

# **Hydrogeological Research Programme at Marandoo – Trial Dewatering and Re-injection Test, Karijini National Park**

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**Hamersley Iron Pty Limited**

**Report and Recommendations  
of the Environmental Protection Authority**

**Environmental Protection Authority  
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# 1. Introduction

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment and Heritage on the environmental factors relevant to a proposal by Hamersley Iron Pty Limited to conduct hydrogeological test work on groundwater aquifers at its Marandoo iron ore mine and within the Karijini National Park.

The proponent has submitted a referral document for this proposal setting out the details of the proposal, potential environmental impacts, and giving a number of appropriate commitments to manage the potential environmental impacts that were identified (Hamersley Iron Pty Limited, 2002). The EPA considers that the proposal described can be managed in an acceptable manner subject to these commitments being made legally binding.

The EPA therefore has determined under Section 40 (1) that the level of assessment for the proposal is Assessment on Referral Information, and this report provides the EPA advice and recommendations in accordance with Section 44 (1).

# 2. The proposal

Hamersley Iron Pty Limited wishes to conduct hydrogeological test work on groundwater aquifers at its Marandoo iron ore mine (Figure 1) and within the Karijini National Park. The key components of the proposal are (see Figure 2 for programme layout):

- drilling, construction, and short term (3 day) test pumping of production bores and trial re-injection bores;
- establishing a network of observation bores that intersect key aquifers;
- running a pipeline from the production bores to the re-injection bores;
- establishing a temporary track to the re-injection bores to allow access for vehicles; and
- conducting a short term trial dewatering and re-injection.

The research programme seeks to clarify the extent of connection of the Marra Mamba orebody aquifer with a deep Wittenoom Dolomite aquifer that extends beneath the Karijini National Park and the connection between this Wittenoom Dolomite aquifer and two shallow un-named calcrete aquifers (Figures 3 and 4).

The research programme incorporates a 60-day trial dewatering programme from the Marra Mamba orebody aquifer during which water will be re-injected into the deep Wittenoom Dolomite aquifer. The production bores will be located in the Marandoo Mining Lease while the re-injection bores will be located in the Karijini National Park. A temporary pipeline will supply the water from the production bores to the re-injection bores in the Karijini National Park. Piezometers will be used to monitor responses in groundwater levels during the trial dewatering and re-injection programme.

It should be noted that this proposal involves activities both within the boundary of the Karijini National Park and the boundary of the Marandoo Mining Lease (M272SA, which is not part of the National Park). The Marandoo mine was assessed by the EPA in 1992 (EPA 1992) and environmental approval granted by the Minister for the Environment on 6 October 1992. In its assessment of the Marandoo mine the EPA noted that the proposal was limited to mining above the watertable, and advised the proponent it should investigate, at an early stage, alternative methods of mining if it intended to put forward future proposals for mining below the watertable at Marandoo. This current proposal is consistent with the EPA's advice.

Understanding the connectivity of the Marra Mamba aquifer with and between these aquifers would provide the basis for:

- evaluating the feasibility of dewatering the orebody to access the below-watertable Marandoo ore; and
- predicting the environmental impacts of dewatering on the aquifers and significant vegetation inside the Karijini National Park.

The main characteristics of the proposal are summarised in Table 1 below.

**Table 1. Key Characteristics of the proposal**

<b>Component</b>	<b>Project characteristic</b>	<b>Description</b>
<b>Dewatering bores</b>	Number of new bores	Five
	Location of bores	Marandoo Mining Lease (M272SA)
	Aquifer targeted	Marra Mamba (orebody) aquifer
	Depth of bores	Between 120 metres and 240 metres
	Diameter of bore holes	Approximately 300 millimetres (inside diameter)
	Activities to be undertaken	Drill, construct and short term (3 days) test pumping
<b>Re-injection bores</b>	Number of new bores	Two
	Location of bores	Approximately 1.2 kilometres inside Karijini National Park
	Aquifer targeted	Wittenoom Dolomite
	Depth of bores	Between 130 metres and 150 metres
	Diameter of bore holes	Up to approximately 300 millimetres (inside diameter)
	Activities to be undertaken	Drill, construct and short term (3 days) test pumping
<b>Piezometers</b>	Number of new piezometers	Eight sets of multi-aquifer piezometers (ie some sets will have three separate monitoring holes)
	Location of piezometers	<ul style="list-style-type: none"> <li>• Two sets in Karijini National Park (existing sets will also be used)</li> <li>• Two sets in Transport Corridor</li> <li>• Four sets in Mining Lease (existing sets will also be used)</li> </ul>
	Aquifers targeted	Two shallow calcrete aquifers, deep Wittenoom Dolomite aquifer and Marra Mamba aquifer (where they occur)
	Activities to be undertaken	Monitor water level fluctuations during and after the trial
<b>Temporary pipeline</b>	Length	Total length approximately 5.2 kilometres, of which approximately 3 kilometres is in the Mining Lease, one kilometre in the Transport Corridor and 1.2 kilometres in the Karijini National Park
	Diameter of pipeline	Between 300 millimetres and 400 millimetres
	Type of pipeline	Black poly
	Arrangement	Pipeline will link 3 or 4 production bores to each other and then feed water to the re-injection bores
<b>Trial dewatering and re-injection</b>	Activities to be undertaken	Pumping of water from the Marra Mamba aquifer and re-injection of discharge into Wittenoom Dolomite aquifer. Monitoring of dewatering and re-injection impacts via piezometers.
	Duration of test	60 days
	Volumes to be dewatered/re-injected	Up to 12 million litres per day
<b>Other infrastructure</b>	Track	A temporary track that runs alongside the pipeline will be established to allow access to the piezometers and re-injection bores
	Drill pads	Drill pads will be required at each bore and piezometer site to enable drilling to occur
	Pumps/generators	A generator will be placed next to each production bore to pump water to the re-injection bores
<b>Decommissioning and rehabilitation</b>	Infrastructure to be removed post-trial	Pipeline, vehicular track, down-hole instrumentation and generators/pumps
	Infrastructure to be retained post-trial	Production bores (in Mining Lease), re-injection bores (in Karijini National Park) and piezometers (all)
	Rehabilitation	Disturbed areas (drill pads, track, pipeline) inside the Karijini National Park and Transport Corridor will be rehabilitated in the manner agreed with CALM

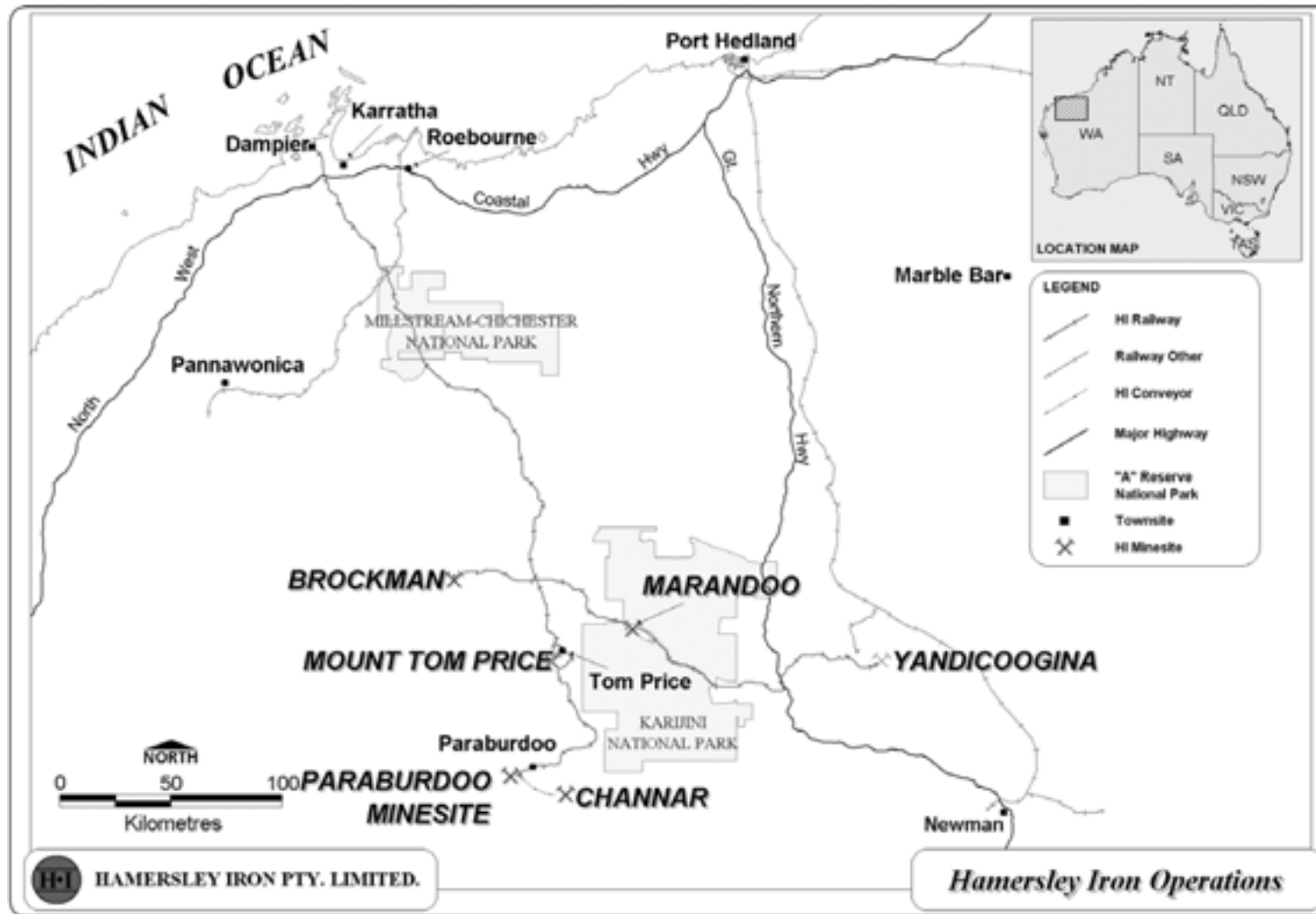


Figure 1: Location Map

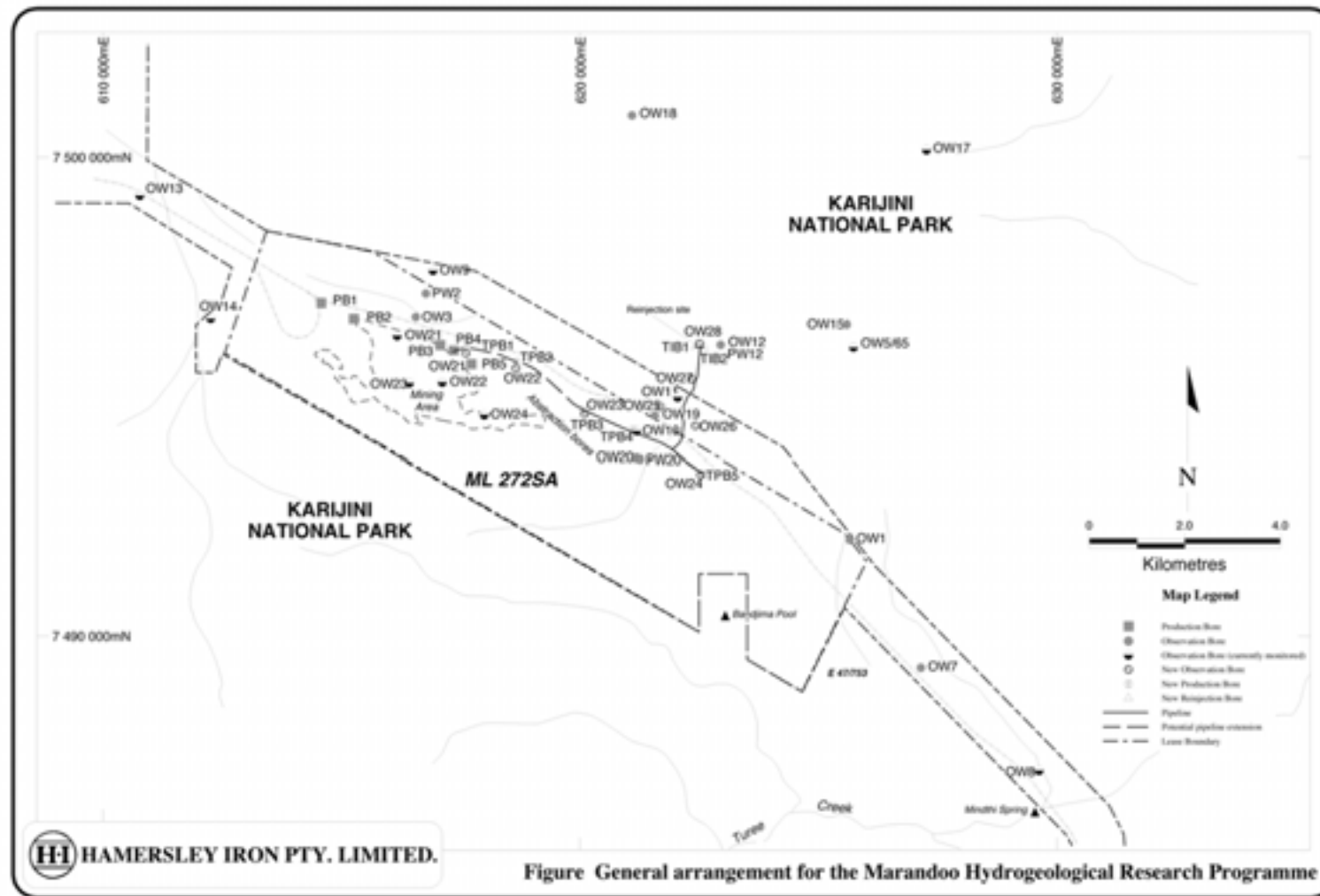


Figure General arrangement for the Marandoo Hydrogeological Research Programme

Figure 2: Programme Layout (Source: Hamersley Iron Pty Limited, 2002)



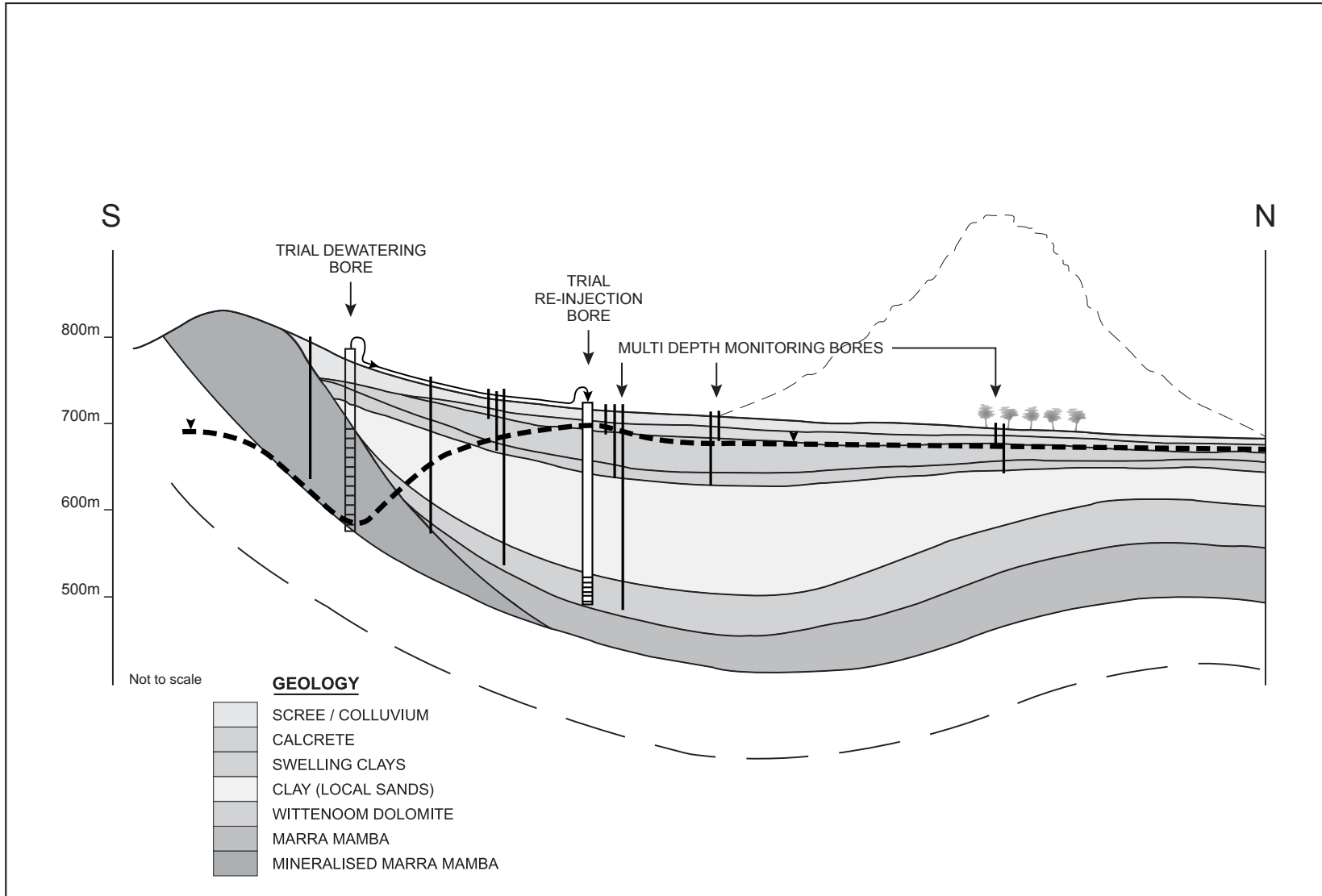


Figure 3: Schematic Diagram of Aquifers and Bores (Source: Hamersley Iron Pty Limited, 2002)

### Simplified Schematic of the Hydrogeological Uncertainties at Marandoo (Aquifer Interconnections)

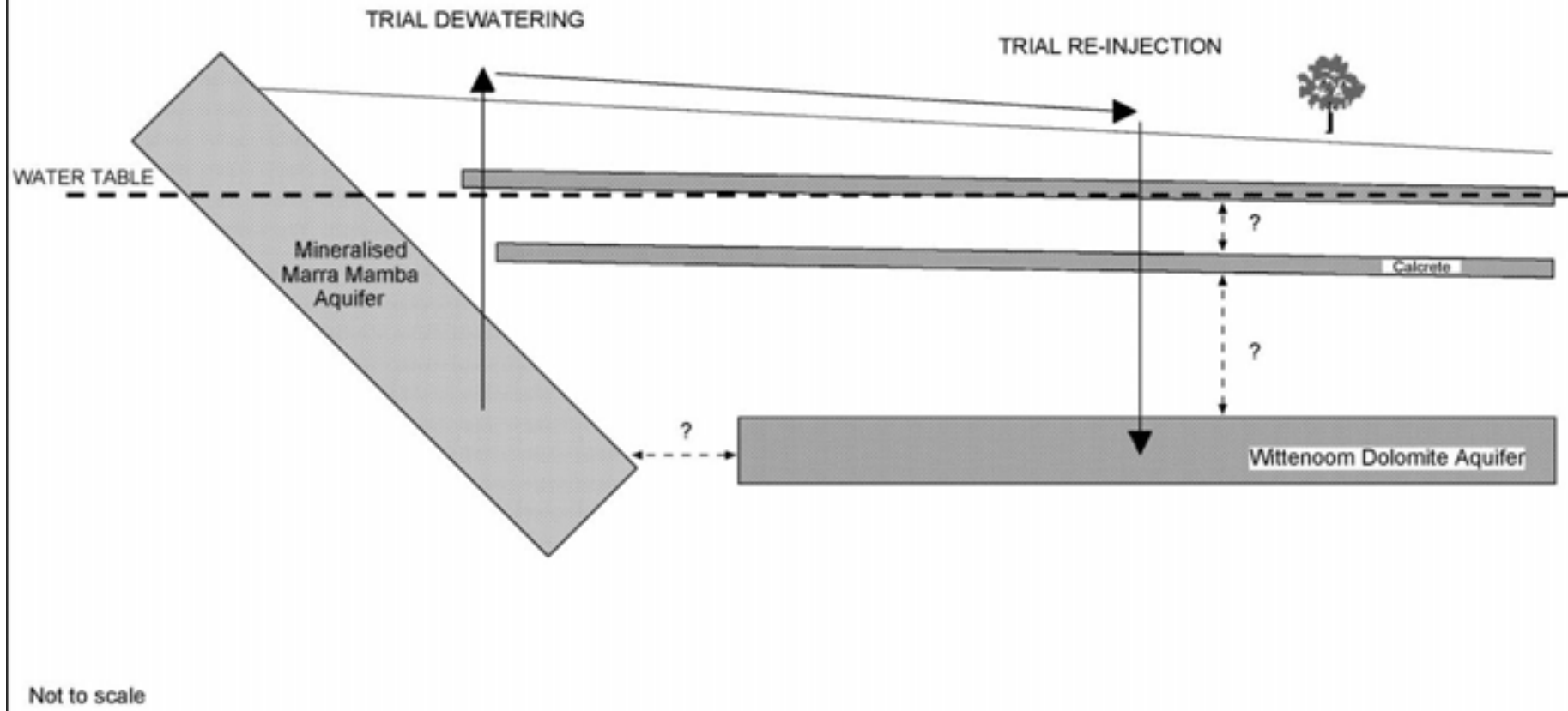


Figure 4: Groundwater Parameters to be Investigated (Source: Hamersley Iron Pty Limited, 2002)

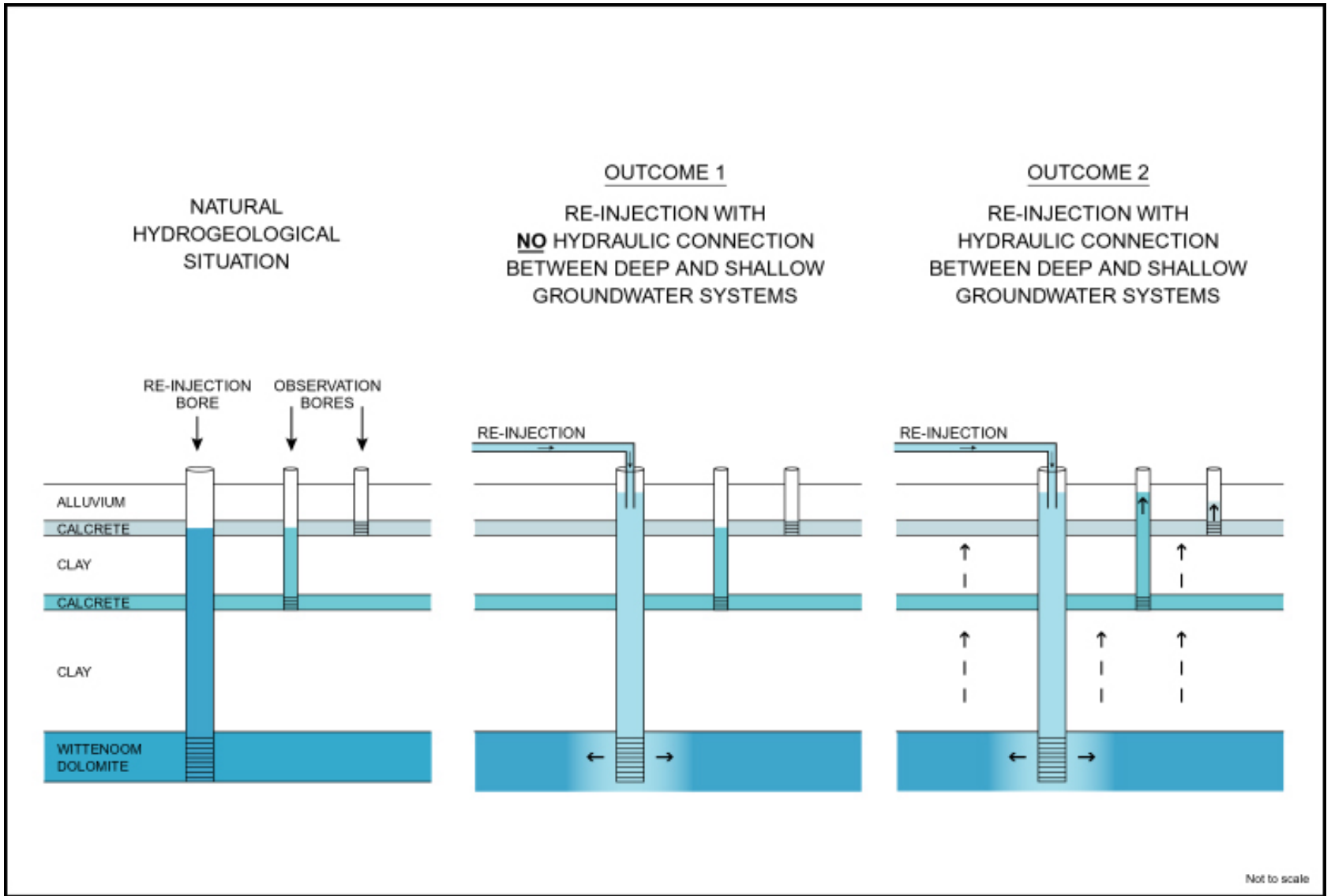


Figure 5: Likely Outcomes of Hydrogeological Test Work

### **3. Relevant environmental factors**

In the EPA's opinion the following environmental factor is relevant to the proposal:

- a) Groundwater – changes to groundwater levels and possible effects on groundwater dependent ecosystems

#### **3.1 Groundwater**

The EPA's environmental objective for this factor is to:

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

Given that this proposal is designed to produce measurable effects on the groundwater system in the vicinity of the Marandoo mine and within the Karijini National Park, there exists some potential for impacts on groundwater dependent ecosystems.

In considering this proposal the EPA sought the advice of the Department of Conservation and Land Management (CALM – as the agency responsible for the management of the National Park) and the Water and Rivers Commission (WRC– as the government agency with expertise in groundwater investigations). CALM advised that it had no objections to the proposal provided its agreement was reached with regional CALM officers regarding the management of issues related to the proponent's access to the National Park. In addition, it advised that the Conservation Commission had considered this proposal and had accepted that the proposal be approved subject to conditions and commitments. The WRC advised that it had carried out an independent review of the proposed trial and concluded that it was unlikely that the re-injection trial would adversely impact aquifers within the Karijini National Park.

The EPA understands that injection of water into the aquifers under the National Park is expected to cause an increase in water pressure within the deeper Wittenoom Dolomite Aquifer and possibly a slight rise in water levels in the shallow aquifers. Likely scenarios are depicted in Figure 5. Also, given that the trial is of short duration (approximately 60 days), these effects are likely to be within the range of natural variation in response to rainfall and so would not adversely affect any groundwater dependent ecosystems.

The proponent has given commitments to carry out its activities in the National Park in close consultation with the CALM, and to conduct audits to ensure that the proposal is implemented as described. An Environmental Management Plan to specifically address issues within the Karijini National Park will be prepared to the requirements of CALM prior to ground disturbance (Commitment 1, Appendix 2). Joint compliance audits will be carried out by CALM and the proponent at various stages during the trial and at its conclusion (Commitment 14, Appendix 2).

### **4. Conclusions**

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

The EPA concludes that the proposal is unlikely to have any adverse impact on groundwater dependent ecosystems in the Karijini National Park, provided it is implemented in accordance with the description provided in the referral document and the environmental commitments made by the proponent. The EPA therefore recommends that these commitments be adopted by the Minister as legally binding environmental conditions under Part IV of the *Environmental Protection Act 1986*.

## **5. Recommendations**

The EPA considers that the proponent has demonstrated, by its commitments, that the proposal can be managed in an environmentally acceptable manner and provides the following recommendations to the Minister for the Environment and Heritage:

1. That the Minister notes that the proposal being assessed is for the Hydrogeological Research Programme at Marandoo – Trial Dewatering and Re-injection Test, Karijini National Park.
2. That the Minister notes that this report follows a decision by the EPA to set a level of assessment as Assessment on Referral Information, because the commitments given by the proponent as part of the referral need to be made legally binding through environmental conditions set in accordance with Part IV of the *Environmental Protection Act 1986*.
3. That the Minister considers the report on the relevant environmental factor as set out in Section 3.1.
4. That the Minister notes that the EPA has concluded the proposal is unlikely to have any adverse impact on groundwater dependent ecosystems in the Karijini National Park, provided there is satisfactory implementation by the proponent of the recommended conditions and proponent commitments as set out in Appendix 2.
5. That the Minister imposes the conditions and procedures recommended in Appendix 2 of this report.

## **Appendix 1**

### **References**

Environmental Protection Authority 1992, *Marandoo Iron Ore Mine and Central Pilbara Railway – Hamersley Iron Pty Limited – Report and recommendations of the Environmental Protection Authority*, Bulletin 643.

Hamersley Iron Pty Limited 2002, *Hydrological Research Programme at Marandoo, Trial Dewatering and Re-injection Test, Referral Document, April 2002.*

## **Appendix 2**

### **Recommended Environmental Conditions and Proponent's Commitments**

## RECOMMENDED CONDITIONS AND PROCEDURES

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

#### HYDROGEOLOGICAL RESEARCH PROGRAMME AT MARANDOO – TRIAL DEWATERING AND RE-INJECTION TEST, KARIJINI NATIONAL PARK

**Proposal:** To undertake a hydrogeological research programme at the Marandoo mine site, as documented in schedule 1 of this statement. Marandoo mine site is 35 kilometres north-east of the town of Tom Price in the Pilbara, and is operated by Hamersley Iron Pty Limited. The Marandoo Mining Lease (M272SA) abuts the Karijini National Park.

**Proponent:** Hamersley Iron Pty Limited

**Proponent Address:** Central Park, 152-158 St George's Terrace  
PERTH WA 6837

**Assessment Number:** 1428

**Report of the Environmental Protection Authority:** Bulletin 1048

The proposal referred to above may be implemented subject to the following conditions and procedures:

#### **Procedural conditions**

##### **1 Implementation and Changes**

- 1-1 The proponent shall implement the proposal as documented in schedule 1 of this statement subject to the conditions 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 and Heritage 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 and Heritage determines, on advice of the Environmental Protection Authority, is not substantial, the proponent may implement those changes upon receipt of written advice.



## **2 Proponent Commitments**

- 2-1 The proponent shall implement the 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 the conditions in this statement.

## **3 Proponent Nomination and Contact Details**

- 3-1 The proponent for the time being nominated by the Minister for the Environment and Heritage under section 38(6) or (7) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal until such time as the Minister for the Environment and Heritage has exercised the Minister's power under section 38(7) of the Act to revoke the nomination of that proponent and nominate another person as the proponent for the proposal.
- 3-2 If the proponent wishes to relinquish the nomination, the proponent shall apply for the transfer of proponent and provide a letter with a copy of this statement endorsed by the proposed replacement proponent that the proposal will be carried out in accordance with this statement. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall also be provided.
- 3-3 The nominated proponent shall notify the Department of Environmental Protection of any change of contact name and address within 60 days of such change.

## **4 Commencement and Time Limit of Approval**

- 4-1 The proponent shall provide evidence to the Minister for the Environment and Heritage within five years of the date of this statement that the proposal has been substantially commenced or the approval granted in this statement shall lapse and be void.

Note: The Minister for the Environment and Heritage will determine any dispute as to whether the proposal has been substantially commenced.

- 4-2 The proponent shall make application for any extension of approval for the substantial commencement of the proposal beyond five years from the date of this statement to the Minister for the Environment and Heritage, on advice of the Environmental Protection Authority, prior to the expiration of the five-year period referred to in condition 4-1.

The application shall demonstrate that:

- the environmental factors of the proposal have not changed significantly;
- new, significant, environmental issues have not arisen; and
- all relevant government authorities have been consulted.

Note: The Minister for the Environment and Heritage may consider the grant of an extension of the time limit of approval not exceeding five years for the substantial commencement of the proposal.

## **Environmental conditions**

### **5 Compliance Audit**

5-1 The proponent shall prepare an audit program in consultation with and submit compliance reports to the Department of Environmental Protection which address:

- the implementation of the proposal as defined in schedule 1 of this statement;
- evidence of compliance with the conditions and commitments; and
- the performance of the environmental management plans and programs.

Note: Under sections 48(1) and 47(2) of the *Environmental Protection Act 1986*, the Chief Executive Officer of the Department of Environmental Protection is empowered to audit the compliance of the proponent with the statement and should directly receive the compliance documentation, including environmental management plans, related to the conditions, procedures and commitments contained in this statement. Usually, the Department of Environmental Protection prepares an audit table which can be utilised by the proponent, if required, to prepare an audit program to ensure that the proposal is implemented as required. The Chief Executive Officer is responsible for the preparation of written advice to the proponent, which is signed off by either the Minister or, under an endorsed condition clearance process, a delegate within the Environmental Protection Authority or the Department of Environmental Protection that the requirements have been met.

## **Procedures**

- 1 Where a condition states "to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority", the Chief Executive Officer of the Department of Environmental Protection will obtain that advice for the preparation of written advice to the proponent.
- 2 The Environmental Protection Authority may seek advice from other agencies, as required, in order to provide its advice to the Chief Executive Officer of the Department of Environmental Protection.

## **Notes**

- 1 The Minister for the Environment and Heritage will determine any dispute between the proponent and the Environmental Protection Authority or the Department of Environmental Protection over the fulfilment of the requirements of the conditions.

# Schedule 1

## 1. The Proposal

The proposal is to undertake a hydrogeological research programme at the Marandoo mine site. Marandoo mine site is 35 kilometres north-east of the town of Tom Price in the Pilbara, and is operated by Hamersley Iron Pty Limited. The Marandoo Mining Lease (M272SA) abuts the Karijini National Park.

The research programme seeks to clarify the extent of connection of the Marra Mamba orebody aquifer with a deep Wittenoom Dolomite aquifer that extends beneath the Karijini National Park and between this Wittenoom Dolomite aquifer with two shallow un-named calcrete aquifers.

Understanding the connectivity of the Marra Mamba aquifer with and between these aquifers will provide the basis for:

- evaluating the feasibility of dewatering the orebody to access the below-watertable Marandoo ore; and
- predicting the environmental impacts of dewatering on the aquifers and significant vegetation inside the Karijini National Park.

The main components of the research programme are:

- Drilling, constructing and short term (3 day) test pumping of production bores and trial re-injection bores;
- Establishing a network of piezometers that intersect key aquifers;
- Running a pipeline from the production bores to the re-injection bores;
- Establishing a temporary track to the re-injection bores to allow access for vehicles; and
- Conducting a short term trial dewatering and re-injection.

The research programme incorporates a 60-day trial dewatering programme from the Marra Mamba orebody aquifer during which water will be re-injected into the deep Wittenoom Dolomite aquifer. The production bores will be located in the Marandoo Mining Lease while the re-injection bores will be located in the Karijini National Park. A temporary pipeline will supply the water from the production bores to the re-injection bores in the Karijini National Park. Piezometers will be used to monitor responses in groundwater levels during the trial dewatering and re-injection programme.

The pipeline, vehicular track, down-hole instrumentation will be removed from the Karijini National Park upon the completion of the trial. The re-injection bores and piezometers inside the Karijini National Park will be retained until such time that Marandoo is decommissioned. All disturbed areas inside the Karijini National Park will be rehabilitated, including areas used for drill pads, pipeline and track.

The trial dewatering and re-injection component of the research programme is scheduled to be completed by end 2002. Drilling is scheduled to commence as soon as all approvals have been obtained.

The Key Proposal Characteristics are shown in Table 1.

**Table 1 - Key Proposal Characteristics**

<b>Component</b>	<b>Project characteristic</b>	<b>Description</b>
<b>Dewatering bores</b>	Number of new bores	Five
	Location of bores	Marandoo Mining Lease (M272SA)
	Aquifer targeted	Marra Mamba (orebody) aquifer
	Depth of bores	Between 120 metres and 240 metres
	Diameter of bore holes	Approximately 300 millimetres (inside diameter)
	Activities to be undertaken	Drill, construct and short term (3 days) test pumping
<b>Re-injection bores</b>	Number of new bores	Two
	Location of bores	Approximately 1.2 kilometres inside Karijini National Park
	Aquifer targeted	Wittenoom Dolomite
	Depth of bores	Between 130 metres and 150 metres
	Diameter of bore holes	Up to approximately 300 millimetres (inside diameter)
	Activities to be undertaken	Drill, construct and short term (3 days) test pumping
<b>Piezometers</b>	Number of new piezometers	Eight sets of multi-aquifer piezometers (ie some sets will have three separate monitoring holes)
	Location of piezometers	<ul style="list-style-type: none"> <li>• Two sets in Karijini National Park (existing sets will also be used)</li> <li>• Two sets in Transport Corridor</li> <li>• Four sets in Mining Lease (existing sets will also be used)</li> </ul>
	Aquifers targeted	Two shallow calcrete aquifers, deep Wittenoom Dolomite aquifer and Marra Mamba aquifer (where they occur)
	Activities to be undertaken	Monitor water level fluctuations during and after the trial
<b>Temporary pipeline</b>	Length	Total length approximately 5.2 kilometres, of which approximately 3 kilometres is in the Mining Lease, one kilometre in the Transport Corridor and 1.2 kilometres in the Karijini National Park
	Diameter of pipeline	Between 300 millimetres and 400 millimetres
	Type of pipeline	Black poly
	Arrangement	Pipeline will link 3 or 4 production bores to each other and then feed water to the re-injection bores
<b>Trial dewatering and re-injection</b>	Activities to be undertaken	Pumping of water from the Marra Mamba aquifer and re-injection of discharge into Wittenoom Dolomite aquifer. Monitoring of dewatering and re-injection impacts via piezometers.
	Duration of test	60 days
	Volumes to be dewatered/re-injected	Up to 12 million litres per day
<b>Other infrastructure</b>	Track	A temporary track that runs alongside the pipeline will be established to allow access to the piezometers and re-injection bores
	Drill pads	Drill pads will be required at each bore and piezometer site to enable drilling to occur
	Pumps/generators	A generator will be placed next to each production bore to pump water to the re-injection bores
<b>Decommissioning and rehabilitation</b>	Infrastructure to be removed post-trial	Pipeline, vehicular track, down-hole instrumentation and generators/pumps
	Infrastructure to be retained post-trial	Production bores (in Mining Lease), re-injection bores (in Karijini National Park) and piezometers (all)
	Rehabilitation	Disturbed areas (drill pads, track, pipeline) inside the Karijini National Park and Transport Corridor will be rehabilitated in the manner agreed with CALM

**Proponent's  
Environmental Management Commitments**

April 2002

Hydrogeological Research Programme at Marandoo –  
Trial Dewatering and Re-injection Test, Karijini  
National Park

Hamersley Iron Pty Limited

## Proponent Commitments - Marandoo hydrogeological research programme

No.	Topic	Action	Objective/s	Timing	Advice from
1.	Environmental Management Plan	<p>Prepare and implement an Environmental Management Plan for the research programme that has been agreed to by CALM that specifically addresses the issues listed below where they relate to the Karijini National Park:</p> <ul style="list-style-type: none"> <li>• Route and general approach for the pipeline/track to the re-injection bores</li> <li>• Approaches to establishing the access track, drill pads and pipeline and surface treatment for the access track to avoid long term damage to soil surface</li> <li>• Surface water management during individual bore test pumping</li> <li>• Vehicle controls</li> <li>• Vehicle hygiene and national park regulations</li> <li>• Hydrocarbon storage and handling during drilling works</li> <li>• Controls to limit the risk of fire</li> <li>• Avoidance of Coolibah trees and habitat</li> <li>• Liaison with CALM Rangers and others within CALM</li> <li>• Rehabilitation requirements</li> <li>• Auditing and reporting</li> </ul>	Manage environmental aspects of the research programme and minimise environmental impacts.	Prior to start of ground disturbance	CALM, WRC
2.	Groundwater Licence	Apply for a Groundwater Licence from the Water and Rivers Commission to abstract groundwater from the Mining Lease. Develop and implement an operating strategy for the management of water.	Obtain required groundwater abstraction licence and implement operating strategy.	Prior to start of ground disturbance	WRC
3.	Surface discharge of water	No surface discharge of water will be permitted to flow into the Karijini National Park during the trial dewatering and re-injection (some discharge from the individual bore test pumping at the re-injection site will occur prior to the commencement of the trial).	Contain surface water flow within the Mining Lease during the trial.	During test pumping.	CALM via EMP review

No.	Topic	Action	Objective/s	Timing	Advice from
		The trial will be terminated if the re-injection fails and cannot be restored requiring more than two days of surface discharge.			
4.	Declared and Priority listed flora	Undertake a survey for Declared Rare Flora and Priority listed flora and forward the findings of that survey to CALM (Karratha). If any DRF is identified, re-position the infrastructure and/or implement appropriate management measures to protect them.	Identify and protect any Rare or Priority listed Flora. Manage any Rare or Priority listed Flora that may be recorded.	Prior to start of ground disturbance	CALM
5.	Vehicle hygiene	Implement a procedure for the compulsory wash down of all vehicles and machinery prior to their first entry into the Karijini National Park as part of vehicle hygiene regime.	Minimise risk of introducing weeds and seeds into Karijini National Park.	All times.	CALM via EMP review
6.	Coolibah woodland access	Prohibit any vehicles from entering the Coolibah woodland, with access to the existing monitoring sites only permitted on foot.	Preclude vehicle access to Coolibah woodlands during trial.	All times.	CALM via EMP review
7.	Hydrocarbon management	Prohibit any fuel from being taken into the Karijini National Park, except for fuel contained in a secured tank on the support truck for re-fuelling the drill rig and fuel held in normal vehicle tanks.	Minimise risk of loss of containment of hydrocarbons and soil/water contamination.	All times.	CALM via EMP review
8.	Aboriginal heritage	Undertake an Aboriginal heritage (ethnographic and archaeological) survey of those areas not previously surveyed in accordance with the proponent's existing protocols and procedures that involve consultation with the relevant Aboriginal group/s. Relocate any infrastructure so as to avoid any identified sites or submit a Section 18 application in full consultation with relevant Aboriginal groups.	Identify any heritage sites.  Avoid or seek approval to disturb any recorded sites.	Prior to start of ground disturbance	Department of Indigenous Affairs.
9.	Peer review of hydrogeological design	Commission a peer (third party) review of the design and approach of the hydrogeological research programme and make available to Government agencies upon request, including the EPA.	Obtain third party view on validity of the design of the trial.	Design phase	External Consultant
10.	Photographic monitoring	Establish photographic records of the area of the trial and make outcomes available to Government agencies upon request.	Obtain photographic record of trial area and make available for scrutiny.	Before, during and after the trial.	-
11.	Stygofauna	Undertake stygofauna sampling at available piezometers and	Understand the distribution of	April 2002, prior to	Western

No.	Topic	Action	Objective/s	Timing	Advice from
		production bores, with particular emphasis on sampling the Wittenoom Dolomite aquifer and shallow calcrete aquifers. Provide collected specimens to the Western Australian Museum and the University of Western Australia and forward a copy of any report to CALM (Karratha).	the stygofauna population.  Share outcomes with the general research community.	the commencement of the trial, after the trial, and in April 2003.	Australian Museum
12.	Removal of infrastructure	Decommission and remove from site the temporary track, down hole equipment, generators and the re-injection pipeline upon completion of the trial.	Remove infrastructure and equipment from Karijini National Park that do not need to be retained.	Within 2 months of the completion of the trial.	CALM
13.	Rehabilitation	Agree with CALM (Karratha) the rehabilitation requirements for disturbed areas in the Karijini National Park toward the end of the trial and then implement that agreed approach.	Rehabilitate disturbed areas within the Karijini National Park.	Implement agreed rehabilitation approach within 2 months of end of the trial	CALM, via EMP review and inspection
14.	Compliance audits	Conduct joint Proponent-CALM (Karratha) compliance audits at agreed stages of the research programme and at times suitable to both parties.	Verify compliance with conditions and commitments and evaluate environmental performance.	During drilling of bores, near end of the trial and post-rehabilitation or as agreed with CALM.	CALM, via EMP review
15.	“Duckboards”	Design, construct and utilise appropriate “duckboards” around the drill rig during drilling activities as a means of reducing soil disturbance.	Minimise soil compaction and soil disturbance.	Design phase and during drilling activities	CALM, via EMP review

### Abbreviations/Glossary

CALM - Department of Conservation and Land Management

WRC - Water and Rivers Commission

EPA - Environmental Protection Authority

EMP - Environmental Management Plan

Duckboards - normally wooden, flat platform that sits above the ground to minimise direct foot contact with the ground