Multiple Iron Ore Mine Development, Mining Area C-Northern Flank, 100km Northwest of Newman

BHP Iron Ore Pty Ltd

Report and recommendations
of the Environmental Protection Authority

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Summary and recommendations

This report provides Environmental Protection Authority (EPA) advice to the Minister for the Environment on the proposal by BHP Iron Ore Pty Ltd to develop fourteen iron ore deposits at Mining Area C-Northern Flank, 100 kilometres northwest of Newman, and associated infrastructure. This includes a 35 kilometre long rail spur from the mine area to link with BHP's existing rail line from Marillana Creek to Port Hedland.

Initially two ore deposits will be developed, the "C" Deposit in Marra Mamba Iron Formation and the Brockman Detrital Deposit. Both will require crushing and screening plants. The Brockman Detrital ore will also pass through a beneficiation plant. A permanent workforce of 200 will be housed in a village nearby. Electricity will come from a spur line off the new 132kV transmission line from Newman which continues past Mining Area C to Marillana Creek.

Relevant environmental factors

In the EPA's opinion the following are the environmental factors which are relevant to this proposal:

- vegetation communities- the direct impacts of clearing for the development, indirect impacts of dewatering and the potential for rain shadow effects from the railway embankment;
- surface water quality and quantity- the effects of mining and clearing on surface water;
- groundwater quality and quantity- the effects from water usage on vegetation and Weeli Wolli Spring;
- subterranean fauna- the impact of mine dewatering and water usage on the aquifer habitat of stygofauna;
- aboriginal culture and heritage- the effects of mining on or near sites of significance;
- rehabilitation of disturbed areas- to prevent encroachment from weeds and ensure that appropriate vegetation communities similar to those in adjacent undisturbed areas are returned ;
- landforms- long term stability to prevent erosion from wind and rain;
- visual amenity- the compatibility of landforms resulting from the mining and placement of waste piles and the residue containment area;
- decommissioning- the overall plan to ensure disturbed areas are left clean, safe, stable and rehabilitated; and
- long term management- with particular regard to cumulative effects from groundwater usage.

The proponent has prepared an environmental management plan which is designed to evolve with new information and practices, will be regularly available to the public and recognises the possibility that a formal review might be necessary in the light of new and unexpected information.

Conclusions

The EPA has considered the proposal by BHP Iron Ore Pty Ltd and concluded that it can be managed to meet the EPA's objectives, provided that the conditions in Section 4 and set out in detail in Appendix 1 are imposed.

The EPA considers that the key environmental factors associated with this proposal are groundwater usage and the potential for cumulative impacts over the long term. The EPA considers that the effects of groundwater drawdown on Weeli Wolli Creek and Spring can be managed by the proponent's commitment to establish a comprehensive groundwater monitoring programme to assess the potential impacts on groundwater usage, and the recommended condition requiring the company to prepare and, if necessary, implement an alternative groundwater source. Long term cumulative effects on areas proposed for mining can be managed using the proponent's environmental management plan to update information on these areas and to ensure that new knowledge about environmental effects and rehabilitation is implemented as it becomes relevant to the mining operation.

Recommendations

The EPA submits the following recommendations to the Minister for the Environment:

1. That the Minister considers the report on the relevant environmental factors of surface and ground water supplies; dependent vegetation; occurrence and distribution of stygofauna; landforms, visual amenity, rehabilitation and decommissioning of disturbed areas; aboriginal culture and heritage; long term cumulative impacts of mining and water usage and their management , as set out in Section 3.

2. That the Minister notes that this is a long term project and that this report covers an assessment of the detail of the first two areas and more generally a further twelve areas.

3. That the Minister notes that the publicly available documents were both a Public Environmental Review and an Environmental Management Plan covering a whole-of-life project, with special emphasis in the Environmental Management Plan on the first two mining areas.

4. That the Minister notes that for subsequent mining of deposits within the overall area recommended for approval the EPA would require Environmental Management Plans which would be prepared for EPA consideration and be made available for public input to assist the EPA.

5. That the Minister notes that the EPA has concluded that the proposal can be managed in an environmentally acceptable manner, provided that there is satisfactory implementation by the proponent of the recommended conditions set out in Section 4, including the proponent's commitments.

6. That the Minister notes the other advice relating to the need for coordination, with government involvement, on the issues of shared transport infrastructure facilities, groundwater supplies, long term management, and stygofauna, flora and fauna surveys as set out in Section 5.

7. That the Minister imposes the conditions recommended in Appendix 1 of the report.

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1. Introduction

This report provides Environmental Protection Authority (EPA) advice to the Minister for the Environment on the environmental factors relevant to the proposal by BHP Iron Ore Pty Ltd (BHP) to develop several iron ore mines and associated infrastructure at Mining Area C-Northern Flank, located 100 kilometres northwest of Newman.

The mines are to be developed in stages and initially two ore deposits will be developed, the C Deposit and the Brockman Detrital Deposit. Mining of 14 deposits is proposed over the longer term, probably 50-plus years. Crushing, screening and beneficiation plants will create a product on site for transport by rail to Port Hedland. A permanent operational workforce of 200 is to live in a village to be constructed 8km west of the plant site.

Following referral of the proposal to the EPA on 21st March 1997 the level of assessment was set at Public Environmental Review (PER), the reason for this level being that the project is large, has several different components and, because many separate pits are proposed, has potential for significant cumulative impacts over the 50+ year operational period. The PER was released for public review from 3rd November 1997 till 5th January 1998.

In compiling this report, the EPA has considered the relevant environmental factors associated with the proposal, issues raised by the public, specialist advice from government agencies, the proponent's response to issues raised and the EPA's own research.

The proponent has prepared and submitted for public review with the PER a draft environmental management plan (EMP). BHP proposes to update this regularly and submit it for review. The EPA has assessed the current EMP, suggested changes to the proponent's commitments, which BHP has adopted, and concludes that the proposal would be acceptable.

The environmental factors relevant to the proposal are discussed in Section 3.

Conditions and procedures to which the proposal should be subject if the Minister determines that it may be implemented are set out in Section 4. Section 5 contains other advice to the Minister and Section 6 presents the EPA's recommendations to the Minister.

Appendix 1 contains recommended environmental conditions and the proponent's consolidated commitments; a list of people and organisations that made submissions is included in Appendix 2; and references are listed in Appendix 3.

2. The proposal

The proposal comprises the following main features:

- at least fourteen iron ore deposits are proposed to be mined over fifty-plus years, although only a few would be in operation at any one time. Initially two deposits, the C Deposit in the Marra Mamba Iron Formation and the Brockman Detrital deposit, in Brockman Iron Formation, are to be developed. Mining at C Deposit will occur for 12 years and for 25 years at the Brockman Detrital Deposit;
- two crushing and screening plants and a beneficiation plant, the latter for the Brockman detrital ores, plus ancillary workshops and facilities;
- for the initial two deposits an out-of-pit overburden storage area covering 212ha. Subsequently overburden will be returned to mined-out pits;
- for the Brockman Deposit an out-of-pit residue storage area of 8ha for slurries from the beneficiation process and subsequent in-pit slurry storage totalling approximately 30ha;

- a 35km rail spur to link the project with BHP's Marillana Creek-Port Hedland railway;
- a temporary construction camp and subsequent village for up to 500 construction and (subsequently) 200 operations personnel;
- a borefield to supply up to 9ML of water per day, initially located in the Wittenoom Formation aquifer 8 kilometres to the east of Deposit C;
- a 132kV electricity transmission spur line off BHP's proposed Newman to Marillana Creek power line;
- mining and ore processing by a contractor, whilst BHP itself will be responsible for overall management, as well as blending and train-loading operations.

A summary of the main elements of the proposed operation is presented below.

Table 1. Key proposal characteristics - 'C' and Brockman Detrital Deposits

Characteristics	C Deposit	Deposit Brockman Detrital	Entire project (A-F, R, P1-P6, and Brockman Detrital)
Project life	12 years	25 years	50 years
Ore Reserves	124Mt	35Mt	~1300Mt
Ore Mining Rate	up to 15Mtpa	up to 6Mtpa	n/a
Overburden and Low Grade Ore	280Mt	101Mt	n/a
Average Stripping Rate	2.3:1	2.9:1	n/a
Pit Depth	150m	40m	n/a
Pit Area	228ha	208ha	n/a
Overburden Storage Area *	183ha	29ha	n/a
Residue Storage Area	not applicable	8ha (out-of-pit storage)	n/a
Total Area Disturbed (pit, overburden, low grade stockpile and residue)	411ha	245ha	~5000ha
Water Requirements	up to 9ML/day		
Power Supply	132 kV spur line from the Newman Pilbara Energy P/L Power Station to Marillana Creek		
Ore Processing	crushing and screening	crushing, screening and beneficiation plant	n/a
Train Loading	shared train loading facility		
Rail Spur Length	35km		
Width of Rail Corridor	60m		
Mine Infrastructure Area	50ha		
Permanent Workforce	200		
Construction Workforce	500		
Construction Period	21 months		

* Out-of-pit storage including low grade stockpile n/a not available

Whilst the C Deposit and the Brockman Detrital Deposit contain 124 million tonnes (Mt) and 35Mt of high grade ore equivalent respectively, the total reserves of the 14 deposits outlined to date in the Northern Flank of Mining Area C amount to about 1289 million tonnes. Annual

mining rates will rise over several years from 1-2Mt to over 15Mt at C Deposit and from 2Mt to 6Mt for the Brockman Detrital Deposit. Mining from C Deposit will create a pit 4.5km long by up to 500m wide and 150m deep, resulting in a relatively long, shallow pit profile prior to its partial infill. Approximately 10% of the orebody lies below the water table and mining of this portion will require dewatering. Water pumped from the pit will be used for dust suppression.

The Brockman Detrital Deposit will be similar in area to C Deposit though the mined depth will be only 40m and the water table will not be reached. A few of the twelve other deposits in the Northern Flank Valley included in this proposal would also be mined below the water table (see Section 3.2.1.3).

It is intended that vegetation and topsoil will be stored for later use in rehabilitation. Some overburden from the C Deposit will be used to construct pads and foundations for process plant but, because of the length of the pit and BHP's intention to mine and progressively rehabilitate, most of the overburden will be returned to the pit as it is developed. Some overburden from Brockman Detrital Deposit will be used to fill borrow pits used in construction of the railway formation; most of the remainder will be returned to that pit.

C Deposit and Brockman Detrital Deposit will be developed concurrently but treated in separate crushers and screening plants. 111Mt of material from the Brockman Detrital Deposit will be upgraded in a beneficiation plant, a process requiring over two tonnes of material to create one tonne of ore. The beneficiation process washes detrital ores to remove fines and will generate a total of 2.2Mt of slurry (<0.3mm) from the Brockman Detrital Deposit. A small fraction (up to 140,000m^3) will be piped to a residue impoundment area for initial storage of the fines. Some of the wash water will be recovered for re-use in the process, creating a nett requirement for 2.35Ml wash water per day at an annual production rate of 3Mt. Later, when the pit is sufficiently developed, slurries will be returned to it. The beneficiated product will then be blended with ore from C Deposit.

Ores from different pits will be stockpiled separately and blended in an area which will hold a minimum of two stockpiles, each of around 150,000t. Blended ores will be loaded onto trains bound first for BHP's Marillana Creek (Yandi) mine operation (35km by rail north of Mining Area C) where trains will be combined, and driven to Port Hedland. Shorter trains of 48 cars would initially be used, increasing to 96 cars when production reaches 3Mt a year and up to 240 cars at annual production rates of 7Mt and more. The rail loop will initially be sited to service the C and Brockman Detrital deposits.

The existing 17km long road to the mine area branches off to the east from the Great Northern Highway and will be upgraded. For construction purposes another track on the south side of the valley will be used during the upgrading. A 3km long link road will connect the village, which will be located on the north side of the Packsaddle Range, by crossing the range at a low point.

Approvals for the proposed 132kV power transmission line from Newman to Marillana Creek are the subject of a separate proposal. BHP's Mining Area C proposal requires a connecting line 8km long from the main transmission line.

Water for the mine operation and its associated village will come from borefields tapping Wittenoom Formation strata. Up to 9Ml a day will be required at full production. Alternative supplies have been investigated and may be developed to spread the load and reduce potential impacts as requirements increase.

BHP's PER has intentionally concentrated on detailed surveys of the environment and management of the environmental impacts from only the initial two abovementioned deposits. BHP proposed, and the EPA has endorsed, the concept of a "Life-of-Project" Environmental Management Plan (EMP) which puts in place environmental management and monitoring principles and practices which would apply to all fourteen deposits so far outlined. The EMP will be a regularly updated document which will introduce and address specific aspects of each of the other twelve known deposits to be developed for mining as work progresses and further data come to hand. These data will be available to the public.

BHP's EMP was submitted to the EPA in draft form with its PER so that key features could be publicly reviewed. The EPA has assessed the draft EMP and has made recommendations for changes to some of the proponent's commitments, which are also an integral part of the EMP.

Key features of this EMP are that it will:

- include provision throughout the life of the overall mining project for further public review at intervals, to meet the requirements of the EPA and other decision-making agencies, and incorporate DEP compliance audits;
- be consistent with standard core requirements for environmental management systems (including identifying areas for improvement and developing plans for correction of root causes of deficiencies) as published in the Australian and New Zealand standard ISO 14001;
- be reviewed and updated over the life of the project based on the results of monitoring, auditing and improving industry practices. The environmental factors to be addressed will also meet the requirements of the EPA. The DEP will review these updates regularly.

3. Environmental considerations

3.1 Relevant environmental factors

Section 44(1) of the Environmental Protection Act 1986 requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and the conditions, if any, to which the proposal should be subject. In addition, the EPA may make recommendations as it sees fit.

Due to the nature of this proposal there are a number of distinct environmental issues, some of which involve several environmental factors. A discussion presented under headings related to the relevant factors would be unnecessarily repetitive and so this report will outline the assessment of the relevant factors by discussing the key issues relevant to the proposal.

This report cross-references the issues that have environmental significance with the relevant environmental factors (see Section 3.2).

The identification process for the relevant factors is summarised in Table 2 below.

Table 2. Identification of Relevant Environmental Factors

Preliminary Environmental Factor	Proposal Characteristics	Public and Government Agency Comments	Identification of Relevant Environmental Factors
BIOPHYSICAL			
Vegetation communities-dependence on and interaction with water	Development of the two initial deposits and associated infrastructure will disturb 960 ha of vegetation. Full development of the 14 known deposits will disturb approximately 5000ha of vegetation. Dewatering of deposits to be mined below water table-groundwater modelling indicates that abstraction will lower the groundwater level by 25m at the borefield and 0.1m at Weeli Wolli Spring	Ruby Dock (*Acetosa vesicaria*) is not discussed. Proponent should develop a weed management and environmental hygiene program. (CALM)	Impacts on vegetation communities from dewatering require further EPA evaluation. Considered to be a relevant environmental factor. Weed management practices will be incorporated into the EMP prior to commencement of construction activities (Commitment 1, EMP Section 9).
Declared rare and priority flora	No Declared Rare Flora in the Northern Flank area or the rail corridor. Three Priority 3 and one Priority 4 species were found in the Northern Flank and rail corridor.	no comments received	Two Priority 3 flora populations are likely to be disturbed. Both species have other populations in the region, some of which occur in National Parks, and the landform on which they occur is widespread throughout the region. Factor does not require further EPA evaluation.
Terrestrial fauna	The Northern Flank contains 143 vertebrate species, including: 21 mammal species; 77 bird species; 43 reptile species; & 2 amphibians. The rail corridor contains an additional: 1 reptile species; 2 fish species; & 8 bird species.	no comments received	Fauna habitats in the vicinity of C Deposit, the Brockman Detrital Deposit and associated infrastructure will be disturbed resulting in the loss of some less mobile species. Habitats are well represented elsewhere in the region. The proponent has committed to a policy of minimum land disturbance with rehabilitation to occur as soon as practicable following mining (Commitment 1, EMP Section 1). Factor does not require further EPA evaluation.

Preliminary Environ-mental Factor	Proposal Characteristics	Public and Government Agency Comments	Identification of Relevant Environmental Factors
Specially protected (threatened) fauna	Two threatened fauna species were recorded within the Project Area: Schedule 3 - Rainbow Bee-eater ; and Schedule 4 - Peregrine Falcon	no comments received (Note: the Pebble Mound Mouse has recently been delisted from Schedule 1)	The two species of Schedule-listed birds are unlikely to be directly affected as the Project Area does not present suitable habitat. Factor does not require further EPA evaluation.
Subterranean fauna	Groundwater modelling has indicated that the abstraction of groundwater for water supply will lower the groundwater level by 25m at the Project borefield and 0.1 m downstream at Weeli Wolli Spring.	PER contains various descriptions of location of calcrete. Stygofauna are not limited to calcrete deposits. (WA Museum) The main regional aquifer is karstic dolomite of the Wittenoom Formation. These conditions are like the Millstream aquifer where the stygofauna are of Gondwanan origin. (WA Museum) The Upper Fortescue drainage being a closed system is likely to have a different stygofauna from that at Millstream. (WA Museum)	Considered to be a relevant environmental factor.
Groundwater quantity	Development of the two initial deposits will require groundwater abstraction of up to 9 ML / day for process water, dust suppression and potable water. Groundwater modelling has indicated that the abstraction of groundwater for water supply will lower the groundwater level by 25m at the Project borefield and 0.1m downstream at Weeli Wolli Spring.	Submitters raised a number of issues, including: • impact on Weeli Wolli Spring; • alternative water supplies; • artificial maintenance of Weeli Wolli Spring flow; • local impacts of dewatering; • cumulative impact on groundwater if mining occurs at Hope Downs; • government agency involvement; and • quantify Commitment 5 "significant impact".	Considered to be a relevant environmental factor.
Surface water quantity	Development of the two initial deposits will intersect approx. 17 identifiable creeks, which are tributaries of the main creek flowing through the center of Northern Flank valley.	Where original creek lines are to be reconstructed the Catchment and Waterway Management Branch of the WRC must be consulted and detailed plans submitted	Considered to be a relevant environmental factor.

Preliminary Environ-mental Factor	Proposal Characteristics	Public and Government Agency Comments	Identification of Relevant Environmental Factors
Landform	The Packsaddle and Jirrpalpur Ranges will be impacted by mining. Partially filled mine pits and rehabilitated overburden and tailings storages will remain when mining finishes.	concerns over long term sustainability of structures (DEP)	Considered to be a relevant environmental factor.
Rehabilitation	Overburden will be directly infilled to depleted areas of the pit, and original drainage lines will be restored where practicable. Overburden dumps and pits to be revegetated.	seeds used for rehabilitation should be from the local provenance, being collected from within a range of 50 to 100 km of the rehabilitation site. (CALM)	Considered to be a relevant environmental factor.
POLLUTION MANAGEMENT			
Greenhouse gases	Greenhouse gas emissions will be generated through the use of equipment and fuels. Current rate of emissions from BHP iron ore operations is 0.012t CO_2 equivalent per tonne of ore produced. The proponent is a member of the Greenhouse Challenge Program.	no comments received	The proponent conducts monitoring of greenhouse emissions as part of the Greenhouse Challenge. Greenhouse gas emissions will be reduced (by 10% from 1995-2000) through increasing the efficiency of mobile equipment, fuel selection and use of electricity. Factor does not require further EPA evaluation.
Dust	Mining will generate dust through blasting activities, ore and overburden mining, crushing and screening, conveyor transfer points, rail loadout, road haulage and truck unloading. Asbestos material may be encountered with overburden associated with C Deposit.	no comments received	Nearest residence will be the mine workforce village, 7km from operations. The proponent has made a commitment to manage dust through watering from water trucks, water jets, water sprays and dust extraction and collection systems at the rail loadout facility (Commitment 1, EMP Section 6). If asbestos is encountered, a comprehensive management system will be adopted, as detailed in Section 6 of the draft EMP. Factor does not require further EPA evaluation.

Preliminary Environ-mental Factor	Proposal Characteristics	Public and Government Agency Comments	Identification of Relevant Environmental Factors
Groundwater quality	Disposal of slurry from beneficiation plant Development of the two initial deposits will require groundwater abstraction of up to 9 ML/day for process water, dust suppression and potable water.	Contact between the slurry from the beneficiation plant and either gravel or karstic areas may cause the sediment to block the interstices, and lining may be considered. (WA Museum) The residue storage facility should be reviewed and assessed by a geotechnical specialist. (DME) What is the projected effect of the reduced groundwater flow towards Weeli Wolli Spring on the TDS of the water at the spring over the entire mine life? (WA Museum)	Considered to be a relevant environmental factor.
Surface water quality	Process water discharged from the beneficiation plant to the residue containment area and pits will be entrained in a slurry of fine grained material (approx. 60% solids). Sediment runoff from overburden dumps will initially contain sediment until revegetation is complete	Management of the rail route from Marillana Creek to the Northern Flank should include re-contouring of original landforms. Banks and floodways should be stabilised and revegetated wherever the route crosses drainage lines and larger water courses. (WRC)	Considered to be a relevant environmental factor.
Noise	The closest noise sensitive residence will be the accommodation village, located behind Packsaddle Range, approx. 7km from the operations.	no comments received	The proponent has made a commitment to comply with all relevant legislation (Commitment 1, EMP Section 7). Factor does not require further EPA evaluation.

Preliminary Environ-mental Factor	Proposal Characteristics	Public and Government Agency Comments	Identification of Relevant Environmental Factors
SOCIAL SURROUNDINGS			
Public health and safety	During construction approx. 10 trucks (semi-trailers) per day will use the Great Northern Highway. During operations traffic movements will range between five and 10 light trucks per week. Ore will be transported by rail.	Port handling facilities and impact on workers and residences in Port and South Hedland were not discussed in the PER. Mining Area C is in the Wittenoom belt where asbestos is prevalent. The high winds at the port will cause windborne dust, and asbestos may be present in this dust. (member of public)	Port handling facilities at Port Hedland were not discussed as they are subject to existing management plans. Asbestos does not occur within mineralised high grade ore but can be present in the formation below the ore. Therefore, if fibrous minerals are encountered, it will be associated with overburden material which will be stored on-site, rather than with the product railed to Port Hedland. Management of asbestos is discussed in the draft EMP, Section 6 (Commitment 1). Factor does not require further EPA evaluation.
Visual amenity	Mining will impact on the visual character of the area through the development of pits, overburden storage areas and infrastructure requirements.	Seek constructed landscape compatible with pre-existing surrounds (DEP)	Considered to be a relevant environmental factor.
Aboriginal culture and heritage	The mining of C Deposit and Brockman Detrital Deposit will directly affect 15 aboriginal sites.	It is suggested that BHP considers the results of its management outcomes in regard to Aboriginal heritage in the Annual Report. The inclusion of Aboriginal heritage in the Annual Report would provide a safeguard and a way of monitoring the protection of heritage sites during the lifetime of the mine. (Aboriginal Affairs Dept)	Considered to be a relevant environmental factor.
OTHER			
Decommission-ing	Railway formation will be retained following the removal of rails and sleepers .	• The rail formation should be breached or removed, at least in part, for long term protection of vegetation. (CALM)	Considered to be a relevant environmental factor.

Preliminary Environ-mental Factor	Proposal Characteristics	Public and Government Agency Comments	Identification of Relevant Environmental Factors
Long-term management	BHP intends to develop at least 14 deposits in the Northern Flank area of Mining Area C, initially developing 2 deposits. BHP will potentially operate in this area for more than 50 years if approval is granted to develop the Northern Flank area of Mining Area C.	Submitters made various suggestions for long-term management of the area: • the formation of a group, similar to the Mining and Management Planning Liaison Group used for ALCOA should be considered; • joint management of Weeli Wolli Spring, between CALM and BHP, either as a Section 16A Agreement (CALM Act), or as a Memorandum of Understanding; EMP to be forwarded with project development proposals to DRD who will then consult with relevant government agencies before submission to the Minister for Resources Development for approval.	Considered to be a relevant environmental factor.

The above relevant factors were identified from the EPA's consideration of all preliminary environmental factors outlined in the environmental review document, submissions (Appendix 2) and the adequacy of the proponent's response. On this basis the EPA considers that the impacts on declared rare and priority flora, terrestrial fauna, specially protected (threatened) fauna, greenhouse gases, dust, noise, and public health and safety do not require further evaluation by the EPA.

3.2 Issues of environmental significance

There are a number of distinct environmental issues related to the proposal, some of which involve several environmental factors. To simplify their consideration and management, factors have been grouped into three sets of issues.

It is the EPA's opinion that the following issues have environmental significance for the proposal and consequently require detailed evaluation in this report:

(a) Clearing and land disturbance- for mine development, residues storage, stockpiles, processing plants and infrastructure;

(b) Water usage- for dust control, beneficiation plant, human consumption and landscaping;

(c) Cumulative impacts and long term effects of multiple mine developments.

The relationship between the issues that are relevant to the proposal and the associated environmental factors is shown in Table 3 below.

Table 3. Matrix of environmental factors and issues for the proposal.

	ISSUE		
FACTOR	LAND DISTURBANCE	WATER USAGE	CUMULATIVE IMPACTS
Vegetation	*	*	*
Surface water	*	*	*
Groundwater	*	*	*
Subterranean fauna		*	*
Aboriginal culture and heritage	*		*
Landforms	*		*
Visual amenity	*		*
Rehabilitation	*		*
Decommissioning	*		*
Long term management	*	*	*

The environmental significance of the above issues and their assessment is summarised in Table 4 and discussed in the subsections below it. The assessment of each issue, combined with the consideration of the environmental factors relevant to each issue, is where the EPA considers if the proposal can be managed to meet the environmental objectives set for each factor.

Table 4. Summary of Assessment of Relevant Environmental Factors

Relevant Factor	Relevant Area	EPA Objective	EPA Assessment	EPA Advice
WATER				
Vegetation communities-dependence upon and interaction with water	Weeli Wolli Springs, area of influence of dewatering	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.	Groundwater monitoring as described in Commitment 4 is designed to detect any changes in the groundwater regime which may result in an impact on Weeli Wolli Spring-the only area where vegetation is likely to be affected. If the monitoring indicates that groundwater abstraction will cause a significant impact at Weeli Wolli Spring, an alternative water management strategy will be developed (Commitment 5).	Having particular regard to: • the proponent's proposed monitoring programme; • the proponent's proposed alternative water management strategy; and • the recommended condition that the proponent prepares an alternative water management strategy to the requirements of the EPA; it is the EPA's opinion that the proposal can be managed to meet its objective for this environmental factor, provided that the EPA's recommended conditions and the proponent's commitments are made legally enforceable.
Surface water quantity	Northern Flank, rail formation, Weeli Wolli Springs, area of influence of dewatering	Maintain the quantity of surface water so that existing and potential uses, including ecosystem maintenance, are protected.	The impact threshold resulting in the development of alternative water supplies (other than from the Northern Flank valley) is 10% of mean monthly flow at Weeli Wolli Spring. If the threshold level is exceeded the proponent will immediately implement an alternative water management strategy approved by the EPA on advice from the DEP, CALM and WRC,	Having particular regard to: • commitment (1) to undertake additional surface water surveys to identify potential impacts on surface water resources; and • proponent commitments to seek other supplies if impact threshold is triggered (Commitments 4 and 5; • the recommended condition that the proponent prepares a Rail Route Environmental Management Plan to the requirements of the EPA; it is the EPA's opinion that the proposal can be managed to meet its objective for this environmental factor, provided that the EPA's recommended conditions and the proponent's commitments are made legally enforceable.

Relevant Factor	Relevant Area	EPA Objective	EPA Assessment	EPA Advice
Surface water quality	Northern Flank, Weeli Wolli Springs, rail corridor	Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA, 1993);	Surface waters from drainage lines will be directed around pits and overburden storage areas to continue along natural pathways. Where pits are to be infilled to near the original ground level drainage lines will be reinstated, where practicable. Drainage from overburden storage areas will pass through silt traps prior to discharge. Water used in processing will be discharged to a residue storage facility. As much process water as possible will be recycled from the residue storage area for reuse (Commitment 5, EMP Section 3). Potential at river and creek crossings for erosion	Having particular regard to the proponent's: • strategy for progressive rehabilitation; • commitment to seek other supplies if the impact threshold is triggered (Commitments 4 and 5); • Commitment (1) to undertake additional surface water surveys to identify potential impacts on surface water resources; and • the recommended condition that the proponent prepares a Rail Route Environmental Management Plan to the requirements of the EPA; it is the EPA's opinion that the proposal can be managed to meet its objective for this environmental factor, provided that the EPA's recommended conditions and the proponent's commitments are made legally enforceable.
Groundwater quantity	Northern Flank, Weeli Wolli Springs, area of influence of dewatering	Maintain the quantity of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.	Groundwater monitoring as described in Commitment 4 will detect any changes in the groundwater regime which may result in an impact on Weeli Wolli Spring. If the monitoring indicates that groundwater abstraction will cause a significant impact at Weeli Wolli Spring, an alternative water management strategy will be developed (Commitment 5).	Having particular regard to: • the proponent's Commitment (4) to establishing a comprehensive groundwater monitoring programme to assess the potential impacts of groundwater usage on Weeli Wolli Spring; and • to establish an alternative water management strategy (Commitment 5) and • the recommended condition that the proponent prepares an alternative water management strategy to the requirements of the EPA; it is the EPA's opinion that the proposal can be managed to meet its objective for this environmental factor, provided that the EPA's recommended conditions and the proponent's commitments are made legally enforceable.

Relevant Factor	Relevant Area	EPA Objective	EPA Assessment	EPA Advice
Groundwater quality	Northern Flank, Weeli Wolli Springs;	Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA, 1993)	All areas mined below the watertable will be directly infilled with overburden to at least the original watertable level to prevent evaporation raising groundwater total dissolved solids. Groundwater quality will be monitored and sampled as detailed in Section 4 of the draft EMP.	Having particular regard to: • the proponent's commitment (1) to develop a Life of Project EMP which will address groundwater and the management of wastes and hazardous materials; and • the proponent's commitment (4) to establishing a comprehensive groundwater monitoring programme to assess the potential impacts of groundwater usage on Weeli Wolli Spring; • significant environmental impacts being unlikely; it is the EPA's opinion that the proposal can be managed to meet its objective for this environmental factor, provided that the EPA's recommended conditions and the proponent's commitments are made legally enforceable.

Relevant Factor	Relevant Area	EPA Objective	EPA Assessment	EPA Advice
Subterranean fauna	Weeli Wolli Springs, area of influence of dewatering	Maintain the abundance, species diversity and geographical distribution of subterranean fauna.	Stygofauna may be found in cobble beds associated with current and paleodrainage systems. However, in all areas affected by mining and dewatering, the cobble beds are unsaturated. The cobble beds of the streams and river are confined to the stream beds, are relatively thin and apart from the Weeli Wolli Spring area, they are unsaturated. The karstic Wittenoom Dolomite may be a habitat for stygofauna, however this formation should remain saturated, as it is to be used for limited water supply purposes only. To improve the knowledge of the distribution, conservation value and significance of stygofauna species, the proponent commits to assist the WA Museum to conduct an agreed and verifiable stygofauna sampling program in the vicinity of Mining Area C (Commitment 7). The likelihood of damage is considered to be low.	Having particular regard to the proponent's Commitment (7) to: • assist with sampling and identification of stygofauna; • assess the conservation significance of any species found; • undertake sampling in the Mining Area C region if species distribution is found to be a significant conservation issue; and • map the local distribution of species sampled; as a component of the EMP, to be begun before the commencement of mining and be continued on an ongoing basis as deposits are scheduled for mining; it is the EPA's opinion that the proposal can be managed to meet its objective for this environmental factor, provided that the EPA's recommended conditions and the proponent's commitments are made legally enforceable.

LAND CLEARING AND DISTURBANCE				
Relevant Factor	**Relevant Area**	**EPA Objective**	**EPA Assessment**	**EPA Advice**
Vegetation	areas surrounding orebodies, waste rock sites, residue storage sites, stockpiles, access corridors, the process plant and the accomodation facility	to maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities	Two Priority 3 populations likely to be affected-*Triumphetta leptacantha* and *T machonochieana* ms. Both are species known from other populations in the region and the landform in which both species occur is widespread in the region. Other known populations of Priority Flora will not be affected. Careful monitoring required for secondary impacts arising from drainage shadow effects along rail formation. BHP proposes that all areas >1ha will require preparation of a clearing Plan and contracts will forbid unauthorised clearing. Removed topsoil and vegetation will be stockpiled for later use, pits will be partly infilled with overburden and cleared areas and stockpiles will be progressively rehabilitated. Exposed faces on overburden storage areas will be laid back to angles of 20^0 or less and agreed measures will be reviewed and updated over the life of the project.	Having particular regard to: • the proponent's measures to mitigate the effects of clearing, including: • all areas >1ha requiring the approval of a plan before clearing; • all contracts will require a condition forbidding unauthorised clearing; • stockpiling of topsoil and vegetation for later use; • partial infilling of pits with overburden; • progressive rehabilitation of areas; and • exposed faces on overburden dumps will be laid back to a maximum angle of 20^0; it is the EPA's opinion that the proposal can be managed to meet its objective for this environmental factor, provided that the EPA's recommended conditions and the proponent's commitments are made legally enforceable.

Relevant Factor	Relevant Area	EPA Objective	EPA Assessment	EPA Advice
Landform	Northern Flank area, rail corridor	Establish stable, sustainable landform consistent with surroundings.	The Packsaddle and Jirrpalpur Ranges will be impacted by mining. Partially filled mine pits and rehabilitated overburden and tailings storages will remain when mining finishes. The area of the rail corridor will be impacted.	Having particular regard to the proponent's rehabilitation objectives and desired outcomes as outlined in Table 5 below, and in particular final landforms for: • overburden storage areas; • shallow detrital mining areas; • deeper open pits; and the recommendation that, during decommissioning, the proponent breaches the rail formation at strategic locations to facilitate drainage; it is the EPA's opinion that the proposal can be managed to meet its objective for this environmental factor, provided that the EPA's recommended conditions and the proponent's commitments are made legally enforceable.

Relevant Factor	Relevant Area	EPA Objective	EPA Assessment	EPA Advice
Aboriginal culture and heritage	Northern Flank, rail corridor	Ensure that the proposal complies with the requirements of the Aboriginal Heritage Act 1972; and ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	Archaeological and ethnographic surveys have been conducted for areas proposed to be affected by development of the Northern Flank and associated infrastructure. 15 sites will potentially be affected by the mining operations and associated infrastructure developments. The proponent is obliged to comply with the Aboriginal Heritage Act 1972, and will avoid sites where possible, or make formal application to disturb sites if necessary. If approval to disturb sites is not granted, the proponent will engineer mine landforms to avoid the sites. Aboriginal heritage issues will be included in the Annual Report (Commitment 1, EMP Section 11).	Having particular regard to the proponent's strategy for the effective minimisation of impacts to significant sites which includes: • compliance with provisions of the Aboriginal Heritage Act 1972-80; • the flagging, fencing off or signposting of sites for avoidance; • avoidance of disturbance to significant sites wherever possible; • where this is not possible and approval is not given to disturb the sites, the engineering of mine landforms to avoid the sites; • a requirement for all site personnel to undergo an induction course on site; and • a recommendation that this induction course takes place prior to personnel starting work at locations where aboriginal sites may be or are yet to be determined; it is the EPA's opinion that the proposal can be managed to meet its objective for this environmental factor, provided that the EPA's recommended conditions and the proponent's commitments are made legally enforceable.
Visual amenity	Northern Flank, rail corridor	Visual amenity of the area adjacent to the project should not be unduly affected by the proposal.	Mining will require the construction of infrastructure, overburden storage areas and pits. The rail corridor will follow a route from Marillana Creek to the Northern Flank. The topography of the region, rehabilitation provisions and the distances between the operations and the nearest view points will ensure visual impacts are acceptable.	Having particular regard to the proponent's rehabilitation objectives and desired outcomes as outlined in Table 5 below, and in particular final landforms for: • overburden storage areas; • shallow detrital mining areas; • deeper open pits; it is the EPA's opinion that the proposal can be managed to meet its objective for this environmental factor, provided that the EPA's recommended conditions and the proponent's commitments are made legally enforceable.

Relevant Factor	Relevant Area	EPA Objective	EPA Assessment	EPA Advice
Rehabilitation	Northern Flank area, rail corridor	Establish stable, sustainable landform consistent with surroundings.	The proponent has made a commitment to rehabilitate and to use local native seed species, to be collected as close as practicable to the operations except where limited by availability (rehab. management practices, EMP Section 9).	Having particular regard to the proponent's rehabilitation criteria for use in the EMP (Commitment 1), the main points of which are to: • minimise disturbance; • re-use topsoil; • return as much waste material to mined pits as possible; • rehabilitate progressively; • use weed management practices; • use local seed; monitor and maintain rehabilitating areas until they attain a stable condition; and • require the mining contractor to agree to a contract which includes rehabilitation as part of the job specification; it is the EPA's opinion that the proposal can be managed to meet its objective for this environmental factor, provided that the EPA's recommended conditions and the proponent's commitments are made legally enforceable.
Decommissioning	Northern Flank	Achieve the satisfactory decommission-ing of the project, removal of rail, plant and installations and rehabilitation of the site and its environs.	A mine closure plan will be developed in consultation with government, prior to the completion of operations at C Deposit and the Brockman Detrital Deposit (Commitment 1, EMP Section 10).	Having particular regard to the proponent's rehabilitation objectives and desired outcomes as outlined in Table 5 below, and in particular final landforms for: • overburden storage areas; • shallow detrital mining areas; • deeper open pits; and • treatment (eg. ripping of compacted ground) of areas to enable them to be rehabilitated once buildings and plant have been removed; and • the recommendation that, during decommissioning, the proponent breaches the rail formation at strategic locations to facilitate drainage; it is the EPA's opinion that the proposal can be managed to meet its objective for this environmental factor, provided that the EPA's recommended conditions and the proponent's commitments are made legally enforceable.

Relevant Factor	Relevant Area	EPA Objective	EPA Assessment	EPA Advice
CUMULATIVE IMPACTS				
Long term management	Northern Flank, Weeli Wolli Springs, area of influence of dewatering, rail corridor	To ensure that a process is established which enables the assessment and approval of further mining of identified deposits in the Northern Flank area, including public input as required.	The proponent has committed to the preparation of an EMP, that includes an annual reporting requirement (Commitment 1) and the preparation of an EMS. The proponent has made a commitment to undertake additional surveys to assess potential environmental impacts prior to the development of deposits other than the Marramamba C Deposit and Brockman Detrital Deposit in the Northern Flank (Commitment 2). The proponent has made a commitment to review and update the EMP for the development of further deposits to reflect site specific characteristics (Commitment 2).	Having particular regard to the proponent's undertaking to: • implement the EMP as detailed in the PER, commitment 3 and further described in the proponent's response to submissions; and • the recommended condition, which details the process for review of the Environmental Management Plan, including public access; it is the EPA's opinion that the proposal can be managed to meet its objective for this environmental factor, provided that the EPA's recommended conditions and the proponent's commitments are made legally enforceable.

3. 2. 1 Clearing and land disturbance

Description

The development will require the clearing of 961ha of vegetation for the initial two deposits and related facilities. For Deposit C this comprises 228ha at the pit and 183ha for storage of overburden and low grade ore. The Brockman Detrital Deposit pit footprint will cover 208ha and the overburden and residue storage areas will claim 37ha. The processing plant and mine stockpiles, the village site and all access corridors will require another 305ha of clearing. Areas to be cleared for the twelve other known deposits have not yet been detailed but over the 50+ year life of mining in this area clearing may total in the order of 5000ha. The environmental factors relevant to this component are: vegetation, landforms, visual amenity, rehabilitation, some aspects of surface water and aboriginal sites.

Land disturbance

Land disturbance recognises the post-clearing phase, when earthmoving equipment is employed to mine and dump waste. Land disturbance also covers the cut, fill and borrowing activities associated with road making and the 35km rail formation from Mining Area C to Marillana Creek. After mining operations cease, BHP proposes to leave access roads and the rail formation insitu but to rip the compacted surfaces and reseed them (see Table 5 below) and discussion in Section 3.2.1.6.

In recognition that some areas are to be irrevocably altered in the mining process, BHP has a policy of minimising land disturbance. Proposals to minimise the effects of this disturbance (additional to those previously listed above in Clearing) are:

- personnel to undergo an environmental induction programme;
- prior to the commencement of operations a Closure Plan will be prepared to identify post-disturbance landuse;
- out-of-pit overburden storage areas to be located and constructed to blend with surrounding landforms;
- progressive rehabilitation of completed pit faces where they are cut into the range by ripping and seeding with native species;
- removal of infrastructure no longer required;
- preliminary completion criteria for rehabilitation to be developed in consultation with DEP and DME within one year of commencement of mining;
- the completion of rehabilitation at the conclusion of mining; and
- monitoring and maintenance of the rehabilitated areas until the vegetation is seen to be progressing towards a stable condition.

3.2.1.1 Vegetation

Mining Area C is dominated largely by low scattered trees or mallees of Snappy Gum (*Eucalyptus leucophloia*) over open hummock grassland of Limestone Spinifex (*Triodia wiseana*). A flora survey of the Northern Flank listed ten vegetation associations on the basis of species composition and a further five associations were found in drainage lines. The survey listed 422 taxa in the Northern Flank area and 254 taxa in the rail corridor; the high numbers found reflect the timing of the survey after significant rains. The sites with the highest species richness were in drainage lines or gullies, with the exception of one site on a clay flat.

No Declared Rare Flora species were collected within the Northern Flank or the rail corridor but two Priority 3 flora populations are likely to be disturbed by mining. (Priority 3 refers to poorly known species which are known from generally less than five populations, at least some of which are believed to be not under immediate threat). A population of *Triumphetta leptacantha* is located on the Brockman Detrital Deposit and at several sites within the rail corridor in Yandicoogina Creek. A population of *T. maconochieana* ms has been mapped immediately to the south of the C Deposit.

Three weed species were recorded from the Northern Flank. The most common was Beggar Tick but Thornapples were also found in low densities. Nearly 70% of the areas surveyed showed no weed invasion; those with some introduced flora present were often in low-lying Mulga woodland adjacent to drainage lines. The rail corridor was shown to contain six introduced species, all at low densities, and 77% of all surveyed sites were found to be weed-free. Weed management practices will be incorporated into the EMP, to be effected at the commencement of construction activities.

Issues concerning the impacts of the railway are considered important. BHP intends to monitor the rail route for environmental and structural purposes. This will determine whether drainage diversion from the rail formation, cuttings and culverts is affecting vegetation. Any

adverse environmental impacts will be included in reports which will be used to upgrade maintenance practices in the EMP.

Assessment

The areas considered for the assessment of the environmental significance of this component are those surrounding the orebodies, sites for waste rock, residue storage and stockpiles, access corridors for roads, railway and the power line, the process plant and the accommodation village.

The EPA objective for this factor is to maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.

Several hundred hectares of vegetation will need to be cleared to allow the first stage of this proposal, and the total to be cleared for the entire project (ie. inclusive of the other twelve deposits) is of the order of 5000ha. The two Priority Three flora populations likely to be affected by the mining are species which are known from other populations in the region; at least three locations for *Triumphetta leptacantha* and at least five for *Triumphetta maconochieana* ms. The landform in which both species occur is widespread in the region and is known to support other populations of these species. The other known populations of Priority Flora will not be affected by the project.

An area of 210ha will be directly alienated by the railway and 60m wide formation. No Declared Rare Flora or Priority Species were found along the proposed route. However, careful attention will need to be given to monitoring any secondary impacts arising from drainage shadow effects.

BHP has proposed the following measures to mitigate the effects of clearing and land disturbance :

- all areas greater than one hectare will require the preparation of a plan before clearing is allowed and all contracts will include a condition forbidding unauthorised clearing;
- removed topsoil and vegetation will be stockpiled for later use in rehabilitation, pits will be partly infilled with overburden, and cleared areas and stockpiles will be rehabilitated progressively;
- so as to reduce the potential for erosion, exposed faces on overburden storage areas will be laid back to an angle of 20^{o} or less prior to their revegetation.

One of the fundamental principles of the life-of-project EMP is that agreed measures will be reviewed and revised in the light of results received from monitoring. Thus over the project's life, which is expected to span some decades, the mining and rehabilitation plan will be updated to reflect the knowledge of the day. The EMP is further discussed below in "Cumulative Impacts".

Taking into account the above measures for mitigation of the effects of clearing on loss of vegetation, the regional extent of similar vegetation and the presence of secure populations of the Priority 3 flora, the EPA is of the opinion that its objective for this factor could be met.

3.2.1.2 Surface water quantity and quality

Surface water quantity and quality are considered to be relevant factors in regard to clearing and land disturbance because of the extent of bare surfaces created for dumps, the effect that the clearing of vegetation can have on surface runoff patterns and the degree to which water

infiltrates after rain events. The creation of pits, access infrastructure and waste dumps will divert surface flows and concentrate water in new areas.

Typically the orebodies in the Northern Flank Valley of Mining Area C cut across several small creek lines with catchments of the order of 0.5-2km^2 and flows can be turbid during flood events. Many of these creeks respond quickly to rainfall and produce short duration flows.

The Northern Flank Valley containing the orebodies is located in the upper reaches of and drains eastward into Weeli Wolli Creek upstream of a major feature known as the Weeli Wolli Spring, located about 25km east of the proposed plant site. Weeli Wolli Spring is believed to be a permanent feature supported mainly by groundwater discharge (discussed in more detail below in "Water Usage").

Weeli Wolli Creek is ephemeral for the most part but eventually discharges into the Fortescue Marsh, some 60km to the north. The total Weeli Wolli Creek catchment above its outfall to the Fortescue Marsh comprises approximately 13% of the Fortescue Marsh catchment area and is calculated to contribute between 5% and 10% of the average annual inflow to the marsh.

A total of 20 route options were appraised for the railway from the project area to BHP's Marillana Creek mining operation. The chosen option was selected to strike a balance between the length of the route and environmental considerations. Drainage crossings are especially important. The rail spur will cross Marillana and Yandicoogina Creeks on bridges which will be up to 300m long and 45m above the creeks. Some lesser drainage crossings will be spanned using culverts. Special attention is required to ensure that drainage patterns are not significantly modified upstream and downstream of the railway formation.

Assessment

Areas for consideration of this factor are all components of the mine and access corridors, surface streams in the immediate environs of the proposed mining areas, plant sites and residue storage area.

The EPA objectives for this factor are:

(1) to maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance, are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA 1993); and

(2) to maintain the quantity of surface water so that existing and potential uses, including ecosystem maintenance, are protected.

Clearing of vegetation will be a precursor to land disturbing activities, such as the creation of pits, waste dumps and stockpiles. Because ground from which the vegetation has been cleared is vulnerable to erosion in the event of rain the practice will be to only clear the minimum area necessary for the purpose and to do the clearing as late as possible prior to the ground disturbing activity. As described above a Plan will be prepared and approved for all proposals to clear areas greater than 1ha. Water in creek lines diverted around pits and other created landforms will still find its way down the valley. The pits will collect water which would otherwise have joined surface drainage but will instead infiltrate the ground profile before also moving in a generally easterly direction toward Weeli Wolli Spring. On the scale of the overall catchment (~1.7% of the western catchment of Weeli Wolli Creek) these changes to surface water flows are not expected to be significant.

As a result of mining, more surface water is likely to infiltrate into pits resulting in less runoff down creeks. This will tend to increase groundwater recharge (see Groundwater section below) but as the area of the Northern Flank catchment reporting to the Weeli Wolli Spring is calculated to be only 7.5% of the total any effects at the spring itself are likely to be minor.

BHP plans to construct and maintain sediment traps on larger watercourses downstream of disturbed areas and stockpiles. Water from major creeks will be diverted around the pits during mining but subsequently, after pit infill, some pre-existing creek lines may be re-instated. Some partially filled pit areas may have the potential to divert surface runoff.

Rehabilitation measures (discussed below) are also expected to improve infiltration of surface water and reduce the amount of sediment transport after rain.

With regard to the other orebodies to be mined after Deposit C and the Brockman Detrital Deposit, BHP has proposed (Commitment 2) to undertake additional surface water surveys to identify potential impacts on surface water resources, flora and fauna.

The EPA recommends that detailed plans for the rail route and the measures proposed to be taken to minimise environmental impacts along it are prepared to the requirements of the EPA prior to commencement of construction of the railway formation.

After consideration of the above measures for mitigation of the effects on surface water quantity and quality and the EPA recommendation above for detailed plans to be prepared prior to construction of the railway the EPA believes that the objectives for these factors can be met.

3.2.1.3 Groundwater quantity and quality

Aspects of this factor are also discussed under "Water Usage" below. Where pits are to be mined below the water table (Deposits C, E and R) dewatering will be required as the water table is approached. Were the pits to be left open to the water table after mining has ceased the pit bottoms would remain permanently flooded, allowing evaporation, loss of some of the groundwater resource and increased salinisation of the groundwater. BHP's intention is to return as much waste material to each pit as possible. The depth of cover above the water table will be at least sufficient to prevent capillary effects from drawing water to the surface of the pit bottoms.

Assessment

The areas under consideration for assessment of this factor are those relating to the three pits to be mined below the water table and the residue storage area for the fines from the beneficiation process for detrital ores.

The EPA objectives for this factor are:

(1) to maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance, are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA 1993); and

(2) to maintain the quantity of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.

There are no hazardous materials to be used in the beneficiation plant. The slurry will therefore not affect the quality of groundwater. As much water as possible will be decanted and recycled from the residue dam and a groundwater monitoring programme for water resources adjacent to the site will be developed to the requirements of the EPA on advice

from DEP and the Water and Rivers Commission. The results will be used to update the EMP and make modifications to management practices if necessary.

There is also some potential for groundwater to be affected by the spillage of contaminants (such as hydrocarbons and ammonium nitrate for blasting) around the mine area and the process plant. The EPA considers that this aspect can be managed by correct handling of materials in areas where pollutants may be spilt and adherence to the section of the EMP dealing with this issue. Groundwater monitoring adjacent to the site has been proposed by BHP (Commitment 4) and will be designed and managed to DEP Licence and Water and Rivers Commission requirements.

After consideration of the above measures for mitigation of the effects of ground disturbances the EPA believes that the objectives for this factor can be met.

3.2.1.4 Aboriginal culture and heritage

BHP has undertaken archaeological and ethnographic surveys of the areas to be affected by this proposal, as required to comply with the Aboriginal Heritage Act. This work has been done in a number of stages and to date BHP has successfully consulted recognised Banjima and Nyiyarparli custodians and gained support for all the currently proposed Section 16 and Section 18 site disturbances under the Aboriginal Heritage Act 1972-80. Further surveys will be carried out on the other twelve known deposits; the results will be incorporated into the EMP and the mining proposals for these areas at the appropriate time ie. during the planning stages prior to development for mining of these deposits.

Fifteen aboriginal sites are potentially affected by the proposal; five are in the infrastructure corridor and ten relate to C Deposit. Of these ten in the area of C Deposit, nine are stone arrangements, the other is an ethnographic site. The five other sites in the infrastructure corridor are a mixture of artefact scatters, rock shelters and engravings.

BHP has commenced a management programme for aboriginal sites. This includes flagging, fencing and/or signposting of sites for their protection or avoidance. BHP will carry out periodic inspections to ensure compliance with the Aboriginal Heritage Act.

Assessment

The areas under consideration for assessment of this factor are parts of the minesite and rail corridor where aboriginal sites are in proximity to proposed areas of ground disturbance.

The EPA's objectives for this factor are to ensure that the proposal complies with the requirements of the Aboriginal Heritage Act 1972-80; and to ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.

Where practicable, disturbance to aboriginal sites will be avoided. Where this is not possible BHP has committed to comply with provisions in the Aboriginal Heritage Act to seek approval for this disturbance to occur. Where approval to disturb sites is not given BHP will engineer mine landforms to avoid the sites. In order to protect sites close to proposed developments BHP, in conjunction with aboriginal heritage custodians and Native Title claimants, has commenced an Aboriginal Site Management Programme. In addition to marking all sites for protection and avoidance this programme will require all employees and contractors to take an induction course to make them aware of their responsibilities under the legislation. The EPA believes that this induction course should be taken by personnel prior to starting work on site.

To enable them to monitor compliance with the requirements of the Aboriginal Heritage Act, BHP will facilitate regular visits and inspections of its operations for aboriginal heritage custodians and Native Title Claimant representatives.

Taking into account the above measures the EPA considers that its objectives for this factor can be met.

3.2.1.5 Rehabilitation, landforms, visual amenity

These factors are closely related to "Vegetation", discussed above, because rehabilitation will focus on landforms which have been previously cleared and mined or developed.

Mining Area C lies on the Hamersley Plateau which is characterised by rugged hills and long strike ridges rising to over 300m above the surrounding valleys and plains. The Northern Flank contains gorges and ridges typical of the region. The Northern Flank Valley is a gently undulating outwash plain drained to the east by the Weeli Wolli Creek. It is flanked by the Packsaddle Range to the north comprising Brockman Iron Formation rocks and by the Jirrpalpur Range to the south. This is made of Marra Mamba Iron Formation.

Some 25km downstream from the proposed plant site is the major hydrologic and ecological feature known as the Weeli Wolli Spring in the gorge of the same name.

The identified orebodies are mainly located on the flanks of the ranges bordering the Northern Flank Valley, however the Brockman Detrital Deposit is sited in the valley floor north of the main creek. The main valley stream channel is relatively shallow and meandering. Many of its tributaries tend to flow parallel to the main channel before joining it and during flood events these tributaries are likely to overspill and form a relatively wide flood zone.

Assessment

The areas under consideration for assessment of these factors are all those where ground disturbance is proposed.

The EPA objective for Landform and Rehabilitation is to establish sustainable landforms consistent with the surroundings. The EPA's objective for Visual Amenity is for the area adjacent to the project to not be unduly affected by the proposal.

BHP has proposed rehabilitation criteria for all areas where disturbance is proposed. These blend safety, visual criteria, stability and compatibility with surrounding landforms to achieve outcomes for the long term. Aspects of these criteria are discussed above in more detail under Vegetation and are summarised below in Table 5. However, the aim is to minimise the amount of disturbance, set aside all topsoil as a resource for later use, return as much waste material to the pits as possible and rehabilitate progressively. A mixture of local species will be used on areas to be seeded. Monitoring and maintenance of rehabilitated areas will continue until the vegetation is seen to be progressing towards a stable condition, and the mining contractor will be required to agree to a contract clause which states that it will not be released from its obligations until the site has been rehabilitated. As well, weed management practices are a part of the EMP.

Taking into account the above measures for rehabilitation and mitigation of the impacts on landforms and visual amenity and the details in Table 5 below the EPA is of the opinion that its objectives for these factors can be met, provided its recommendation for breaching the rail formation is implemented (Section 3.2.1.6).

Table 5. Summary of proponent's rehabilitation objectives and desired outcomes

SITE ELEMENT	FINAL LANDFORM	FINAL VEGETATION
Overburden storage areas	Flat-topped spurs, 200 scree outslopes stabilised; rounded forms like existing hills	Rehabilitation with native species leading to landform stability. Final goal is scattered eucalypts over spinifex
Open pit	Open pit to DME safety standards, partially or fully filled with overburden	Accessible internal benches and pit floors will be ripped and seeded
Detrital mining areas	Shallow areas recontoured to blend with surroundings. Deep areas partially or fully filled with overburden material	Rehabilitation with native species leading to landform stability. Final goal is scattered eucalypts over spinifex
Process plant	All infrastructure removed	Site ripped and seeded with species consistent with the vegetation type on outwash plains
Road/rail spurs	All infrastructure removed, formation retained. (EPA recommends breaching formation)	Site ripped and seeded with species consistent with the vegetation type on outwash plains
Powerline	All infrastructure removed	Site ripped and seeded with species consistent with the vegetation type on outwash plains
Borefield	All infrastructure removed	Site ripped and seeded with species consistent with the vegetation type on outwash plains

3.2.1.6 Decommissioning

A Mine Closure Plan to meet the requirements of the Department of Minerals and Energy and the EPA will be developed prior to the completion of operations at C Deposit and the Brockman Detrital deposit. This plan will detail such aspects as:

- closure activities, accurate maps showing locations of disposal sites;
- details of ultimate landforms;
- bunding, fencing and signage;
- overburden storage areas; the removal of infrastructure.

An external audit conducted three years before closure will review the level of completeness of the plan.

It is proposed for all disturbed areas at or above the natural ground surface to be rehabilitated. The techniques to be used for rehabilitation will be those accepted as best practice at that time. These will be proposed in the updated EMP, reviewed and approved by the DEP and the Department of Minerals and Energy.

Assessment

The area under consideration for assessment of this factor is around all pits and areas of clearing and ground disturbance, including the process plant site, workshops, access corridors and the village.

The EPA's objective for this factor is to ensure that, as far as practicable, infrastructure has been removed and the site is rehabilitated to a stable landform which us consistent with the surrounding landscape.

For the areas disturbed during construction of the railway formation BHP proposes after construction to rip all compacted areas, spread topsoil, monitor rehabilitation and carry out remedial treatment if necessary. Borrow pits and access tracks would receive similar treatment. For decommissioning BHP proposed to leave the formation intact as it should have achieved a stable landform over several decades.

There is potential, however, once the railway is no longer in use and has ceased to be monitored, that culverts may block and that drainage may become impeded. To prevent this from affecting vegetation in the vicinity which relies on the movement of surface water under the formation through culverts the EPA recommends to the proponent that the formation should be breached at strategic locations. The details of where breaches should be carried out should be part of the EMP at the appropriate time. BHP has agreed to this recommendation.

The EPA considers that, based on the proponent's Commitment 1 (Life of Project EMP) and the EPA's recommendation regarding the breaching of the railway formation, its objective for these factors can be met.

3.2.1.7 Long term management

With several deposits possibly being mined at any time, and over several decades, the potential exists for large areas to be open and under active use. Equally, it is proposed, under BHP's stated policy of minimum land disturbance, to progressively return mined-out areas and other mine components no longer in use to their final landform. The EMP will address the programme for rehabilitation of areas and be updated on at least an annual basis. A fuller discussion of this factor can be found under "Cumulative impacts" below.

3.2.2 Water usage

Description

Depending on the mining rate, water requirements are predicted to reach 9 megalitres (ML) a day. However, during the two year construction phase only 2ML a day is predicted to be used at the minesite, plus 0.6ML a day of potable water at the village. Supply for the proposed village will come from a nearby bore into Wittenoom Formation dolomites at the western end of the Northern Flank Valley. Modelling of the effects from the maximum predicted pumping rate of 0.6ML a day indicates that this is sustainable over the mine life.

The Wittenoom Formation is a basement aquifer unit comprising (sometimes karstic) dolomites and shales lying stratigraphically between the Brockman Iron Formation above and the Marra Mamba Iron Formation. The Wittenoom Dolomite is semi-confined and does not outcrop in the Mining Area C Valley, although it comes closer to surface further east at Weeli Wolli Spring. Drilling at the proposed process water supply borefield intercepted the aquifer unit at a depth of about 80m below surface and 17km further west, at the proposed village borefield supply, at depths around 150m below surface. The fact that the aquifer is generally

at depth and that the overlying Tertiary overburden is of low permeability (letter from BHP dated 16.10.98) means that there is little or no connection between it and water in the near-surface (phreatic) zone of the water table. Vegetation normally draws its water supply from the phreatic and vadose (ie above the phreatic) zones which connect with the ground surface.

Water will be needed for dust control and in the beneficiation plant for the Brockman Detrital Deposit. The borefield for this supply will also be located in Wittenoom Formation dolomites but approximately 8km east of C Deposit. This is 16km from Weeli Wolli Spring and modelling has indicated that pumping from here may begin to impact on water supplies to the spring after about seven years.

3.2.2.1 Vegetation and surface water

As described above there is expected to be little connection between the aquifer from which water is to be drawn and the vegetation at surface. The one exception is potentially at Weeli Wolli Spring where groundwater comes to the surface.

Assessment

The area for assessment of this factor is the Northern Flank, the area of influence from dewatering operations at minesites and the borefields, Weeli Wolli Spring and parts of the creek downstream, and areas adjacent to the railway formation.

The EPA objective for the vegetation factor is to maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities. For surface water the EPA objectives are (1) to maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance, are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA 1993); and (2) to maintain the quantity of surface water so that existing and potential uses, including ecosystem maintenance, are protected.

Water usage at the mine and village is not expected to affect vegetation because, as described above in "Vegetation", water drawn from the aquifer will not affect surface supplies, except potentially at Weeli Wolli Spring where groundwater from the Northern Flank Valley in the mine area comes to the surface.

It will be important for the continued vitality of the spring and downstream areas of vegetation that water flow at Weeli Wolli is not significantly diminished as a result of groundwater extraction, either from the borefield or the pits where dewatering is being undertaken. Measures need to be adopted to ensure that there is an early warning system and that a contingency plan for an alternative supply of water is in place. A discussion of these aspects follows.

3.2.2.2 Groundwater quantity and quality

The overall groundwater catchment which incorporates the Northern Flank Valley covers an area of 1560km^2 with regional flow toward Weeli Wolli Spring. The main regional aquifer in the project area is karstic dolomite of the Wittenoom Formation which lies beneath the Tertiary rock sequence, itself usually a relatively low permeability zone containing significant amounts of clay and silt. The aquifer is therefore relatively confined within much of the Northern Flank Valley stratigraphic rock sequence.

Small portions of deposits C, E and R extend below the water table. Pits with ore below the watertable will need to be dewatered for the latter stages of mining. The water will most likely be used to control dust on access roads and disturbed surfaces.

Hydraulic testing of the C Deposit shows it is bounded by low permeability shales and unmineralised Marra Mamba Iron Formation. The orebody is therefore relatively isolated from the regional groundwater system. Mining of the orebody is not expected to change the groundwater situation significantly because the host Marra Mamba Banded Iron Formation has low permeability. Less is known about the hydrologic characteristics of the other two bodies at this stage but they appear from work to date to be broadly similar to the C Deposit.

Modelling of the groundwater envelope around all three orebodies with portions below the water table has been developed for the case of each entire pit being dewatered simultaneously within a year. For Deposit C modelling has also been undertaken for water abstraction at the same levels to be maintained for a further eleven years (to correspond with the time taken to mine the deposit). This is a more severe test than would be expected to actually occur because each deposit will be mined progressively, making it unnecessary for the entire orebody to be dewatered at one time, and only the deepest parts of the deposits (where pumping will be required) are below the water table. The modelling shows that the measurable radius of drawdown (to 0.1m) in the aquifer is restricted to areas more than 5km away from and to the west of Weeli Wolli Spring.

Weeli Wolli Spring forms the surface water and groundwater outlet from the southern half of the Weeli Wolli Creek catchment. The spring is permanent and is supported mainly by groundwater flow. Water is forced to rise to the narrow gap through the Packsaddle Range by the convergence of basement rocks (containing the aquifer) with the land surface. Dense vegetation grows in the gorge as a result of the access to permanent water and the gorge has high conservation values.

BHP has committed to establishing a comprehensive groundwater monitoring programme to assess the potential impacts of the proposed groundwater usage on the Weeli Wolli Spring. This programme will be to the requirements of the DEP and Water and Rivers Commission and will involve biological monitoring at the spring.

If the programme indicates that water abstraction is beginning to cause a statistically significant impact (defined as a statistically significant long term decrease in water level of 0.1 metres or 10% of mean monthly flow) in monitoring bores to be established 100-200m upstream of the point of outflow of Weeli Wolli Spring, BHP (Commitments 4 and 5) proposes to develop an alternative water management strategy. Alternative supplies are therefore being investigated, including the option of transferring water from dewatering operations at BHP's Marillana Creek Mine in a pipeline along the proposed rail route. Another possible source mentioned is Lake Robinson area (Coondewanna Flats).

Groundwater chemistry has been tested in several boreholes in the vicinity of the orebodies. The water is generally fresh but hard, with concentrations of total dissolved solids increasing toward Weeli Wolli Spring.

Beneficiation of the detrital ores uses no hazardous additives (ferrosilicate flocculant is used) in the wash water, therefore the slurry discharge to the residue storage area is expected to have little impact on groundwater quality. BHP's EMP includes provisions for sampling of discharged waters and a monitoring network will be established to sample water resources adjacent to the processing site. Specific conditions of the DEP's Pollution Prevention Licence will address these matters as well as requiring attention to the handling and storage of fuels and any waste materials with the potential to pollute groundwater.

Assessment

The areas considered for the assessment of the significance of this component cover the mining areas and the Weeli Wolli Creek system downstream of the mining areas, including the Weeli Wolli Spring itself as well as downstream parts of the creek and riparian vegetation subject to surface flows from the spring, which may be adversely affected if the volume of water at the spring diminishes.

The EPA objectives for this factor are:

(1) to maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance, are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA 1993); and

(2) to maintain the quantity and quality of surface water so that existing and potential uses, including ecosystem maintenance, are protected.

Modelling has predicted that after about seven years output at Weeli Wolli Spring is likely to be affected. Therefore an alternative source(s) of water must be found before that time. BHP has committed to develop an alternative water management strategy if its monitoring programme indicates that there is a statistically significant impact (defined as a statistically significant long term decrease in water level of 0.1m or 10% of mean monthly flow) on Weeli Wolli Spring. If impacts are recorded from the monitoring the volume decrease is likely to be in response to a water usage regime which has been in practice for months or even years. Therefore, even if all bore water withdrawals were to be stopped immediately, there could be a lag period of months to years before the baseline spring water volumes resumed.

So as to ensure that an alternative water supply can be brought in at the earliest possible time before a significant impact has been recorded at Weeli Wolli Spring the EPA considers it important for BHP to have a contingency plan prepared to the satisfaction of the EPA on advice from the DEP and Water and Rivers Commission, prior to startup of mining and to be implemented within five years of commencement of the project or prior to any measurable change, as indicated by the monitoring programme at Weeli Wolli Spring, whichever is sooner. The alternative supply from the dewatering of deposits at BHP's Marillana Creek operation is a possible option. With regard to the option of using Lake Robinson (Coondewanna Flats) as a source of groundwater the EPA notes that BHP would need to clarify the relationship between groundwater and coolibah/mulga communities so as to ensure that the high conservation values of the Coondewanna Flats are not likely to be affected by withdrawals of water from the area. Accordingly the EPA recommends that the timing of BHP's Commitment 5 (Alternative Groundwater Management Strategy) be modified so as to ensure this strategy is approved and in place prior to startup of mining. This recognises that modelling is indicative only and that many factors could contribute to the stated seven years to the time when impacts at Weeli Wolli Spring are expected being less in reality.

Taking into account the proposed monitoring programme, its linkage to specific measures for mitigation of the effects of groundwater usage and the EPA's recommendations above regarding alternative supplies the EPA believes that the objectives for groundwater quality and quantity can be met.

3.2.2.3 Subterranean fauna

Stygofauna are ancient aquatic animals fully adapted to living in complete darkness in groundwater associated with cave systems. They are best known from recently documented occurrences in the Cape Range Peninsula, based mostly on limited sampling of caves and

drillholes. More recently stygofauna have been identified in calcrete aquifers at Millstream and in the Fortescue River near Newman.

Five species are declared as Specially Protected (Threatened) fauna under the Wildlife Conservation Act 1950. Fauna thus classified cannot be taken without authorisation. To date BHP has not sampled for stygofauna because there are no plans to withdraw water from calcrete aquifers in the Northern Flank Valley. The nearest calcrete aquifer has been found 10km east of the Northern Flank boundary near the confluence of the Weeli Wolli Creek and other tributaries from the south feeding into Weeli Wolli Gorge.

Some potential nevertheless is thought to exist for stygofauna to inhabit the karstic dolomite aquifer from which the project intends to draw water, as conditions may be similar to the cavernous limestones and calcretes elsewhere in which these fauna have now been identified.

Assessment

The areas under consideration for the assessment of this factor are those portions of the Wittenoom Formation aquifer system likely to be drawn down by BHP's proposed water extraction.

The EPA objective for this factor is to maintain the abundance, species diversity and geographical distribution of subterranean fauna.

Discussions have been held with Dr Humphreys at the WA Museum to establish a protocol for the maintenance of stygofauna abundance and diversity. Following these discussions BHP has agreed to collaborate with the Museum and has undertaken (Commitment 7) to:

(1) assist with sampling and identification of stygofauna;

(2) assess the conservation significance of any species found;

(3) undertake sampling in the Mining Area C region if species distribution is found to be a significant conservation issue; and

(4) map the local distribution of species sampled.

These commitments are consistent with the approach taken by BHP at its Orebody 23 Project which was assessed by the EPA in April 1998 (EPA Bulletin 888).

This work, which would be a component of the EMP, would be begun before the commencement of mining and be continued on an ongoing basis as deposits are scheduled for mining. Given that mining in the area is expected to continue for 50 years or more the EPA considers that mine planning during the life of the project should recognise additional information on the existence and speciation of stygofauna on and in the vicinity of the project lease area as this becomes available, and take this information into account to ensure the EPA's objectives for stygofauna are met.

Taking into consideration the above measures and the proponent's commitments the EPA considers that the objective of this factor can be met.

3.2.2.4 Long term management

Increasing usage of a sporadically recharged groundwater resource will need to take into account the effects of other users in the area. The EPA regards water usage as a key issue and considers that a Regional Water Management Plan is needed. The broader question of long term and cumulative water usage is one which requires additional attention and is dealt with in more detail under Section 3.2.3 "Cumulative Impacts".

3. 2. 3 Cumulative impacts

Description

BHP has outlined sufficient ore reserves to support mining for several decades. Detailed studies have not been done on all the known deposits, and new reserves may be found in addition to those so far delineated. Other mines may also be developed outside of BHP's leases, leading to increased demand for infrastructure and resources such as groundwater.

All of the environmental factors listed in Table 4 are potentially relevant for this component. The impacts on vegetation have been discussed above in 3.2.1.1 under "Land clearing and disturbance" where it was noted that the 14 deposits will require the clearing of approximately 5000ha.

The impacts on surface water are likewise considered to be manageable under careful and progressive clearing, water management and rehabilitation measures, discussed above in Sections 3.2.1.2 and 3.2.1.5 (Rehabilitation, landforms and visual amenity).

Aboriginal culture and heritage may be affected if new sites are discovered but at this stage little is known about the features of the other 12 deposits. The purpose of the environmental management plan (see 3.2.3.2 below) will be to document new work on these areas sufficiently prior to mining so that data can be reviewed by the EPA and appropriate actions can be effected.

The main cumulative impacts are therefore considered to be:

- the long term use of groundwater and the potential for cumulative impacts arising from the depletion of supplies to occur as other users progressively tap into the same resource; (groundwater supply potentially may affect stygofauna- this factor will be addressed by implementation of the stygofauna mapping and sampling programme discussed above in Section 3.2.2.3); and
- long term management of the mining programme and in particular as-yet-unforseen issues which may arise during the course of development for the mining of deposits other than C and Brockman Detrital.

3.2.3.1 Groundwater

The EPA notes that substantial other undeveloped iron ore deposits exist at Hope Downs, between Mining Area C and Weeli Wolli Spring, and that water requirements for these projects could also potentially affect the aquifer system feeding the spring. BHP's modelling (discussed above in "Water usage") did not include data on possible impacts from other developments such as at Hope Downs as the company does not hold that tenement. Other developments further southeast at Giles Mini and Orebody 24 are also likely.

Assessment

The area considered for assessment of this factor is the area within the influence of dewatering.

The EPA objectives for this factor are, in the long term:

(1) to maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance, are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA 1993); and

(2) to maintain the quantity and quality of surface water so that existing and potential uses, including ecosystem maintenance, are protected.

The EPA considers that an integrated Regional Water Management Plan is needed to address the potential impacts of reduced availability of water to Weeli Wolli Spring, associated vegetation and habitats, from several separate users over a long timeframe. Rather than proponents acquiring data in isolation from other users the EPA would prefer to encourage cooperative initiatives between users and involved agencies (such as the DEP, Department of Resources Development and Water and Rivers Commission) to determine what might be the cumulative effects of increased groundwater usage and to develop a strategic regional groundwater plan for the future. The Central Pilbara Mineral Province Study being coordinated by the Department of Resources Development may be an appropriate vehicle for such studies.

3.2.3.2 Long term management

Mining and environmental management practices are expected to evolve over the long period during which this project will be active. BHP has produced the first of a series of plans which can accommodate such future modifications, known as the life-of-project environmental management plan (EMP).

Although the characteristics of the other twelve deposits may be broadly similar to Deposit C and the Brockman Detrital Deposit there may be cases where a specific issue needs comment from the broader community. Where this happens the EPA will require BHP to prepare and submit for assessment a document which will be available to the public, which incorporates any additional data determined by the EPA to be necessary to address the issue.

Assessment

The EPA's objective for this factor is to ensure that a process is established which enables the assessment and approval of further mining of identified deposits in the Northern Flank Area, including public input, as required.

BHP's EMP is designed to address this situation. It will be periodically updated and submitted to the EPA for review. As orebodies are prepared for mining in the Northern Flank the EMP will be modified to address any site-specific characteristics. The proponent is fully aware of the EPA's requirement that, in certain circumstances, a document may need to be prepared and made available to the public and that further development of some specific areas may require the outcome of a formal assessment under Part IV of the Environmental Protection Act. BHP accepts the above requirements and its Commitments 1, 2, 3 and 5 reflect them.

The EPA is consequently of the opinion that its objective for this factor could be met.

4. Conditions and commitments

Section 44(1) of the Environmental Protection Act 1986 requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and on the

conditions to which it should be subject, if implemented. In addition the EPA may make recommendations as it sees fit.

In developing the recommended conditions for each project, The EPA's preferred course of action is to have the proponent provide an array of commitments to ameliorate the impacts of the proposal on the environment. The commitments are considered by the EPA as part of its assessment of the proposal, and following discussion with the proponent the EPA may seek additional commitments.

The EPA recognises that not all of the commitments are written in a form which makes them readily enforceable, but they do provide a clear statement of the action to be taken as part of the proponent's responsibility for and commitment to continuous improvement in environmental performance. The commitments, modified if necessary to ensure enforceability, then form part of the conditions to which the proposal should be subject if it is to be implemented.

The EPA may, of course, also recommend conditions additional to that relating to the proponent's commitments.

Having considered the proponent's commitments and the information provided in this report, the EPA has developed a set of conditions which the EPA recommends be imposed if the proposal by BHP Iron Ore P/L for a multiple iron ore mine development is approved. These conditions are presented in Appendix 1.

4.1 Proponent's commitments

BHP has made changes to its commitments to reflect discussions with the DEP which have been a part of the assessment process. The proponent's commitments as set out in the PER and subsequently modified, as shown below, should be made enforceable conditions.

Table 6. Summary of proponent's commitments

Commitment	Objective	Action	Timing	Whose Advice	Measurement / Compliance
Commitment 1: Development of a "Life of Project" Environmental Management Plan					
The proponent will prepare, to a timetable agreed with the Department of Environmental Protection, and implement a Life of Project Environmental Management Plan (EMP) for mining operations within the Northern Flank of Mining Area C to the satisfaction of the Environmental Protection Authority on advice from the Department of Environmental Protection and other relevant Government agencies. The EMP will be developed in accordance with statutory conditions applied to the approved operations. The EMP will be reviewed and updated, and will include provision for public review to meet the requirements of the EPA. The EMP will address and the proponent will commit to practice guidelines to manage the following environmental factors to the objectives of the EPA: 1. Surrounding environment 2. Vegetation and topsoil	To manage the environmental impact of the Project.	Develop and implement "Life of Project" Environmental Management Plan.	Preparation of Plan prior to the commencement of mining. Implementation ongoing to a timetable agreed with the DEP	EPA, on advice of DEP, WRC and DME.	"Life of Project Environmental Management Plan developed and compliance reports submitted.

management 3. Overburden storage 4. Surface water 5. Groundwater 6. Flora 7. Fauna 8. Aboriginal heritage 9. Noise 10. Dust 11. Waste and hazardous materials 12. Rehabilitation 13. Decommissioning 14. Contracting, and 15. Continuous improvement.					
Commitment 2: Additional Surveys					
The proponent will undertake additional surveys on areas related to ore deposits other than Deposit C and Brockman Detrital Deposit to assess potential environmental impacts prior to the development of these other deposits in the Northern Flank. Those surveys will include: • vegetation and flora • fauna • surface water resources; and • Aboriginal heritage.	To ensure that potential environmental impacts as a result of the development of further deposits are identified and assessed.	Undertake additional surveys.	Prior to the commencement of the development of deposits other than Deposit C and Brockman Detrital Deposit within the Northern Flank.	EPA, on advice of DEP, CALM, WRC, WA Museum	Additional surveys undertaken.

Commitment	Objective	Action	Timing	Whose Advice	Measurement/ Compliance
Commitment 3: Life of Project Environmental Management Plan Review					
The proponent will review and update the Life of Project Environmental Management Plan for the development of deposits other than Deposit C and Brockman Detrital Deposit in the Northern Flank to reflect site specific characteristics and the results of any additional surveys as detailed in Commitment 1, and implement.	To manage the potential environmental impacts associated with the development of deposits other than Deposit C and Brockman Detrital Deposit in the Northern Flank.	Review and revise the Life of Project Environmental Management Plan and implement.	Prior to the commencement of the development of deposits other than Deposit C and Brockman Detrital Deposit within the Northern Flank.	EPA, on advice of DEP, CALM and DME	Life of Project Environmental Management Plan reviewed and revised as required and compliance reports submitted.
Commitment 4: Groundwater Monitoring					
The proponent will establish a comprehensive groundwater monitoring programme to assess the potential impacts of groundwater abstraction in the Northern Flank valley on Weeli Wolli Spring.	To detect any changes in the groundwater regime which may result in an impact on Weeli Wolli Spring.	An ongoing monitoring programme will be developed and implemented.	Prior to and during groundwater abstraction.	EPA on advice of DEP, WRC and CALM	Groundwater monitoring programme developed and implemented.
Commitment 5 Alternative Groundwater Management Strategies					
If the groundwater monitoring programme indicates that groundwater abstraction will cause a significant impact (which is defined as a statistically significant long term decrease in water level of 0.1 metres or 10% of mean monthly flow at the monitoring bore as agreed by Water and Rivers Commission) on Weeli Wolli Spring, the proponent will implement an alternative water management strategy.	To ensure potential impacts from groundwater abstraction on Weeli Wolli Spring are minimised.	An alternative water management strategy will be developed prior to the start of mining so as to prevent any statistically significant long term decrease in water level as defined.	If groundwater monitoring indicates a potential impact on Weeli Wolli Spring.	EPA on advice of DEP, WRC and CALM	Investigation and development of an alternative water management strategy and implemented when appropriate.
Commitment 6: Pyritic Shales					
The proponent will ensure that any potentially reactive pyritic shales are managed as part of the EMP within overburden storage areas and/or in-pit to prevent acid generation processes occurring.	To ensure that potentially reactive material is managed to prevent the generation of acid rock drainage.	Pyritic material will be stored above the water table in dedicated cells within the overburden storage area and/or in-pit.	During mining.	EPA, on advice of the DEP and DME.	Pyritic materials stored in dedicated cells as previously described.
Commitment 7: Subterranean Fauna					
In collaboration with the Museum of Western Australia, the proponent will assist with the: 1. Identification of stygofauna species to be sampled in the Northern Flank of Mining Area C. 2. Assess the conservation significance of species found. 3. Map the local distribution of species sampled. 4. Undertake sampling in the Mining Area C region if species distribution is found to be a significant conservation issue.	To determine the risk and consequence of any species of stygofauna becoming threatened or extinct as a result of future mining operations.	Design and implement an approved stygofauna assessment program in collaboration with the Museum of Western Australia.	Prior to the commencement of mining.	EPA on advice from the DEP and Museum of WA.	Approved assessment program implemented.

4.2 Recommended conditions

Taking into account the proponent's commitments the EPA has developed a set of conditions which it recommends should be imposed if the mining proposal is approved. These conditions are presented in Appendix 1.

Matters addressed in the recommended conditions include: implementation of the project, including changes to any aspect of the proposal in accordance with the consolidated environmental commitments, and within the requirements of an environmental management system which includes evaluation of environmental performance, review and improvement of environmental outcomes; an alternative water management strategy which requires options for alternative water supplies to be identified and immediately implemented if necessary to safeguard Weeli Wolli Spring; protection of aboriginal sites which is to be achieved by personnel training prior to starting site work; a rail route environmental management plan to identify environmentally and culturally sensitive areas and ways to minimise impacts to them; and a "life-of-project" environmental management plan review which will recognise any new components of the project and provide a vehicle for public review and comment.

5. Other advice

Long term management

The extended and long term nature of iron ore mining in the Central Pilbara including this project, the proposed West Angelas and Hope Downs projects and existing operations in Mt Newman and Marillana Creek areas means that there is considerable potential for cumulative impacts requiring long term management. Attention should be given to the cumulative impacts of projects with an appropriate level of government involvement. The Central Pilbara Mineral Province Study being coordinated by the Department of Resources Development may be an appropriate vehicle for further examination of this issue.

Infrastructure

Other mining proposals in the area (such as Hope Downs) will, if developed, require transport systems for their product. Traditionally each mining company in the Pilbara has developed its own rail network (and other infrastructures) independently of other producers. This could lead to the situation where there is duplication of rail routes to and from essentially the same regions, with associated environmental and cost penalties which perhaps are not warranted.

The EPA wishes to avoid future scenarios where two or more railways are proposed if one, with appropriate connecting spurs, would suffice. This is particularly so where the ground traversed is in some way special, as with national parks, or sensitive environments, as for example mulga woodlands where the trees have been shown to be highly susceptible to changes in surface water flow-drainage regimes caused by ground disturbing railway formations. Accordingly the EPA would like to see a more cooperative approach, to be fostered by government in close liaison with involved companies, which looks strategically at emerging or likely development scenarios and encourages shared infrastructure facilities on a mutual benefits basis. Such a study needs early commitment due to the long lead times of most of these projects.

Groundwater usage

Mines are large users of water. Proposed mine developments may plan to tap the same groundwater supply which could lead to environmental impacts on vegetation and existing surface water features, as well as affect the availability of supplies for other users. Hence a coordinated regional approach to groundwater resources and future usage is needed.

Stygofauna

The assessment of developments in the Pilbara is also hampered by the absence of consolidated information on the regional distributions of subterranean fauna.

Regional flora and fauna

An adequate database for significant vegetation and faunal associations in the region is not available. It is believed that a large number of surveys have been carried out in the region to date but that these are dispersed amongst different mining companies and government agencies. There is a need to initiate a project to consolidate data on flora and fauna for the Pilbara.

The Central Pilbara Mineral Province Study being coordinated by the Department of Resources Development may be an appropriate vehicle to further studies on these matters.

6. Conclusions

The EPA has considered the proposal by BHP Iron Ore Pty Ltd and concluded that it can be managed to meet the EPA's objectives, provided that the conditions in Section 4 and set out in detail in Appendix 1 are imposed.

The EPA considers that the key environmental factors associated with this proposal are groundwater usage and the potential for cumulative impacts over the long term. The EPA considers that the effects of groundwater drawdown on Weeli Wolli Creek and Spring can be managed by the proponent's commitment to establish a comprehensive groundwater monitoring programme to assess the potential impacts on groundwater usage, and the recommended condition requiring the company to prepare and, if necessary, implement an alternative groundwater source. Long term cumulative effects on areas proposed for mining can be managed using the proponent's environmental management plan to update information on these areas and to ensure that new knowledge about environmental effects and rehabilitation is implemented as it becomes relevant to the mining operation.

7. Recommendations

The EPA submits the following recommendations to the Minister for the Environment:

1. That the Minister considers the report on the relevant environmental factors of surface and ground water supplies; dependent vegetation; occurrence and distribution of stygofauna; landforms, visual amenity, rehabilitation and decommissioning of disturbed areas; aboriginal culture and heritage; long term cumulative impacts of mining and water usage and their management , as set out in Section 3.

2. That the Minister notes that this is a long term project and that this report covers an assessment of the detail of the first two areas and more generally a further twelve areas.

3. That the Minister notes that the publicly available documents were both a Public Environmental Review and an Environmental Management Plan covering a whole-of-life project, with special emphasis in the Environmental Management Plan on the first two mining areas.

4. That the Minister notes that for subsequent mining of deposits within the overall area recommended for approval the EPA would require Environmental Management Plans which would be prepared for EPA consideration and be made available for public input to assist the EPA.

5. That the Minister notes that the EPA has concluded that the proposal can be managed in an environmentally acceptable manner, provided that there is satisfactory implementation by the proponent of the recommended conditions set out in Section 4, including the proponent's commitments.

6. That the Minister notes the other advice relating to the need for coordination, with government involvement, on the issues of shared transport infrastructure facilities, groundwater supplies, long term management, and stygofauna, flora and fauna surveys as set out in Section 5.

7. That the Minister imposes the conditions recommended in Appendix 1 of the report.

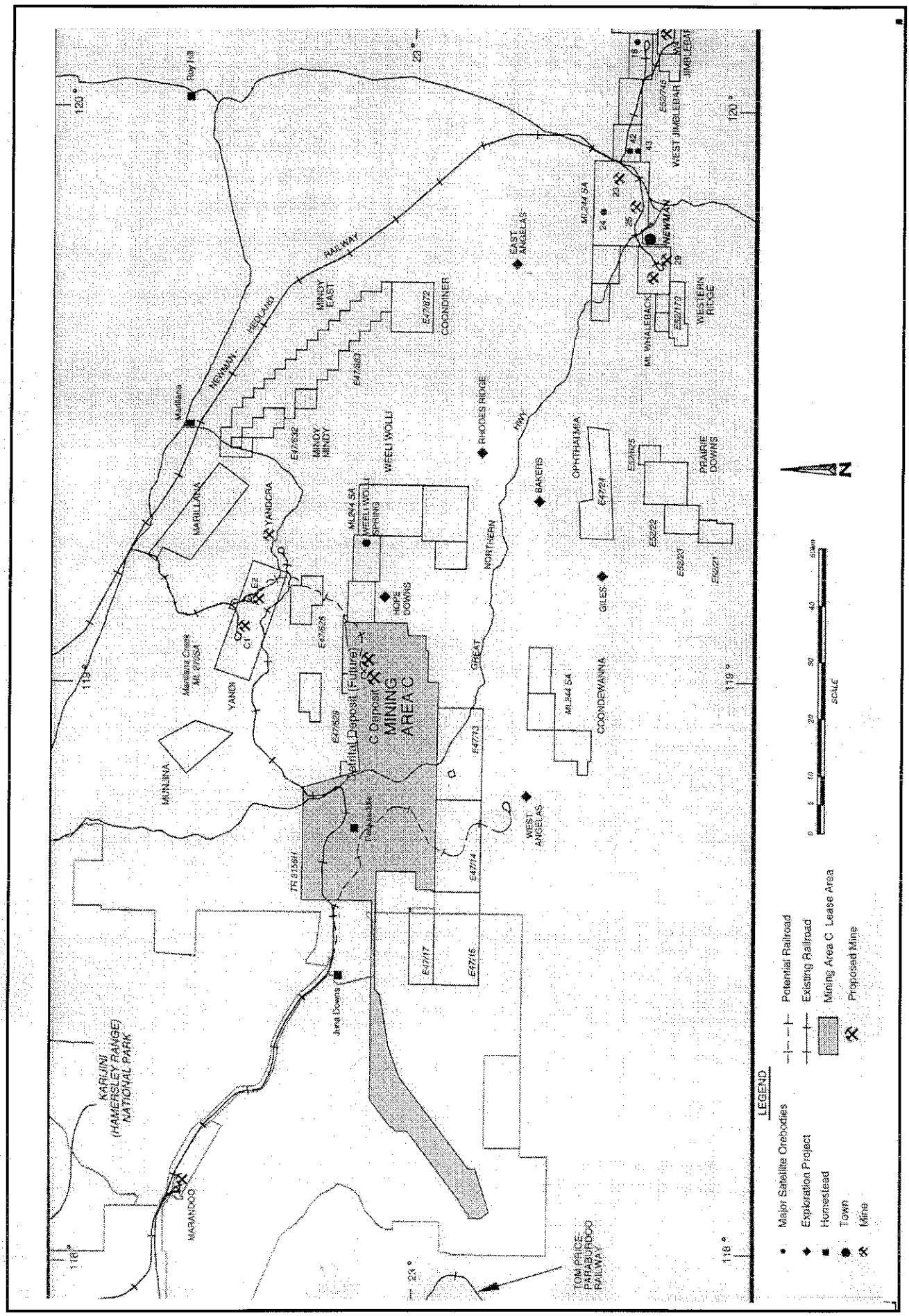


Figure 1. Mining Area C Location Map.

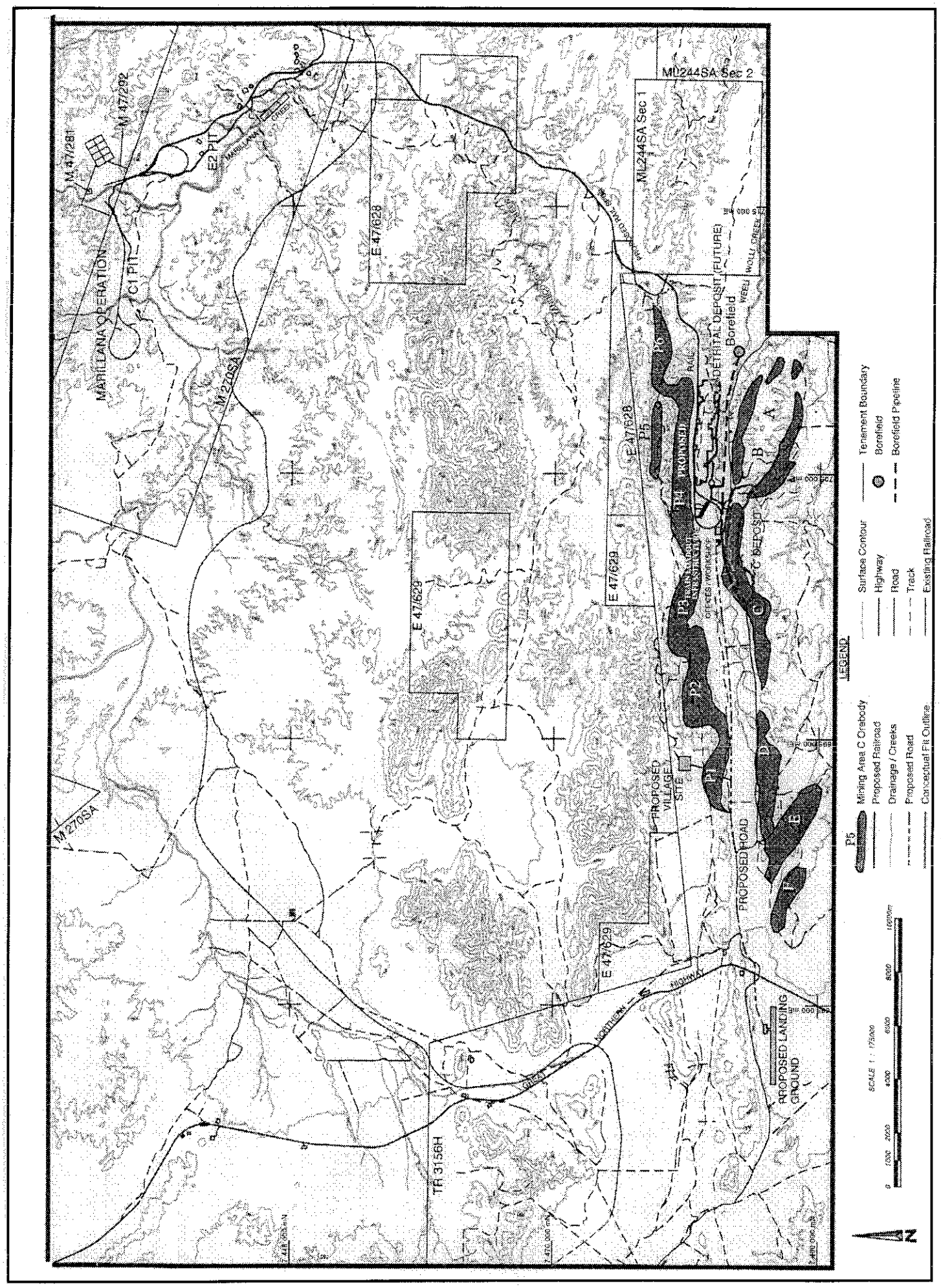


Figure 2. Mining Area C General Arrangement Map.

Appendix 1

Recommended Environmental Conditions and Proponent's Consolidated Commitments

Statement No.

RECOMMENDED CONDITIONS

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

MULTIPLE IRON ORE MINE DEVELOPMENT, MINING AREA C - NORTHERN FLANK, 100 KM NORTH-WEST OF NEWMAN

Proposal: The mining of fourteen deposits (A-F and R, P1-P6 and the Brockman Detrital Deposit) of iron ore in the Northern Flank area of Mining Area C, located in the Hamersley Range in the Pilbara region of Western Australia, including on-site processing, the provision of services, infrastructure and a village and the construction and operation of a rail line, as documented in schedule 1 of this statement.

Proponent: BHP Iron Ore Pty Ltd

Proponent Address: 200 St George's Terrace, Perth WA 6000

Assessment Number: 1108

Report of the Environmental Protection Authority: Bulletin 913

The proposal to which the above report of the Environmental Protection Authority relates may be implemented subject to the following conditions and procedures:

1 Implementation

1-1 Subject to these conditions and procedures, the proponent shall implement the proposal as documented in schedule 1 of this statement.

1-2 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.

1-3 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.

2 Proponent Commitments

2-1 The proponent shall implement the consolidated environmental management commitments documented in schedule 2 of this statement.

2-2 The proponent shall implement subsequent environmental management commitments which the proponent makes as part of the fulfilment of conditions and procedures in this statement.

3 Environmental Management System

3-1 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 ground-disturbing activity for construction purposes, 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 environmental policy and commitment;
2 planning of environmental requirements;
3 implementation and operation of environmental requirements;
4 measurement and evaluation of environmental performance; and
5 review and improvement of environmental outcomes.

3-2 The proponent shall implement the environmental management system referred to in condition 3-1.

4 Training in Aboriginal Sites Protection

4-1 Prior to personnel starting work within the proposal area where significant aboriginal sites exist or may exist, the proponent shall train all such personnel on the recognition and protection of aboriginal sites.

5 Alternative Water Management Strategy

5-1 Prior to the commencement of mining, the proponent shall prepare an Alternative Water Management Strategy as referred to in commitment 5 in schedule 2 to prevent any significant impact caused by groundwater abstraction on Weeli Wolli Spring (as defined in commitment 5), to the requirements of the Environmental Protection Authority on advice of the Department of Environmental Protection, the Water and Rivers Commission and the Department of Conservation and Land Management.

The Alternative Water Management Strategy shall:

1 identify options for alternative water management ;
2 provide measures to ensure that the Alternative Water Management Strategy is implemented immediately in the event that a significant impact on Weeli Wolli Spring as defined in commitment 5 in schedule 2, is observed.

5-2 The proponent shall implement the Alternative Water Management Strategy as referred to in condition 5-1 and commitment 5 as appropriate to achieve the protection of Weeli Wolli Spring.

6 Rail Route Environmental Management Plan

6-1 Prior to commencement of construction of the rail formation, the proponent shall prepare a Rail Route Environmental Management Plan to minimise adverse environmental impacts of the railway and its formation, to the requirements of the Environmental Protection Authority on advice of the Department of Environmental Protection.

This Plan shall include:

1 a report of a detailed vegetation and fauna survey;
2 topographical information;
3 a report on a survey of surface water resources;
4 a visual amenity study;
5 an Aboriginal heritage report;
6 measures to minimise adverse environmental impacts of the railway and its formation, in particular drainage impacts; and
7 provisions for breaching the formation following decommissioning.

6-2 The proponent shall implement the Rail Route Environmental Management Plan required by condition 6-1.

7 Life of Project Environmental Management Plan Reviews

7-1 The proponent shall make the Life of Project Environmental Management Plan Reviews referred to in commitment 3 in schedule 2 available for public review to the requirements of the Environmental Protection Authority on advice of the Department of Environmental Protection.

7-2 The proponent shall incorporate any public comment resulting from the requirements of condition 7-1 into the relevant Life of Project Environmental Management Plan Review, to the requirements of the Environmental Protection Authority.

8 Performance Review

8-1 Each six years following the commencement of construction, the proponent shall submit a Performance Review to the Department of Environmental Protection:

- to document the outcomes, beneficial or otherwise;
- to review the success of goals, objectives and targets; and
- to evaluate the environmental performance over the six years;

relevant to the following:

1 environmental objectives reported on in Environmental Protection Authority Bulletin **913;**
2 proponent's consolidated environmental management commitments documented in schedule 2 of this statement and those arising from the fulfilment of conditions and procedures in this statement;
3 environmental management system environmental management targets;
4 environmental management programs and plans; and/or
5 environmental performance indicators;

to the requirements of the Environmental Protection Authority on advice of the Department of Environmental Protection.

Note: The Environmental Protection Authority may recommend changes and actions to the Minister for the Environment following consideration of the Performance Review.

8-2 Notwithstanding the requirements of condition 8-1, in the event that the timing requirements of that condition are not compatible with the timing requirements of the triennial reporting required under the Iron Ore (Mount Goldsworthy) Agreement Act 1964, then the timing of the latter shall prevail.

9 Proponent

9-1 The proponent for the time being nominated by the Minister for the Environment under section 38(6) or (7) of the Environmental Protection Act is responsible for the implementation of the proposal until such time as the Minister for the Environment has exercised the Minister's power under section 38(7) of the Act to revoke the nomination of that proponent and nominate another person in respect of the proposal.

9-2 Any request for the exercise of that power of the Minister referred to in condition 9-1 shall be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement proponent to carry out the proposal in accordance with the conditions and procedures set out in the statement.

9-3 The proponent shall notify the Department of Environmental Protection of any change of proponent contact name and address within 30 days of such change.

10 Commencement

10-1 The proponent shall provide evidence to the Minister for the Environment within five years of the date of this statement that the proposal has been substantially commenced.

10-2 Where the proposal has not been substantially commenced within five years of the date of this statement, the approval to implement the proposal as granted in this statement shall lapse and be void. The Minister for the Environment will determine any question as to whether the proposal has been substantially commenced.

10-3 The proponent shall make application to the Minister for the Environment for any extension of approval for the substantial commencement of the proposal beyond five years from the date of this statement at least six months prior to the expiration of the five year period referred to in conditions 10-1 and 10-2.

10-4 Where the proponent demonstrates to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority that the environmental parameters of the proposal have not changed significantly, then the Minister may grant an extension not exceeding five years for the substantial commencement of the proposal.

11 Compliance Auditing

11-1 The proponent shall submit periodic Performance and Compliance Reports, in accordance with an audit program prepared in consultation between the proponent and the Department of Environmental Protection (see note 2 below).

11-2 Unless otherwise specified, the Chief Executive Officer of the Department of Environmental Protection is responsible for assessing compliance with the conditions, procedures and commitments contained in this statement and for issuing formal clearances.

11-3 Where compliance with any condition, procedure or commitment is in dispute, the matter will be determined by the Minister for the Environment.

Notes

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

2 The audit programme referred to in condition 11-1 will take into account the triennial reports required by the Iron Ore (Mount Goldsworthy) Agreement Act 1964.

Schedule 1

The Proposal

The proposal is to mine the Northern Flank of Mining Area C, which is located in the Hamersley Range of the Pilbara region of Western Australia approximately 100 kilometres northwest of Newman in the area shown on Figure 1. Fourteen (14) iron ore deposits have been identified in the Northern Flank area, as shown in Figure 2.

Initially two deposits will be mined, known as the Marra Mamba C Deposit and the Brockman Detrital Deposit, however the proposal encompasses the areas to be affected by the mining of the fourteen deposits identified in the Northern Flank area. The ore will be processed and blended on-site, before being loaded into trains and hauled to Port Hedland.

The proposal includes the provision of services and infrastructure for the mine sites, a village and the construction and operation of a rail spur. The rail spur is shown on Figure 1.

The key characteristics of the proposal are as follows:

Element	Description
Life of project (mine production)	> 50 years (continual operation)
Ore reserves	1,300 Million tonnes approximately in 14 deposits
Ore mining rate	up to 18 million tonnes per annum (for initial two deposits ie "C" Deposit and Brockman Detrital Deposit)
Area of disturbance: • Deposits C and Brockman Detrital • Rail corridor • other infrastructure • life of project	 656ha 210ha 95ha approx. 5000ha
Water requirements	up to 9ML/day
Rail spur length	35km
Width of rail corridor	60m
Permanent workforce	200 people
Construction workforce	500 people

Figures

Figure 1: Mining Area C-location map
Figure 2: Mining Area C-General arrangement map

Schedule 2

Proponent's Consolidated Environmental Management Commitments

4 November 1998

Multiple iron ore mine development, Mining Area C - Northern Flank, 100 km north west of Newman (1108)

BHP IRON ORE PTY LTD

CONSOLIDATED COMMITMENTS

Commitment	Objective	Action	Timing	Whose Advice	Measurement / Compliance
Commitment 1: Development of a "Life of Project" Environmental Management Plan					
The proponent will prepare, to a timetable agreed with the Department of Environmental Protection, and implement a Life of Project Environmental Management Plan (EMP) for mining operations within the Northern Flank of Mining Area C to the satisfaction of the Environmental Protection Authority on advice from the Department of Environmental Protection and other relevant Government agencies. The EMP will be developed in accordance with statutory conditions applied to the approved operations. The EMP will be reviewed and updated, and will include provision for public review to meet the requirements of the EPA. The EMP will address and the proponent will commit to practice guidelines to manage the following environmental factors to the objectives of the EPA: 1. Surrounding environment 2. Vegetation and topsoil management 3. Overburden storage 4. Surface water 5. Groundwater 6. Flora 7. Fauna 8. Aboriginal heritage 9. Noise 10. Dust 11. Waste and hazardous materials 12. Rehabilitation 13. Decommissioning 14. Contracting, and 15. Continuous improvement.	To manage the environmental impact of the Project.	Develop and implement "Life of Project" Environmental Management Plan.	Preparation of Plan prior to the commencement of mining. Implementation ongoing to a timetable agreed with the DEP	EPA, on advice of DEP, WRC and DME.	"Life of Project Environmental Management Plan developed and compliance reports submitted.
Commitment 2: Additional Surveys					
The proponent will undertake additional surveys on areas related to ore deposits other than Deposit C and Brockman Detrital Deposit to assess potential environmental impacts prior to the development of these other deposits in the Northern Flank. Those surveys will include: • vegetation and flora • fauna • surface water resources; and • Aboriginal heritage.	To ensure that potential environmental impacts as a result of the development of further deposits are identified and assessed.	Undertake additional surveys.	Prior to the commencement of the development of deposits other than Deposit C and Brockman Detrital Deposit within the Northern Flank.	DEP, on advice of CALM, WRC, WA Museum	Additional surveys undertaken.

Commitment	Objective	Action	Timing	Whose Advice	Measurement/ Compliance
Commitment 3: Life of Project Environmental Management Plan Review					
The proponent will review and update the Life of Project Environmental Management Plan for the development of deposits other than Deposit C and Brockman Detrital Deposit in the Northern Flank to reflect site specific characteristics and the results of any additional surveys as detailed in Commitment 1, and implement.	To manage the potential environmental impacts associated with the development of deposits other than Deposit C and Brockman Detrital Deposit in the Northern Flank.	Review and revise the Life of Project Environmental Management Plan and implement.	Prior to the commencement of the development of deposits other than Deposit C and Brockman Detrital Deposit within the Northern Flank.	EPA, on advice of DEP, CALM and DME	Life of Project Environmental Management Plan reviewed and revised as required and compliance reports submitted.
Commitment 4: Groundwater Monitoring					
The proponent will establish a comprehensive groundwater monitoring programme to assess the potential impacts of groundwater abstraction in the Northern Flank valley on Weeli Wolli Spring.	To detect any changes in the groundwater regime which may result in an impact on Weeli Wolli Spring.	An ongoing monitoring programme will be developed and implemented.	Prior to and during groundwater abstraction.	DEP on advice of WRC and CALM	Groundwater monitoring programme developed and implemented.
Commitment 5 Alternative Groundwater Management Strategies					
If the groundwater monitoring programme indicates that groundwater abstraction will cause a significant impact (which is defined as a statistically significant long term decrease in water level of 0.1 metres or 10% of mean monthly flow at the monitoring bore as agreed by Water and Rivers Commission) on Weeli Wolli Spring, the proponent will implement an alternative water management strategy.	To ensure potential impacts from groundwater abstraction on Weeli Wolli Spring are minimised.	An alternative water management strategy will be developed prior to the start of mining so as to prevent any statistically significant long term decrease in water level as defined.	If groundwater monitoring indicates a potential impact on Weeli Wolli Spring.	DEP on advice of WRC and CALM	Investigation and development of an alternative water management strategy and implemented when appropriate.
Commitment 6: Pyritic Shales					
The proponent will ensure that any potentially reactive pyritic shales are managed as part of the EMP within overburden storage areas and/or in-pit to prevent acid generation processes occurring.	To ensure that potentially reactive material is managed to prevent the generation of acid rock drainage.	Pyritic material will be stored above the water table in dedicated cells within the overburden storage area and/or in-pit.	During mining.	DEP, on advice of the DME.	Pyritic materials stored in dedicated cells as previously described.
Commitment 7: Subterranean Fauna					
In collaboration with the Museum of Western Australia, the proponent will assist with the: 1. Identification of stygofauna species to be sampled in the Northern Flank of Mining Area C. 2. Assess the conservation significance of species found. 3. Map the local distribution of species sampled. 4. Undertake sampling in the Mining Area C region if species distribution is found to be a significant conservation issue.	To determine the risk and consequence of any species of stygofauna becoming threatened or extinct as a result of future mining operations.	Design and implement an approved stygofauna assessment program in collaboration with the Museum of Western Australia.	Prior to the commencement of mining.	DEP on advice from the Museum of WA.	Approved assessment program implemented.

Appendix 2

List of Submitters

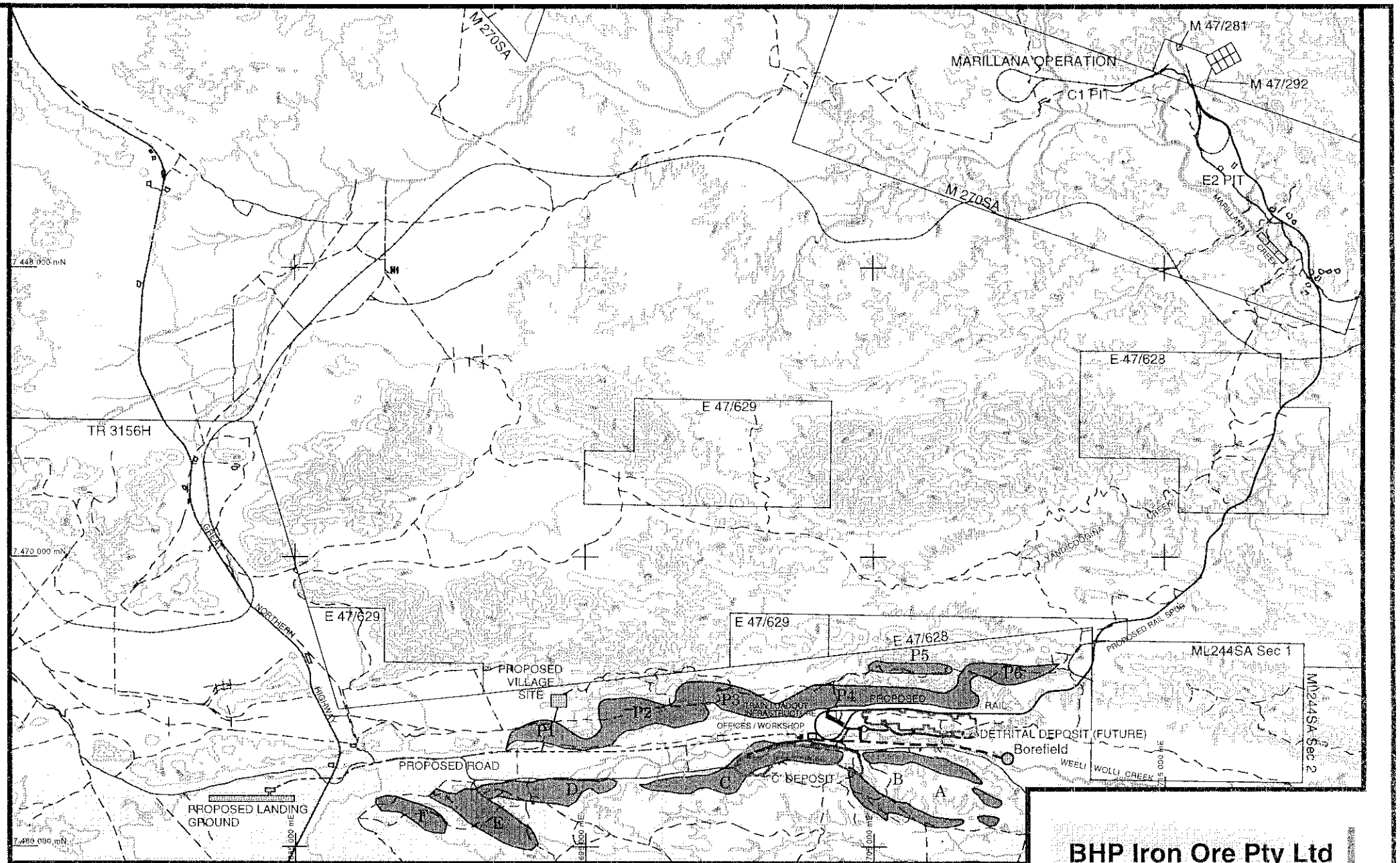
Appendix 3

References

References

BHP Iron Ore Pty Ltd, Multiple Iron Ore Development Project Mining Area C. Public Environmental Review, Woodward Clyde, November 1997

BHP Iron Ore Pty Ltd, Multiple Iron Ore Development Project Mining Area C. Draft Life of Project Environmental Management Plan, BHP Iron Ore Pty Ltd, November 1997



LEGEND

- P5 — Mining Area C Orebody
- Proposed Railroad
- Drainage / Creeks
- Proposed Road
- Conceptual Pit Outline
- Surface Contour
- Highway
- Road
- Track
- Existing Railroad
- Tenement Boundary
- Borefield
- Borefield Pipeline

N

SCALE 1 : 175000

0 1000 2000 4000 6000 8000 10000m

BHP Iron Ore Pty Ltd

MINING AREA C

General Arrangement Map

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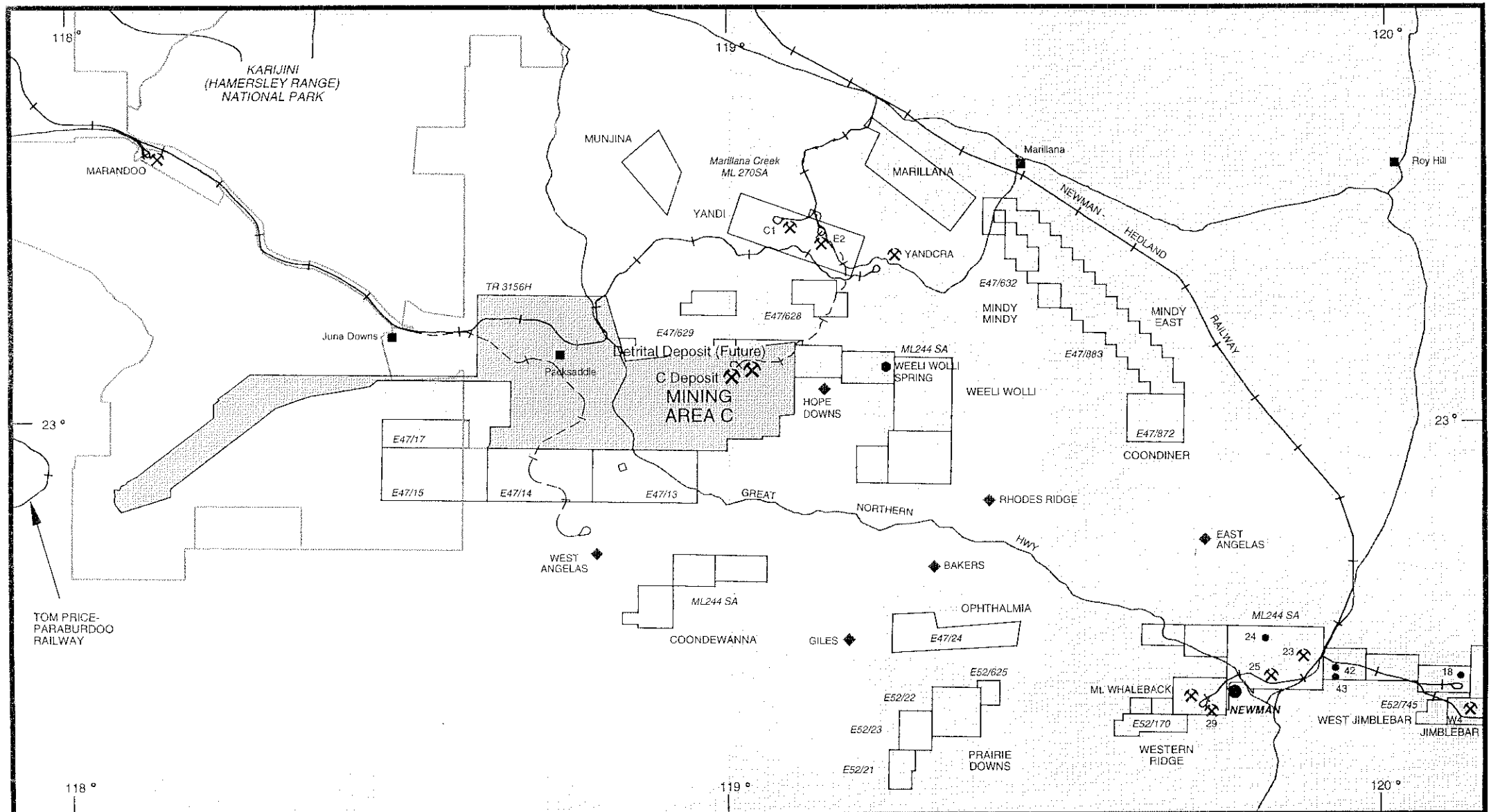

LEGEND

- Major Satellite Orebodies
- Exploration Project
- Homestead
- Town
- Mine
- Potential Railroad
- Existing Railroad
- Mining Area C Lease Area
- Proposed Mine

0 5 10 20 30 40 50km

SCALE

N

BHP Iron Ore Pty Ltd

MINING AREA C
Location Map

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List of Submitters

A member of the public
Aboriginal Affairs Department
Conservation Council of WA
Department of Conservation and Land Management
Department of Minerals and Energy
Department of Resources Development
Museum of WA
Water and Rivers Commission