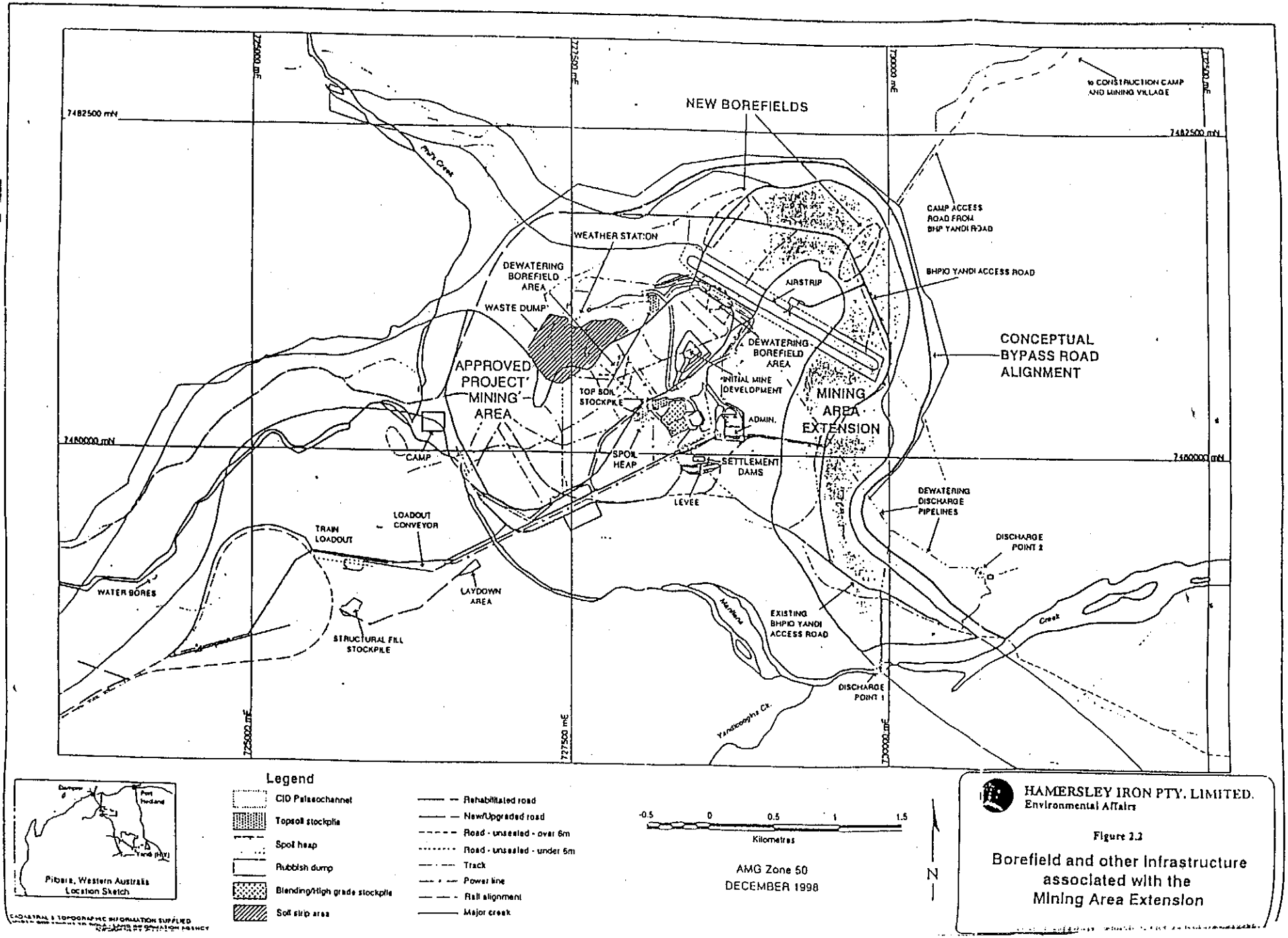


Figure 1. Location plan

Figure 2. project layout



Schedule 2

Proponent's Environmental Management Commitments

April 1996

Yandicoogina Iron Ore Mine & Railway
90 Kilometres north-west of Newman
Hamersley Range
(979/1174)

Hamersley Iron Pty Limited

ISSUE	OBJECTIVE	COMMIT -MENT NUMBER	COMMITMENT	PHASE
Legislation	Comply with relevant legislation.	1	The construction and operation of the project will be undertaken in accordance with the requirements of relevant Commonwealth and State legislation and regulations.	Pre-construction and Post-commissioning.
Amendments to the project	Refer significant project amendments for assessment.	2	Details of any plan to alter the project from that outlined in the CER that is likely to result in significant environmental impacts will be provided to the EPA for environmental assessment.	Pre-construction and Post-commissioning.
Understanding hydrogeological system	Understand hydrogeological systems and develop and evaluate options for long term management.	3 4	Hamersley will continue to evaluate the impacts of mining and decommissioning on Marillana Creek and the CID jointly with BHPIO for the purposes of further understanding the hydrogeological system in order to develop and evaluate options for viable and compatible long term management strategies. Results of evaluations will be reported to the Pilbara Iron Ore Environmental Management Committee.	Pre-construction, Construction and Post-commissioning.
Groundwater monitoring in Marillana Creek	Monitor groundwater in the Marillana Creek alluvium.	5 6 7	Hamersley will establish groundwater monitoring bores in the alluvium to monitor surface and groundwater levels before dewatering commences. The results of this monitoring will be submitted to the State on an annual basis. The monitoring programme will be implemented to the satisfaction of the Minister for the Environment on advice from DEP.	Pre-construction, Construction and Post-commissioning.

Hydrogeological data collection	Collect further hydrogeological data to develop a model for the final void.	8 9 10	Hamersley will continue to collect necessary hydrogeological data for the development of a model to predict long term water levels and quality in the final void. This model will be applied to assist design the final void to minimize long term impacts of mining on local and regional groundwater resources to the satisfaction of the Minister for the Environment on advice of DEP. A report on this model and the final outcome will be prepared and submitted to the DEP before finalising the decommissioning plan.	Pre-construction, Construction and Post-commissioning.
Environmental Audits	Conduct regular environmental reviews.	11 12	Hamersley will conduct internal environmental reviews during the construction (every 6 months) and operation (annually) of the project. These environmental reviews will assess compliance with project commitments, relevant Works Approval and Operating Licence conditions and any other environmental requirements.	Pre-construction, Construction and Post-commissioning.
Environmental Reporting	Prepare reports on environmental management and monitoring.	13	Annual and triennial reports that describe the actions taken to comply with environmental management conditions and monitoring commitments will be prepared by Hamersley and issued to the State.	Post-commissioning.

Environmental Management Programme (EMP)	Prepare an EMP for the construction and operation of the project.	14	Hamersley will submit and implement an EMP for the project prior to the commencement of major construction activities. The EMP will be developed in consultation with the DEP, and to the satisfaction of the Minister for the Environment. The EMP will provide details on the following: 1 groundwater and surface water management during mining and post-mining 2 sheet and gully drainage management along the railway 3 dust and noise emissions 4 waste management 5 flora and fauna protection 6 fire and weed management 7 environmental inductions for construction and operation personnel 8 rehabilitation of disturbed areas, and 9 monitoring programmes.	Pre-construction and Post-commissioning.
Biological	Minimise impacts on riverine vegetation.	15 16 17	During the project life, Hamersley will undertake monitoring to assess the impacts of dewatering on riverine vegetation. If unacceptable impacts are detected, management strategies for the riverine vegetation will be implemented to the satisfaction of the Minister for the Environment on advice from DEP. The results of this monitoring and management will be submitted to the State on a triennial basis.	Pre-construction, Construction and Post-commissioning.
Waste Disposal	Manage wastes in an appropriate manner.	18 19	Burning will not be permitted as a means of rubbish or other waste disposal within the project area. All putrescible, biodegradable, inert substances and other general rubbish will be disposed of in a fenced, excavated waste pit that will be regularly backfilled to cover the waste material.	Post-commissioning.

Sewage Treatment Plants	Ensure sewage treatment plants are approved.	20	Plans for sewage treatment plants proposed at Yandicoogina will be submitted by Hamersley for approval by the Western Australian Department of Health.	Pre-construction.
Hydrocarbons	Appropriate storage of hydrocarbons.	21	All bunding for hydrocarbon storage areas will be constructed in accordance with the requirements of AS1940 - 1993.	Construction and Post-commissioning.
Contaminated Surface Runoff	Ensure that contaminated surface runoff does not enter natural drainage.	22	Management procedures will be put in place to ensure that stormwater runoff from areas that may result in contamination by hydrocarbons does not enter natural drainage channels without prior treatment.	Post-commissioning.
Dust	Minimise dust.	23	Dust suppression measures, including application of water from tankers, will be implemented to minimise dust generation during site preparation and construction activities.	Construction and Post-commissioning.
Pastoral Activities	Minimise potential disruption to pastoral activities.	24	Hamersley will enter into negotiations with the Marillana pastoral station manager on the issue of means of managing any potential disruptions to pastoral activities.	Pre-construction, Construction and Post-commissioning.
Archaeological and Ethnographic Sites in Railway Corridor	Obtain archaeological and ethnographic clearance for the railway corridor.	25	Once suitable access has been established, Aboriginal people involved in the earlier site survey process with Hamersley will be invited to inspect the route of the surveyed railway alignment to identify any significant archaeological or ethnographic sites.	Pre-construction.
Disturbance to Aboriginal Sites	Comply with *Aboriginal Heritage Act.*	26	If any Aboriginal site is required to be disturbed, a written application, as required under Section 18 of the *Aboriginal Heritage Act*, will be made to the Trustees of the Western Australian Museum for consent by the Minister for Aboriginal Affairs.	Pre-construction and Construction.
Rehabilitation	Ensure disturbed areas are rehabilitated.	27	Vegetation and topsoil removed during site preparation will be used to progressively rehabilitate disturbed areas.	Construction and Post-commissioning.

Decommissioning Plan	Prepare plan for decommissioning of the project.	28	A conceptual decommissioning plan will be prepared in consultation with DEP, DOME, and the Water and Rivers Commission to the satisfaction of the Minister for the Environment for subsequent implementation.	Post-commissioning.
		29	The plan will be submitted to Government at least two years prior to decommissioning of the project.	
		30	The plan will address post-mining water management issues giving due consideration to the known results of environmental management at other mines on the channel iron deposit.	

Schedule 3

Proponent's Additional Environmental Management Commitments

12 July 1999

Yandicoogina Iron Ore Mine & Railway
90 Kilometres north-west of Newman
Hamersley Range
(979/1174)

Hamersley Iron Pty Limited

No.	Issue	Objective	Action	Phase	Require-ments (Advice)
31	Environmental Management Programme (EMP)	To manage environmental impacts of the mining area extension.	Review and revise where relevant the Environmental Management Programme for the Project for the purpose of extending the environmental management and monitoring to address issues arising from the mining area extension.	Pre-mining (of mining area extension)	DEP (WRC, DME, and CALM)
32	Decommissioning and rehabilitation plan	To satisfactorily decommission the mine site and rehabilitate the site and its environs.	Prepare a conceptual decommissioning and rehabilitation plan covering all infrastructure associated with the Yandi (HIY) Project area. The plan will incorporate the initial mining area and the mining area extension.	Pre-mining (of the mining area extension) — within six months of the mining area extension being approved	DEP (DME and WRC)
33	Aboriginal heritage (archaeological) sites	To identify any archaeological sites	Involve the Gumala Aboriginal Corporation in a detailed archaeological survey to identify any sites within the areas to be disturbed. The findings of this survey shall be reported to the Aboriginal Affairs Department.	Pre-mining (of mining area extension)	DEP (AAD)

Abbreviations:

AAD	Aboriginal Affairs Department
CALM	Department of Conservation and Land Management
DEP	Department of Environmental Protection
DME	Department of Minerals and Energy
WRC	Water and Rivers Commission

Appendix 2
Rio Tinto Environmental Standards

Air Quality Control

A Intent

The intent of this standard is to ensure that Rio Tinto Operations have identified and minimised air pollutant emissions and their potential impacts from all activities. This is to be accomplished by evaluating and prioritising them according to the significance of their impact, and taking effective measures to design and implement appropriate controls of emissions to ensure protection of ambient air quality.

B Scope

This standard is applicable to all Rio Tinto Business Units and managed Operations. It covers emissions from all sources, including fugitive emissions, during exploration, mining, mineral processing, materials handling, smelting, refining and on-site transport, and also their incremental impacts on the ambient air quality. Where the Business or Operation is also responsible for ancillary activities (eg power generation) or off-site transport (rail, truck and ship), those activities are also under the scope of this standard.

Other relevant documents are:

- Environmental Management System Standard
- Greenhouse Gas Emissions Standard
- Land Use Stewardship Standard
- Occupational Health Standards (hygiene aspects)
- Cleaner Production Principles
- Air Quality Guidance Note

C Requirements

Rio Tinto Business Units and/or managed Operations are required to:

1.0 *Planning*

1.1 Determine and maintain records of background ambient air quality, meteorological characteristics affecting pollutant dispersion and other sources of emission in the vicinity of the facilities.

1.2 Identify and characterise all significant pollutant emissions, from all sources, including fugitive, emissions and their method of release into the environment.

1.3 Identify and assess all community health and environmental risks associated with the exposure to individual and combined air pollutant emissions from the operation's facilities, and prioritise them on the basis of their predicted impacts.

1.4 Employ environmental aspect identification and change management procedures for new developments or substantive changes to existing facilities to determine and manage potential adverse impacts on ambient air quality.

1.5 Demonstrate that emissions, under normal and worst case conditions, from the operation, current or after a modification, will not cause the ambient air to violate regional or national air quality regulations, criteria and/ or licensed conditions.

1.6 Develop internal criteria on ambient air quality when government regulations are absent or incomplete to ensure protection of local community health and the environment. The criteria must have formal approval from the operations MD and be in line with internationally accepted regulations, guidelines and methodologies.

2.0 *Implementation and Operation*

2.1 Implement appropriate procedures or control technologies to manage those emissions selected in the environmental aspects identification process as having potential or actual significant impacts on ambient air quality.

2.2 Prepare emergency preparedness and response procedures to respond to abnormal emission and dispersion conditions and to cover exceedences of air quality standards, including immediate measures to protect community health.

3.0 *Performance Measurement*

3.1 Implement a monitoring program to measure (or estimate if appropriate) all significant emissions, air quality and ambient air impacts or nuisance air impacts from the operations where indicated by environmental aspects identification or regulatory authority. Where appropriate, impacts can be established by dispersion modelling studies that are validated against ambient air quality measurements.

3.2 In any monitoring program, identify and use the specifications of local regulatory authorities for:

a. Monitoring equipment;
b. Modelling assumptions;
c. Modelling programs;
d. Emission factors.

In the absence of such regulatory requirements, or if incomplete or inadequate adopt recognised international specifications, which must have formal approval from the operations MD.

Greenhouse Gas Emissions

A. Intent

The intent of this standard is to ensure greenhouse gas (GHG) emissions minimisation in Rio Tinto. This is to be accomplished by identifying GHG emissions sources, evaluating and prioritising them according to significance, and then designing and implementing appropriate control, reduction and mitigation measures of greenhouse gas emissions to the environment.

B. Scope

This standard is applicable to all Rio Tinto Business Units and those managed operations that significantly contribute to Rio Tinto's total GHG emissions. It covers all sources of GHG emissions during exploration, mining, mineral processing, materials handling, smelting refining and on-site transport. Where the business unit or operation is also responsible for ancillary activities (eg power generation) or off-site transport (rail, truck and ship) those activities will be covered under the scope of this standard.

GHG issues associated with product life cycles are covered in the Product Stewardship Guidance Note.

Other relevant documents are:

- Rio Tinto Climate Change Policy
- Environmental Management System Standard
- Air Quality Control Standard
- Product Stewardship Guidance Note (under preparation)
- Biodiversity Guidance Note
- Greenhouse Gas Emission Guidance Note

C. Requirements

Rio Tinto Business Units and/or managed Operations are required to:

1.0 *Planning*

1.1 Develop, document and maintain knowledge of GHG emissions. This must include an understanding of current and future GHG sources and the factors that affect emission levels from the sources.

1.2 Identify and assess GHG related risks and opportunities for the business or operation. Including, where applicable the use of specific or generic emissions abatement cost curves and assessments of emissions trading and offset opportunities and factor in changes as a result of national or international policies and measures.

1.3 Develop and achieve GHG emissions reduction targets to drive improvements in emissions control and reduction. Progress towards the targets must be supported by suitable sets of actions and milestones that are linked to the business planning process.

1.4 Ensure that technical and commercial considerations of GHG emissions issues (including possible costs inferred by government imposed carbon tax schemes or CO_2 emissions regulations) are included in:

a. Annual business plans and valuations;
b. New project evaluations;
c. Capital expenditure programs;
d. Due diligence reviews for divestments and acquisitions.

2.0 *Implementation and Operation*

2.1 Implement and maintain GHG emission control and reduction programs. Upgrade these as the business needs and external requirements change and as there is progress in the understanding of, and responses to, climate change issues.

2.2 Assign clear responsibilities and accountabilities for GHG management. Responsibilities must include progressing established actions for achieving GHG targets.

3.0 *Performance Measurement*

3.1 Ensure that the appropriate measures are in place for metering, or estimating where appropriate, GHG emissions.

3.2 Conduct periodic reviews to identify potential risks and opportunities associated with GHG issues at the business or where appropriate operation.

Noise and Vibration Control

A Intent

The intent of this standard is to ensure that Rio Tinto Operations minimise their noise and vibrations impacts on the surrounding environment and communities. This is to be accomplished by identifying noise and vibration sources, evaluating and prioritising the sources according to significance of potential impacts then taking effective measures to design and implement appropriate controls.

B Scope

This standard is applicable to all Rio Tinto Business Units and managed Operations. It covers all components of noise and vibration arising from exploration and operations, including mining, mineral processing, materials handling infrastructure and on-site transport, which may significantly impact on people, communities and the surrounding environment. Where the business or operation is also responsible for ancillary activities (eg power generation) or off-site transport (rail, truck and ship), those activities are also under the scope of this standard.

Occupational noise and vibration exposure is not covered by this standard but rather by the Occupational Health Standards B2 and B3.

Other relevant documents are:

- Environmental Management System Standard
- Land Use Stewardship Standard
- Occupational Health Standards
- Biodiversity Guidance Note
- Noise and Vibration Control Guidance Note

C Requirements

Rio Tinto Business Units and/or managed Operations are required to:

1.0 *Planning*

1.1 Develop, document and maintain knowledge of the baseline, and for existing operations, background noise and vibration levels.

1.2 Employ change management procedures and predictive modelling of near and far field noise and vibration levels as part of the pre-feasibility and feasibility study for:

a. New developments;
b. Significant expansions;
c. Changes to existing activities and facilities.

The model will, where applicable, incorporate baseline/background data, community expectations, and regulatory requirements and identify significant exposures to sensitive receptors.

1.3 Identify which components of the facility and which activities are the key contributors to external noise and vibration levels and understand the generation, propagation and potential environmental impact under a range of meteorological and operating conditions. Establish the likely effectiveness of noise and vibration control mechanisms in achieving regulatory or license requirements and accommodating community expectations.

1.4 Develop internal criteria on noise and vibration performance when government regulations are absent or incomplete to ensure protection of local community health and the environment. The criteria must be in line with internationally accepted regulations, guidelines and methodologies

2.0 *Implementation and Operation*

2.1 Have a procedure in place to manage noise and vibration where an assessment based on prediction modelling or monitoring results indicates the need, in order to meet regulatory requirements and accommodate community expectations.

2.2 Establish a model or real time assessment of near and far field noise and vibration levels throughout the life of the operation.

2.3 Adopt a hierarchy of noise and vibration controls, with engineering or design controls for noise sources being the first option implemented. If due to safety reasons this is not permissible consider other control processes.

2.4 Incorporate and maintain noise and vibration control requirements into design and operational criteria for relevant exploration and mining activities, including drilling and blasting, processing activities and new facilities.

2.5 Incorporate noise and vibration performance criteria into purchasing requirements for relevant, equipment and machinery.

3.0 *Performance Measurement*

3.1 Have a procedure in place for monitoring noise and vibration levels outside current operations, that adequately samples potentially affected neighbouring areas, and covering a broad range of operating and meteorological conditions.

3.2 Implement a monitoring program to:

a. Support operational control;
b. Verify compliance with targets and legal requirements;
c. Update and maintain the relevance of near and far-field noise and vibration models;
d. Assess noise and vibration impact on the environment and communities under a broad range of operating and meteorological conditions.

Land-Use Stewardship

A. Intent

The intent of this standard is to ensure sustainable stewardship of the land, which Rio Tinto owns, leases and / or manages. This requires an understanding of the current and potential use of the land, its value and community expectations followed by development of an integrated and strategic approach to land management that identifies and mitigates the impacts of our operations and ownership on that land and progresses biodiversity and generates beneficial business opportunities that flow from effective management.

B. Scope

This standard is applicable to all Rio Tinto Business Units and managed operations and applies to all lands owned, leased and/or managed (RT land) by the group. It covers all activities of the group from exploration through mining and mineral processing to closure and includes the substantial component of the land that is not used directly for mining, processing or ancillary activities.

Other relevant documents are:

- Environmental Management System Standard
- Water Use and Quality Control Standard
- Greenhouse Gas Emission Standard
- Rio Tinto Closure Standard (under preparation)
- Biodiversity Guidance Note
- Progressive Rehabilitation Guidance Note
- Land Use Stewardship Guidance Note
- Community Relations Standard (under preparation)
- Cultural Heritage Management System Guidance Note (under preparation

C. Requirements

Rio Tinto Business Units and/or managed Operations are required to:

1.0 *Planning*

1.1 Develop and maintain a documented description of all the aspects and implications of the land owned, leased and/or managed (RT land) by the operation. This information base must include:

a. The tenure, customary ownership, community expectations, former and current use of RT land and its immediate surroundings;
b. The environmental, social and physical characteristics and capabilities of RT land and its immediate surroundings;
c. The location of significant natural features;
d. The location of cultural heritage features, in consultation with those for whom the features have meaning/significance;
e. The location of potential legacy issue sites.

1.2 Develop in consultation with key stakeholders a Land Use Zoning. The zoning must be compatible with local and regional regulatory land use management plans and shall:

a. Identify and map all land units on RT Land;
b. Register acceptable uses and any restrictions pertaining to the land units.

1.3 Develop targets to drive improvements in land management. Progress towards the targets must by supported by a suitable set of actions.

1.4 Develop and implement a Land-Use Management Plan based on the Land-Use Zoning that promotes an integrated and sustainable approach to land management. The plan shall address:

a. Issues of biodiversity conservation;
b. Environmental offsets;
c. Interactions with adjoining lands, including communities;
d. Legacy and protection of socio-cultural and natural heritage features.

2.0 *Implementation and Operation*

2.1 Integrate Land-Use Management Plans into Business Unit and/or Operations planning, closure planning, progressive rehabilitation programs, project evaluations and capital expenditure reviews.

2.2 Assign clear responsibilities and accountabilities for land-use management. Responsibilities must include progressing the Land-Use Management Plan and its associated targets.

2.3 Implement an authorization procedure to ensure that all development on RT land is compatible with the Land-Use Zoning and the Land-Use Management Plan.

2.4 Ensure that any alterations to the Land-Use Zoning and or Land-Use Management Plan are adequately researched, justified and documented. Management authorisation must be obtained before any alteration to the Land-Use Zoning or the Land-Use Management Plan can be made.

3.0 *Performance Measurement*

3.1 Conduct a systematic auditing procedure of all aspects of land-use management procedures in order to verify their adequacy, performance and areas of risk or opportunity.

Non- Mineral Waste Management

A Intent

The intent of this standard is to ensure sound non-mineral waste management in Rio Tinto Operations by the minimization of waste generation and ensuring the safe handling, treatment and disposal of all generated wastes.

B Scope

This standard is applicable to all Rio Tinto Business Units and managed operations from exploration/development and acquisition through to closure and post closure. It covers non-mineral wastes generated by the activities of the operation, or non-mineral wastes received by the operation to dispose or manage on behalf of others.

Mineral wastes generated as a direct product of mining or processing, are addressed in the Mineral Waste Management Standard.

Other relevant documents are:

- Environmental Management System Standard
- Hazardous Materials and Contamination Control Standard
- Mineral Waste Management Standard
- Water Use and Quality Control Standard
- Land Use Stewardship Standard
- Air Quality Control Standard
- Non-Mineral Waste Management Guidance Note

C Requirements

Rio Tinto Business Units and/or managed Operations are required to:

1.0 *Planning*

1.1 Develop, document and maintain a characterisation of the environmental hazards and risks associated with non-mineral wastes generated, disposed on-site and, transported and disposed off-site or managed on behalf of others.

1.2 Develop and maintain a documented inventory of non-mineral wastes generated or received and disposed on or off-site.

1.3 Maintain measurable indicators and targets for hazard and quantity reduction of significant non-mineral wastes destined for disposal.

1.4 Develop internal criteria on waste classification and management when government regulations are absent or incomplete. The criteria must have formal approval from the operations MD and be in line with internationally accepted regulations, guidelines, definitions and methodologies.

1.5 Develop and implement a Non-mineral Waste Management Plan. The plan shall give priority to those wastes identified as having significant hazard and the actions must demonstrate that the waste management hierarchy has been considered, as follows in order of preference:

a. Waste avoidance and reduction at source;
b. Reuse and recycling and;
c. Waste treatment and/or disposal.

2.0 *Implementation and Operation*

2.1 Ensure that non-mineral wastes are segregated at generation and that wastes awaiting further treatment transport or disposal are securely contained and monitored.

2.2 Maintain operational procedures and effective controls for the safe handling, on-site and off-site transportation, storage and disposal of non-mineral wastes commensurate with their degree of hazard and compatibility.

2.3 Maintain records of all wastes sent off-site, and a documented inventory and location of on-site waste landfills and storage areas. Historical and abandoned landfills shall be included in this inventory and their location document.

2.4 Disposal of waste must only be carried out in engineered and approved facilities and in accordance with established operational procedures.

2.5 Undertake verification assessments of contractors and facilities used for wastes sent off-site for disposal or treatment, to verify that the wastes have been dealt with appropriately.

3.0 *Performance Measurement*

3.1 Establish a procedure to inspect and monitor waste handling and storage facilities commensurate with the degree of hazard of the waste. Corrective action must be taken where unacceptable conditions are identified.

3.2 The Non-mineral Waste Management Plan must be reviewed at least every four years or more frequently when operational or environmental conditions so dictate.

Mineral Waste Management

A Intent

The intent of this standard is to ensure environmentally safe and effective management of mining and process wastes generated or handled by Rio Tinto operations. Waste disposal facilities and sites shall be physically, biologically and chemically safe. Waste production shall be minimised and waste re-use, backfill and recycling maximised.

B Scope

This standard is applicable to all Rio Tinto Business Units and managed Operations and covers the management of mining and process waste generated by their activities, or which are taken by the operations to dispose or manage on behalf of others.

Mineral waste includes: waste rock, tailings from mineral processing, rejects from beneficiation or concentration of coal and other minerals, red mud from alumina production, refinery discards and sludges, smelter and other furnace slags, ashes, and mine-dredging materials.

Other relevant environmental documents are:

- Environmental Management System Standard
- Air Quality Control Standard
- Non-Mineral Waste Management Standard
- Hazardous Materials and Contamination Control Standard
- Rio Tinto Closure Standard (under preparation)
- Acid Rock Drainage Prediction and Control Standard
- Land Use Management Standard
- Water Use and Quality Control Standard
- Mineral Waste Management Guidance Note
- Rio Tinto Guideline for Six-Monthly Social and Environmental Reporting

C Requirements

Rio Tinto Business Units and/or managed Operations are required to:

1.0 *Planning*

1.1 Identify, assess and document the quantities, characteristics and hazards of the wastes that will be generated by mining and processing of each distinct section of the mineral deposit.

1.2 Develop and maintain an inventory of mineral wastes generated, handled and disposed of, whether on or offsite, including descriptions of hazard and other characteristics, volumes and details of location and techniques used for handling and disposal.

1.3 Maintain a procedure for identification of hazards, potential modes of failure and assessment of risks posed by tailings dams and other large waste disposal facilities.

1.4 Maintain, for each waste disposal facility or site, an up to date model of the long-term physical and chemical waste behaviour and impacts on the environment. The model must be validated using data from prediction tests and monitoring.

1.5 Ensure that design and construction of all waste disposal facilities or sites are:

a. Compatible with the waste behaviour, addressing any threats to the environment, particularly those posed by contaminated run-off, seepage, liquefaction and leachate;
b. Engineered to best available technology for stability and safety.

1.6 New developments will not use tailings disposal facilities for water storage functions. Any existing dual storage of wastes and water must undergo a risk assessment and a study of potential alternatives.

1.7 Apply a change management procedure for the approval of any significant modification in waste generation, handling and disposal.

1.8 Avoid any uncontrolled riverine disposal of mineral wastes.

1.9 Develop targets to drive improvements in the aspects of mineral waste management. Progress towards the targets must be supported by a suitable set of actions.

1.10 Establish and maintain a documented Mineral Waste Management Plan that covers all stages of waste management from generation to final use and/or disposal.

2.0 *Implementation and Operation*

2.1 Maintain operational procedures commensurate with the identified hazards of each waste disposal facility for managing:

a. The waste mass and its physical and chemical reactions;
b. The containment structure and its stability issues;
c. Spills, unplanned mixture or segregation of wastes;
d. Waste placement.

2.3 Ensure that the supervision and operation of dams and dumps is commensurate with the environmental and safety hazards posed by the structures.

2.4 Undertake assessments of contractors and facilities used for wastes sent off-site for disposal or treatment, to verify that the wastes have been dealt with appropriately.

3.0 *Performance Measurement*

3.1 Monitor physical stability parameters of waste disposal structures as an early detection and warning mechanism for potential failure.

3.2 Conduct regular monitoring of the geochemical reactions occurring through the profile of the waste, for validation or review of the waste behaviour model and early

profile of the waste, for validation or review of the waste behaviour model and early warning of potential pollution problems.

3.3 Conduct independent and external review by qualified engineering specialist(s) of all major waste storage facilities according to protocols and frequencies adequate to their physical and chemical hazards and level of risks. Frequency of external reviews must not be less than once every 2 years and any significant findings must be reported according to Rio Tinto requirements.

3.4 Maintain an emergency system, including communication with stakeholders, for responding to potential incidents involving waste storage facilities and or transport to disposal facilities.

Water Use and Quality Control

A. Intent

The intent of this standard is to ensure efficient, safe and sustainable use and protection of water resources and ecosystems in and around Rio Tinto Operations. This requires an understanding of the water resources, their spatial and temporal interrelationships, their ownership in the region and the needs of key catchment stakeholders. This provides the basis for the development of an integrated and strategic approach to water management that promotes the maintenance or improvement of water quality, upstream and downstream, minimisation of fresh water use and the maximisation of reuse and recycling.

B. Scope

This standard is applicable to all Rio Tinto Business Units and managed operations from exploration/development through to closure. It covers all activities connected to water abstraction, dewatering, transport, storage, usage (potable and process), and direct/indirect discharge, involving surface water (including runoff), impounded water and ground water.

Other relevant documents are:

- Environmental Management System Standard
- Acid Rock Drainage Prediction and Control Standard
- Rio Tinto Closure Standard (under preparation)
- Hazardous Materials and Contamination Control Standard
- Mineral Waste Management Standard
- Annual S & E Survey Guidelines
- Water Use and Quality Control Guidance Note

C. Requirements

Rio Tinto Business Units and/or managed Operations are required to:

1.0 *Planning*

1.1 Develop, document and maintain an appropriate knowledge of the biotic and abiotic characteristics of surface and groundwater resources in which the operation works. This includes characterisation of climatic, limnological, hydrological, hydro-chemical and hydro-geological systems.

1.2 Develop and maintain an appropriate understanding of the cumulative demands and impacts being placed on water resources and ecosystems in the catchments in which the operations work. This must include understanding the current and future water requirements of key upstream and downstream users and stakeholders, and the regime and quality required to maintain ecosystem integrity.

1.3 Develop and maintain an appropriate ‘site water balance’, including solute balances, detailing all water inputs, uses, outputs and losses.

1.4 Employ environmental aspects identification and change management procedures to ensure that new developments, existing activities and facilities and substantive changes to existing facilities do not degrade the upstream and downstream quality, function, use and integrity of 'natural' water ecosystems (including ephemeral streams).

1.5 Develop internal criteria on water abstraction, dewatering, effluent/discharge or water quality when government regulations are absent or incomplete to ensure protection of water resources. The criteria must have formal approval from the operations MD and be in line with internationally accepted criteria, guidelines and methodologies.

1.6 Develop targets to drive improvements in on-site and off-site water management. Progress towards the targets must be supported by suitable sets of actions.

1.7 Develop and implement a Water Management Plan that consolidates the acquired knowledge about the water resources and ecosystems and the actions required to comply with the intent of this Standard and with all regulations and requirements of the pertinent authorities. The Plan must be reviewed at least every four years or more frequently when operational or environmental conditions so dictate.

2.0 *Implementation and Operation*

2.1 Assign clear responsibilities and accountabilities for on-site and off-site water management. Responsibilities must include progressing the Water Management Plan and its associated targets.

2.2 Design, construct and manage water withdrawal, storage, treatment and discharge facilities using current best practice. In the design phase conduct a risk assessment to identify and correct any potential failure scenarios. Ensure that construction meets regulatory requirements and addresses all the identified hazards/risks. Ensure that operation of the facility conforms to approved design criteria and operational procedures and that precautionary measures are put in place to protect freshwater ecosystems.

2.3 Prepare emergency preparedness and response procedures for the following:

a. Drought;
b. Flood;
c. Failures of large water retention structures;
d. Unplanned effluent discharges.

This should be coordinated and compatible with the similar requirements for large waste storage facilities as contained in the Mineral Waste Management Standard.

3.0 *Performance Measurement*

3.1 Maintain safety inspection procedures, including the detailed verification of all identified hazards, for all major water storage facilities. These requirements should be compatible with the major waste storage facilities inspection and signoff requirements detailed in the Mineral Waste Management Standard.

3.2 Implement a monitoring program to:

a. Support operational control;
b. Verify compliance with targets and legal requirements;
c. Update on-site water balances and off-site catchment models;
d. Assess impact on the environment;
e. Assess, where appropriate, cumulative impacts of the operation on the catchment and other users;
f. Meet reporting requirements.

Appendix 3
Description of vegetation types (from Biota 2004a)

DESCRIPTION OF VEGETATION TYPES (from Biota 2004a)

1. Low Stony Hills

1a. *Hakea chordophylla* scattered low trees over *Grevillea wickhamii* scattered shrubs to open shrubland over *Acacia hilliana* and *Ptilotus rotundifolius* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland

This vegetation was recorded from skeletal stony hillcrests. Occasional low trees of *Eucalyptus leucophloia* were also noted, and there were often patches of *Triodia wiseana* on hillcrests. Other associated species: *Acacia aneura* (flat curved; MET 15548), *A. dictyophleba, Aristida contorta, A. holathera* var. *holathera, Dysphania rhadinostachya, Eucalyptus leucophloia, Senna glutinosa* subsp. x *luerssenii, Solanum lasiophyllum, Triodia pungens* and *T. wiseana.* Sites YEX35, YEX37.

1b. *Eucalyptus leucophloia* low open woodland over *Acacia hilliana* and *A. adoxa* var. *adoxa* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland

This vegetation was recorded from skeletal hillslopes and low stony hills. Steeper slopes and slopes of creeks and gullies sometimes had patches of *Triodia wiseana* mid-dense hummock grassland. Other associated species: *Acacia aneura* (flat curved; MET 15548), *A. inaequilatera, Amphipogon caricinus, Bulbostylis barbata, Dampiera candicans, Grevillea wickhamii, Ptilotus calostachyus, Triodia pungens* and *T. wiseana.* Sites YEX01, YEX06, YEX13, YEX24, YEX30, YEX36.

1c. *Eucalyptus leucophloia*, *Corymbia ferriticola* scattered low trees over *Eremophila latrobei* subsp. *filiformis* ms., *Senna* spp. scattered shrubs over *Cymbopogon ambiguus*, *Eriachne mucronata*, *Themeda* sp. Mt. Barricade and *T. triandra* open tussock grassland

The vegetation of exposed ridges and rocky gullies was variable, and often included species otherwise typical of low-lying areas. Other associated species: *Acacia pruinocarpa, Enchylaena tomentosa, Eriachne pulchella* subsp. *dominii, Gomphrena cunninghamii, Polycarpaea* spp., *Rhagodia eremaea, Rhodanthe margarethae, Salsola tragus, Triodia pungens* and *T. wiseana*. Releves YEX-B, YEX-D, YEX-H (two latter releves not shown on map as locations not recorded).

1d. *Eucalyptus gamophylla* low open woodland over *Acacia* ancistrocarpa open shrubland over *Triodia* aff. basedowii mid-dense hummock grassland

This vegetation was recorded from detrital stony baseslopes. Other associated species: *Acacia tenuissima, Goodenia stobbsiana, Grevillea wickhamii, Sida arenicola* and *Triodia pungens.* Site YEX05.

1e. *Acacia inaequilatera*, Grevillea *wickhamii* scattered shrubs over *Triodia wiseana* middense hummock grassland and *Paraneurachne muelleri* very open grassland

This vegetation was recorded from skeletal stony hillcrests. Other associated species: *Aristida holathera* var. *holathera, Corymbia hamersleyana, Cymbopogon ambiguus, Schizachyrium fragile* and *Solanum phlomoides.* Site YEX22.

1f. *Corymbia hamersleyana* scattered low trees over *Acacia inaequilatera*, *Grevillea wickhamii* scattered tall shrubs to tall open shrubland over *Acacia ancistrocarpa* open shrubland over *Acacia* adoxa var. *adoxa*, *Ptilotus* calostachyus, *Gompholobium*

***polyzygum* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland**

This vegetation was recorded from low undulating stony hills (burnt 1-2 years ago). Occasional *Eucalyptus leucophloia* or *E. gamophylla* were sometimes noted. Other associated species: *Acacia pruinocarpa, Corchorus lasiocarpus* subsp. *parvus, Hakea chordophylla, Ptilotus exaltatus, Senna notabilis* and *Sida arenicola.* Site YEX18 and releve YEX-A.

1g. *Acacia pruinocarpa, Acacia aneura* (flat curved; MET 15 548) scattered low trees over *Eremophila fraseri, Senna glutinosa* subsp. x *luerssenii* over *Triodia* aff. *basedowii* middense hummock grassland

This vegetation was recorded from small low stony hills. Other associated species: *Aristida contorta, Dysphania rhadinostachya, Maireana villosa, Paraneurachne muelleri, Solanum lasiophyllum* and *Triodia wiseana.* Site YEX12.

2. Valleys (Mosaic communities)

2a. *Corymbia* hamersleyana open woodland over *Acacia* inaequilatera, *A. dictyophleba*, *A. tenuissima*, *A. ancistrocarpa*, *A. sclerosperma*, *A. pruinocarpa*, *Hakea chordophylla*, *Eremophila longiflora* tall open shrubland to open shrubland over Triodia spp. middense hummock grassland

This vegetation was recorded from detrital stony lowlands adjacent to Yandicoogina Creek. The dominant spinifex species was variable depending on soil and local aspect, and this vegetation type is therefore a mosaic. The dominant species was typically *Triodia* aff. *basedowii* nearer to hills or on alluvial clay-loam drainage flats, *Triodia lanigera* on valley floors and plains, or *Triodia pungens* near creeks and on alluvial clay flat areas. *Aristida holathera* var. *holathera* was often present as a scattered tussock grass, becoming dense in areas burnt 1-2 years ago. Other associated species: *Acacia* aff. *aneura* (scythe-shaped; MET 15 743), *Corchorus* aff. *lasiocarpus* subsp. *lasiocarpus, Eragrostis eriopoda, Eucalyptus gamophylla, Eulalia aurea, Gossypium australe, Paraneurachne muelleri, Ptilotus astrolasius* var. *astrolasius, Senna notabilis, Sida* aff. *cardiophylla* (Site 1215) and *S. arenicola.* Sites YEX10, YEX14, YEX15, YEX27, YEX31.

2b. Mosaic of Mulga *Acacia aneura* and other *Acacia* species on clay flats, including:

2b.1 *Eucalyptus xerothermica, Acacia aneura* low open woodland over *Acacia bivenosa* open shrubland over *Themeda triandra, Paraneurachne muelleri* open tussock grassland and *Triodia wiseana* and/or *Triodia pungens* open hummock grassland

This vegetation was recorded from shallow drainages and flats. *Aristida holathera* var. *holathera* was often prominent in recently burnt areas. Other associated species: *Acacia pruinocarpa, Aristida contorta, Corymbia hamersleyana, Eulalia aurea, Gossypium australe, Ptilotus astrolasius* var. *astrolasius, P. calostachyus, Senna artemisioides* subsp. *oligophylla* and *S. notabilis.* Sites YEX04, YEX19 (burn regrowth).

2b.2 *Acacia* aneura (flat curved; MET 15 548), Acacia *ayersiana*, *A. pruinocarpa*, *Eucalyptus* xerothermica low woodland over *Eremophila forrestii*, *Senna artemisioides* subsp. *helmsii* shrubland over *Aristida contorta*, *A. inaequiglumis*, *Enneapogon polyphyllus* open annual grassland and mixed very open herbland

This vegetation was recorded from flats. Other associated species: *Acacia tenuissima, Codonocarpus cotinifolius, Cymbopogon ambiguus, Eremophila longifolia, Pterocaulon sphaeranthoides* and *Triodia lanigera.* Site YEX09.

2b.3 *Acacia pruinocarpa*, *A.* synchronicia, Acacia aneura tall open shrubland over *Senna glutinosa* subsp. x *luerssenii* open shrubland over Triodia *wiseana* (*T. pungens*) hummock grassland

This vegetation was recorded from loamy flats adjacent to Weeli Wolli Creek. An open annual grassland dominated by *Aristida contorta* was also often recorded. Other associated species: *Acacia bivenosa, A. dictyophleba, Enneapogon lindleyanus, Ptilotus exaltatus, Senna artemisioides* subsp. *helmsii, S. artemisioides* subsp. *oligophylla* and *Solanum lasiophyllum.* Sites YEX03, YEX32 and releve YEX-N.

2c. *Acacia* dictyophleba, *A.* pruinocarpa, *Acacia* pachyacra, *A.* inaequilatera, *A. ancistrocarpa* tall open shrubland to shrubland over Senna *artemisioides* subsp. *oligophylla* low shrubland over *Triodia lanigera* mid-dense hummock grassland

This vegetation was recorded from semi-sandplain habitat in an alluvial fan. *Triodia pungens* was common in lower lying areas, and an open tussock grassland of *Eragrostis eriopoda* and *Paraneurachne muelleri* was also often recorded. Other associated species: *Aristida holathera* var. *holathera*, *Goodenia microptera, Hakea lorea* subsp. *lorea, Ptilotus astrolasius* var. *astrolasius, Senna notabilis, Scaevola parvifolia* subsp. *pilbarae* and *Senna notabilis.* Sites YEX23, YEX33.

3. Creeks

3a. *Eucalyptus leucophloia*, *Corymbia* hamersleyana low open woodland over *Acacia tumida* var. *pilbarensis*, *A. bivenosa*, *A. ancistrocarpa*, Petalostylis *labicheoides*, *Grevillea wickhamii* tall open shrubland over Acacia *adoxa* var. *adoxa*, *A. hilliana* low open shrubland over *Triodia* spp. mid-dense hummock grassland with *Themeda triandra* and *Paraneurachne muelleri* very open tussock grassland

This vegetation was recorded from stony minor creeks including rocky gullies, occurring on skeletal sandy clay loams. *Eucalyptus gamophylla* was also sometimes recorded. The hummock grassland was variably dominated by *Triodia pungens* (in creekbeds, low in the landscape) or *T.* aff. *basedowii* and *T. wiseana* (on stony banks). Other associated species: *Acacia dictyophleba, A. tenuissima, Bonamia pannosa, Eragrostis cumingii, Eulalia aurea, Hakea chordophylla* and *Ptilotus obovatus* var. *obovatus.* Site YEX26 and releves YEX-G, YEX-J.

3b. *Corymbia hamersleyana* open woodland over *Acacia tumida* var. *pilbarensis*, *A. dictyophleba*, *A. pyrifolia*, *Gossypium robinsonii*, Petalostylis labicheoides, *Grevillea wickhamii*, Rulingia *luteiflora*, Eremophila *longifolia* mixed shrubland to open shrubland over *Triodia pungens* open hummock grassland and *Themeda triandra* tussock grassland

This vegetation was recorded from clay loam substrates in secondary creeks. *Paraneurachne muelleri* and *Eragrostis cumingii* were also typically recorded from the grass stratum. Condition of this vegetation was considered to be Very Good to Excellent (some areas were invaded by Buffel grass **Cenchrus ciliaris*). Other associated species: *Acacia bivenosa, A. citrinoviridis, A. sclerosperma, Centipeda minima, *Conyza bonariensis, Eragrostis tenellula, Eucalyptus victrix, E. xerothermica, Ptilotus obovatus* var. *obovatus, Senna artemisioides* subsp. *oligophylla* x *helmsii, Sida* aff. *fibulifera* and *Sida* sp. spiciform panicles. Sites YEX07, YEX08, YEX11, YEX20, YEX34.

3c. ***Eucalyptus camaldulensis*** **open woodland over** ***Acacia citrinoviridis*****,** ***A. coriacea*** **subsp.** ***pendens*****,** ***A. pruinocarpa*****,** ***Hakea lorea*** **subsp.** ***lorea*****,** ***Atalaya hemiglauca*** **low open woodland over** ***Stylobasium spathulatum*****,** ***Gossypium robinsonii*** **open shrubland over** ****Cenchrus ciliaris*** **closed tussock grassland**

This vegetation was recorded from clay substrates on a major creek floodbank (Weeli Wolli Creek). It was in very poor condition, due to invasion by Buffel grass **Cenchrus ciliaris*. Other associated species: *Cyperus vaginatus, Eucalyptus victrix, *Malvastrum americanum, Ptilotus obovatus* var. *obovatus, Rulingia luteiflora* and *Themeda triandra.* Site YEX02.

3d. ***Eucalyptus camaldulensis*** **and** ***E. victrix*** **scattered trees over scattered mixed shrubs, sedges, tussock grasses and** ***Triodia pungens***

This vegetation type was recorded from a major creek channel, from areas of scoured coarse river sand. Occasional Silver Cadjeput *Melaleuca argentea* trees were recorded. Permanent water areas sometimes had the aquatic or semi-aquatic species Bulrush *Typha domingensis, Potamogeton tricarinatus* and *Schoenoplectus subulatus* and fringing plants such as *Cyperus vaginatus, Lobelia quadrangularis* and *Ammannia* spp. Condition was considered to be Very Good, with scattered weeds including Buffel grass **Cenchrus ciliaris,* Mexican poppy **Argemone ochroleuca* and Ruby dock **Acetosa vesicaria.* Other associated species: *Acacia coriacea* subsp. *pendens, A. tumida* var. *pilbarensis, Atalaya hemiglauca, Cleome viscosa, Corchorus crozophorifolius, Eragrostis tenellula, Eulalia aurea, Melaleuca glomerata, Pluchea rubelliflora, Rostellularia adscendens, Stemodia grossa, Themeda triandra* and *Wahlenbergia tumidifructa.* Sites YEX16, YEX28 and releves YEX-E, YEX-K, YEX-L.

3e. ***Eucalyptus victrix*** **woodland over** ***Acacia coriacea*** **subsp.** ***pendens*****,** ***Atalaya hemiglauca*** **and** ***Melaleuca glomerata*** **tall open shrubland over** ***Triodia pungens*** **open hummock grassland over** ***Cymbopogon dependens*****,** ***Eulalia aurea*** **and** ***Themeda triandra*** **open tussock grassland**

This vegetation type was recorded from coarse river sand in a secondary braided channel of a major creek. Scattered Silver Cadjeput *Melaleuca argentea* trees occurred in some areas. Condition was considered to be Very Good, with occasional weeds including Buffel grass **Cenchrus ciliaris* and Mexican poppy **Argemone ochroleuca*. Other associated species: *Acacia citrinoviridis, A. pyrifolia, Cleome viscosa, Corchorus crozophorifolius, Cyperus vaginatus, Cymbopogon obtectus, Enneapogon clelandii, Eriachne helmsii, Eucalyptus camaldulensis, *Malvastrum americanum, Pluchea dentex, Stemodia grossa* and *Tephrosia rosea* var. *glabrior.* Sites YEX21, YEX25, YEX39.

3f. ***Acacia citrinoviridis*****,** ***A. coriacea*** **subsp.** ***pendens*** **low open forest over** ***Acacia pyrifolia*** **scattered tall shrubs over** ***Corchorus crozophorifolius*****,** ***Tephrosia rosea*** **var.** ***glabrior*** **scattered low shrubs to low open shrubland over** ***Triodia pungens*** **very open hummock grassland and** ***Themeda triandra*****,** ****Cenchrus ciliaris*** **open grassland**

This vegetation type was recorded from clay loam in a major creek flood-out. Occasional Coolibah *Eucalyptus victrix* trees were also noted. Condition was considered to be Very Good, due to some patches of Buffel grass **Cenchrus ciliaris* in Yandicoogina Creek. Other associated species: *Atalaya hemiglauca, Cleome viscosa, Corymbia ferriticola, Eragrostis cumingii, Eriachne tenuiculmis, Polycarpaea longiflora* and *Triodia pungens.* Site YEX17 and releves YEX-M.

3g. ***Corymbia hamersleyana*** **scattered low trees over** ***Acacia citrinoviridis*****,** ***A. pruinocarpa*** **low open woodland over** ***Triodia longiceps*** **mid-dense hummock grassland and** ****Cenchrus ciliaris*** **tussock grassland**

This vegetation type was recorded from clay loam substrate in a major creek (Weeli Wolli Creek) flood-out area. Condition was considered to be poor to very poor due to invasion by Buffel grass **Cenchrus ciliaris*. Other associated species: *Acacia bivenosa, Aristida inaequiglumis, Atalaya hemiglauca, Enneapogon polyphyllus, Eragrostis eriopoda, Paraneurachne muelleri, Ptilotus obovatus* var. *obovatus* and *Themeda triandra.* Site YEX38.

3h. ***Eucalyptus victrix*** **woodland to open woodland over** ***Acacia citrinoviridis*** **low open woodland over** ***Atalaya hemiglauca, Acacia tumida*** **var.** ***pilbarensis*****,** ***A. bivenosa, Petalostylis labicheoides, Gossypium robinsonii*** **shrubland to tall shrubland over** ***Triodia pungens*** **hummock grassland and** ***Themeda triandra*** **open tussock grassland**

This vegetation type was recorded from stony clay loam in a major creek flood-out (Yandicoogina Creek). Other associated species: *Acacia pyrifolia, Aristida inaequiglumis, *Cenchrus ciliaris, Digitaria brownii, Enneapogon lindleyanus, Eriachne mucronata, Eulalia aurea, Hakea lorea* subsp. *lorea, Hybanthus aurantiacus, Pluchea dentex, Porana commixta* and *Stemodia grossa.* Site YEX29 and Releve YEX-F.

Appendix 4
Assessment framework for vegetation and flora significance

ASSESSMENT FRAMEWORK FOR VEGETATION AND FLORA SIGNIFICANCE

Significant vegetation

For this assessment the significance of vegetation lost or disturbed by the proposal was determined by considering the following:

- any special ecological functions of the vegetation
- regional and local abundance of the vegetation communities
- representation in existing or proposed conservation reserves and State Forest
- condition of the vegetation
- presence of Priority or Declared Rare Flora species
- important fauna habitat functions
- presence of threatening processes (for example, weeds).

The assessment of the significance of impacts (following the application of management measures) on significant flora was on the basis of the following:

- change in the local and regional distribution and abundance of Declared Rare and Priority Flora species and species genotypes
- compliance with the *Wildlife Conservation Act 1950*.

Significant flora

The preservation and conservation of flora is covered primarily by the following Western Australian and Commonwealth statutes:

- *Wildlife Conservation Act 1950*
- *Conservation and Land Management Act* 1984
- *Environmental Protection Act 1986*
- *Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth).

Recorded conservation flora will either be Declared Rare Flora for which under the Wildlife Protection Act, it is illegal to remove or defined as Priority Flora.

DRF (Declared Rare Flora -Extant Taxa) are specifically scheduled for protection under the Wildlife Protection Act and are species that have been adequately searched for and are deemed to be either rare, in danger of extinction, or otherwise in need of special protection.

Priority species are those listed as potentially threatened by CALM. They range from Priority one to four species, as follows:

- Priority 1: Poorly Known Taxa. Taxa, which are known from one or a few (generally <5) populations, which are under threat.
- Priority 2: Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat.

- Priority 3: Poorly Known Taxa. Taxa which are known from several populations, at least some of which are not believed to be under immediate threat.

Priority 4: Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

Appendix 5
Addendum to
Yandicoogina Junction
South East project EPS

ADDENDUM TO YANDICOOGINA JUNCTION SOUTH EAST PROJECT EPS

ACTIONS SINCE EPS WRITTEN/RESPONSE TO EPA COMMENTS

The following sections describe works conducted since the EPS document was written and circulated to Government as well as Hamersley's response to questions raised by the EPA Board when considering the project at their meeting of 25 August 2005.

Additional studies conducted

Survey of Backfill Hill

The Yandi Backfill Hill area was surveyed between 31 May and 2 June 2005 by two botanists (Mr Brian Morgan – private consultant, and Mr Emil Thoma of Pilbara Iron). Vegetation units were inferred from regenerating species as the area had been burnt in the last two years. Boundaries of the units were groundtruthed and mapped onto an aerial photograph. Rare flora searches of the area were conducted by traversing the entire area on foot, with individual traverses spaced approximately 50 to 60 m apart.

The landforms and vegetation types recorded from the area were consistent with those mapped for the surrounding Yandi Expansion area (Biota 2004 in main EPS), comprising mainly low stony hills supporting hummock grasslands of *Triodia* aff. *basedowii* and/or *T. wiseana* with variable shrub overstorey including species such as *Acacia inaequilatera*, *Hakea chordophylla* and various *Senna* species. There were no large creeklines within the study area; small flowlines typically supported low open woodlands of *Corymbia hamersleyana* over shrublands of species including *Acacia ancistrocarpa, A. tumida* var. *pilbarensis* and *Grevillea wickhamii* over hummock grasslands of *Triodia pungens*.

The survey recorded 121 native vascular flora species for the area, all of which are typical of the Newman area. No Declared Rare Flora (DRF) or Priority flora species were recorded. A population of the DRF Hamersley Lepidium, *Lepidium catapycnon*, is known from within 1 km of Backfill Hill, however this species was not recorded from the study area. One weed species (Buffel Grass **Cenchrus ciliaris*) was noted in the area.

Follow-up stygofauna survey

An additional round of stygofauna sampling was carried out in the Yandi EPS area in April 2005. Fifty-four wells were selected for sampling between 3 April and 7 April 2005. This included 34 wells within the proposed expansion dewatering 'Impact' area and 20 wells in areas outside of the impact area for the project ('Reference' locations). This included 28 recently constructed wells installed late in 2004 that were not sampled during the initial work on this project.

Eleven of the total wells visited as part of this study could not be sampled for a variety of reasons (three could not be located, two were absent, four were dry, one was collapsed and one not accessible). However, samples were obtained from the remaining 43 wells that were sampleable, and a good spatial spread of collection points across the project area was achieved. Thirty-three of these final 43 wells contained stygofauna (17 Impact wells and 16 Reference wells). The spatial results and general collection of fauna obtained were very similar to the initial phase of sampling at this site.

The only taxon previously recorded only from the Yandi JSE expansion dewatering area was the ostracod *Gomphodella* sp (Biota 2005). Ostracods were collected from six wells during the second phase of sampling, including two wells outside of the area anticipated to be affected by drawdown

from the mine dewatering. Ostracod records were generally distributed in alluvials across the project area, consistent with the initial assessment. No detailed taxonomic or genetic results are available at present but these will be forthcoming later in 2005.

Re-injection Trial

The trial pumping of groundwater from a test well situated within the JSE CID to a trial re-injection well situated within the Billiards CID on the opposite side of Weelli Wolli Creek commenced on 17 August 2005. To date the results of the trial have indicated that re-injection rates of several ML/d per well may be sustainable in the long term, with some reaction within the Weeli Wolli alluvial sequence to prolonged dewatering. This is particularly the case where the JSE CID apparently meanders upstream within the Weeli Wolli drainage and brings into play an area of known calcrete development within the alluvial sequence.

A number of additional alluvial wells were established within Weeli Wolli Creek alluvium as part of the JSE pre feasibility study investigation work. Should a full scale re-injection scheme be established, up to ten new piezometers, including a number of nested and/or specific alluvial monitoring wells, are planned.

Reponses to EPA Queries

Closure, salinity and revegetation

Closure of the pit at both Yandi Junction Central (JC) and Junction South East (JSE) will expose groundwater to evaporation when the water level rebounds through the bottom of the pit after dewatering ceases. This will result in the water table in the CID in and around the pit becoming brackish and being 4-6 m lower than its pre-mining level.

The implications for vegetation surrounding the pit are minimal. At present, vegetation does not depend on the CID for water. Rather it depends on water in the creek alluvial aquifers. Thus vegetation growing around the pit and on the upper slopes of the backfilled pit should be unaffected.

Within the final pit, hydrogeological models suggest that the lower part of the pit will contain a surface of brackish water (to 2,500 mg/L TDS) which will move up and down depending on recharge from seasonal rainfall. Higher in the profile some freshwater seeps from surrounding groundwater may occur. Higher still in the profile, soil moisture should be similar to the natural arid conditions for the area.

The precise design of the post-mining landform and of the rehabilitation program for the lower pit will evolve as Hamersley continually adapts its program in response to results of previous rehabilitation. The program will be updated as part of the Decommissioning and Rehabilitation Plan 5-yearly review cycle. This will ensure the rehabilitation is sustainable and specifically designed for the local conditions. As backfilling and rehabilitation progresses at the adjacent Yandi JC mine, the experience gained with landform restoration and rehabilitation will provide the necessary information to design those factors at Yandi JSE.

Downstream monitoring

It has always been Hamersley's intent to add sites within the Weeli Wolli Creek alluvium to its wider water quality monitoring program. Wells placed within and around the Weeli Wolli Creek during the hydrogeological testing program conducted to date will be included in the future monitoring program.

Details of that program will be provided as part of the water management plan submitted for licensing of dewatering wells.

Potential for future water deficit

The present model of water balance for the future combined JC-JSE operation is conservative in predicting little or no water recovery from the washed fines disposal operation at JC. The model also has a component to account for potential future drought periods. At present, variation within the supply-demand balance of that conservative model leads to a risk that in the latter years of operation, supply of water from dewatering alone is unable to meet peak demand.

Should that prediction prove to be correct and there is a long-term shortfall of water, which is a significant impediment to production, Hamersley will need to seek licensing approval for additional water sources. Hydrogeological investigations suggest that there are sustainable yields which could be found in other parts of the CID or surrounding aquifers to meet this (relatively small) need. The re-injection operation underway is likely to provide a form of water banking for the early surplus of dewatering.