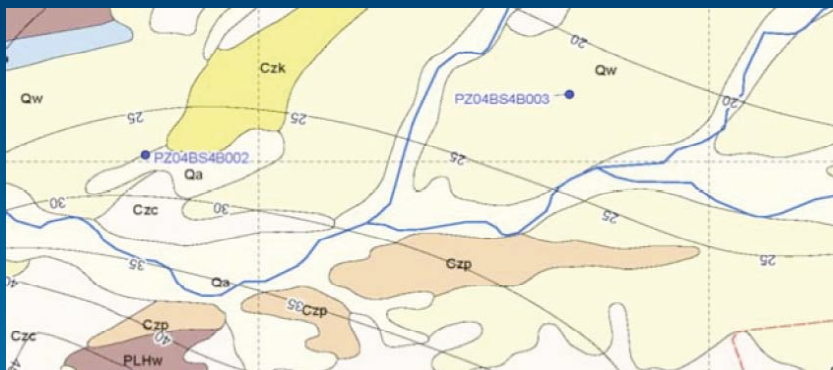


Brockman Syncline 4 Boolgeeda Creek Stygofauna Survey



Prepared for
Pilbara Iron

Prepared by
Biota Environmental Sciences Pty Ltd

May 2007



© Biota Environmental Sciences Pty Ltd 2007
ABN 49 092 687 119
Level 1, 228 Carr Place
Leederville Western Australia 6007
Ph: (08) 9328 1900 Fax: (08) 9328 6138

Project No.: 271

Prepared by: G. Humphreys
J. Adcroft

Checked by: G. Humphreys

Approved for Issue: G. Humphreys

This document has been prepared to the requirements of the client identified on the cover page and no representation is made to any third party. It may be cited for the purposes of scientific research or other fair use, but it may not be reproduced or distributed to any third party by any physical or electronic means without the express permission of the client for whom it was prepared or Biota Environmental Sciences Pty Ltd.

This report is designed for double-sided printing. Copies supplied by Biota are printed on Reflex 'Green' Recycled Paper.

BS4 Boolgeeda Creek Stygofauna Survey

Contents

1.0	Introduction	7
1.1	Project Background	7
1.2	Previous Stygofauna Studies at Brockman Syncline 4	7
1.3	Purpose and Structure of this Document	11
2.0	Methodology	12
2.1	Stygofauna Survey and Analysis Team	12
2.2	Stygofauna Sampling Methods and Data Management	12
2.3	Sampling Design and Effort	12
3.0	Results	16
3.1	Survey Results	16
3.2	Subterranean Fauna Habitats	16
4.0	Discussion and Conclusion	17
5.0	References	18

Appendix 1

Construction Details of New Bores Drilled at Boolgeeda Creek

Tables

Table 1.1:	Boreholes sampled for stygofauna in the BS4 project area (easting and northings given in UTM's, WGS84 datum).	9
Table 1.2:	Structure of this stygofauna survey report in relation to Commitments 5, 6 and 7.	11

Figures

Figure 1.1:	Location of the BS4 project area.	8
Figure 1.2:	Extent of predicted groundwater drawdown in relation to geological formations in the BS4 project area (source: Biota 2005).	10
Figure 2.1:	Location of boreholes sampled for stygofauna in the Boolgeeda Creek locality in the BS4 project area (specifically installed holes shown in green).	13

This page intentionally blank

1.0 Introduction

1.1 Project Background

Pilbara Iron Pty Limited (Pilbara Iron), on behalf of the asset owner and proponent Hamersley Iron Pty Limited, is currently developing the Brockman Syncline 4 Iron Ore Project (BS4 Project) (Hamersley Iron Pty Limited 2005). The BS4 Project is situated approximately 25 km south-west of the existing Pilbara Iron Brockman 2 Mine (B2), and approximately 60 km west-northwest of the town of Tom Price in the Pilbara region of Western Australia. The BS4 project area is shown in Figure 1.1. The major components of the BS4 Project are:

- three mine areas (broadly referred to as the eastern, central and western areas);
- a dry processing plant;
- associated mine infrastructure (waste dumps, low grade stockpiles, haul roads);
- an extension of the existing B2 rail spur to BS4 (approximately 35 km in length); and
- associated infrastructure (a new camp, mine offices, new airstrip, bore fields, power transmission lines, bulk fuel storage, various workshops, waste water treatment plant, ANFO storage facility etc.).

The Western Australian Environmental Protection Authority (EPA) assessed the environmental acceptability of this project at the level of Public Environmental Review (PER). The scope of the BS4 Project is outlined in detail in the PER, as are the potential environmental impacts and the associated environmental management strategies. The EPA subsequently recommended approval of the BS4 Project and recommended conditions for the project (Environmental Protection Authority 2006). The subsequent Ministerial Statement 717 was issued on 24 March 2006. Statement 717 incorporated proponent commitments (Commitments 5, 6 and 7), which identified the requirement for the installation of additional bores for stygofauna sampling at Boolgeeda Creek in addition to sampling of these bores and the preparation of a management plan if stygofauna were impacted by the BS4 project (see Section 1.3).

1.2 Previous Stygofauna Studies at Brockman Syncline 4

Two phases of sampling for stygofauna have previously been completed in the BS4 project area as part of the PER for the project (Biota 2005; Table 1.1). These surveys sampled a total of 27 bores over two field survey phases during 2004 and 2005 (Biota 2005), ensuring adequate spatial spread of collection points across the BS4 project area (see Figure 1.2). This survey effort only recorded a single bathynellid specimen. This animal was collected from bore PZ04BS4B004, which is outside the predicted dewatering impact area for the project (see Figure 1.2). The second phase of sampling in April 2005 did not record any stygofauna from the project area.

These earlier results therefore suggested that there was little in the way of a stygal community of any significance in the BS4 project area (Biota 2005). A review of subterranean habitats generally supported this finding, indicating that most parts of the BS4 area represent unsuitable habitat for stygofauna (Biota 2005). There was, however, an area of drainage line alluvium in the project locality associated with the drainage system in the valley to the north of the BS4 mine area that might represent potential stygofauna habitat. Groundwater modelling indicated that the alluviums associated with this drainage system would be affected by drawdown associated with the project from 5 to 25 m (see Figure 1.2). This area was originally intended to supply water for the project ('the Boolgeeda borefield') and a commitment was made to install bores suitable for sampling stygofauna in the area (see Section 1.3).

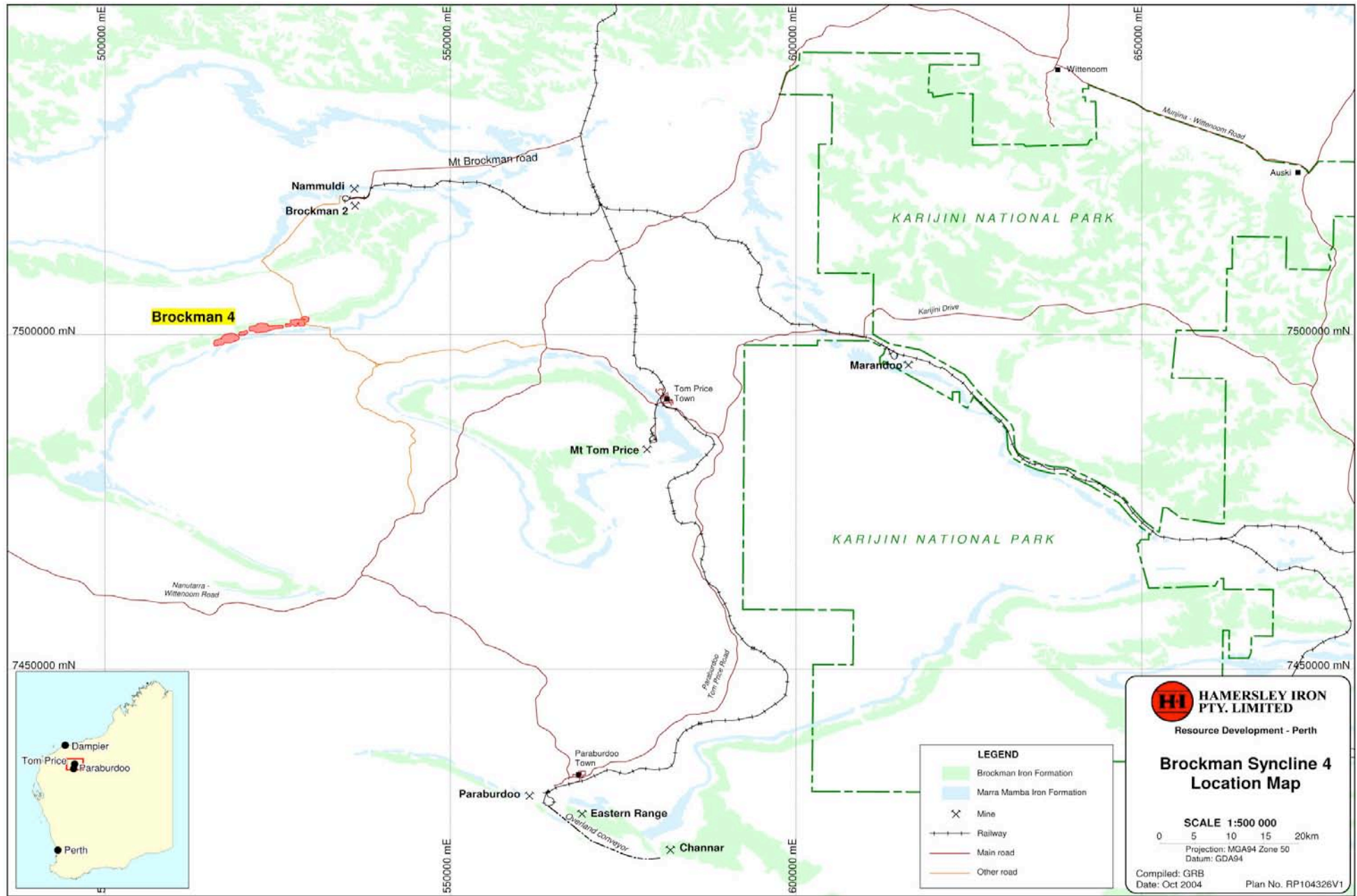


Figure 1.1: Location of the BS4 project area.

Table 1.1: Boreholes sampled for stygofauna in the BS4 project area (easting and northings given in UTM, WGS84 datum).

Bore Name	Easting	Northing	February 05 Sampling	April 05 Sampling
PZ04BS4B002	518748	7505072	3 hauls	3 hauls
PZ04BS4B003	523448	7505775	3 hauls	3 hauls
PZ04BS4B004	528107	7505109	2 hauls	2 hauls
PZ04BS4B005	514471	7497611	1 haul	1 haul
PZ04BS4B006	519307	7498758	1 haul	1 hauls
PZ04BS4B007	524388	7500610	2 hauls	2 hauls
PZ04BS4B009	517601	7502448	1 haul	1 haul
PZ04BS4B010	517750	7501660	2 hauls	2 hauls
PZ04BS4B012	518295	7500852	Contaminated with hydrocarbons *	Not resampled
PZ04BS4B014	517841	7499745	3 hauls	3 hauls
WB04BS4B014	517825	7499742	Inaccessible, lid sealed	Not resampled
PZ04BS4B015	517757	7499925	2 hauls	2 hauls
PZ04BS4B016	522223	7501086	Inaccessible, pvc cap sealed in place	Not resampled
PZ04BS4B017	522129	7501024	2 hauls	2 hauls
WB04BS4B017	522115	7501030	3 hauls	3 hauls
PZ04BS4B018s	518948	7499533	2 hauls	2 hauls
PZ04BS4B018d	518948	7499523	2 hauls	2 hauls
WB04BS4B018	518983	7499509	3 hauls	3 hauls
PZ04BS4B019	518938	7499581	2 hauls	2 hauls
PZ04BS4B020	518972	7499385	2 hauls	2 hauls
PZ04BS4B024	522787	7501252	Blockage @ 90-100m, water table not reached	Not resampled
PZ04BS4B025	515791	7498801	2 hauls	2 hauls
PZ04BS4B026	517364	7499233	1 haul	1 haul
PZ04BS4B027	517922	7499591	3 hauls	3 hauls
PZ04BS4B029	519847	7500213	3 hauls	3 hauls
PZ04BS4B030	521628	7500374	3 hauls	3 hauls
PZ04BS4B031	520275	7499954	2 hauls	2 hauls
PZ04BS4B032	518690	7498731	2 hauls	2 hauls
PZ04BS4B033	522148	7500920	3 hauls	3 hauls
PZ04BS4B034	520268	7499864	3 hauls	3 hauls
PZ04BS4B035	520272	7499912	1 haul; sample aborted due to safety hazard (feral bee swarm)	3 hauls

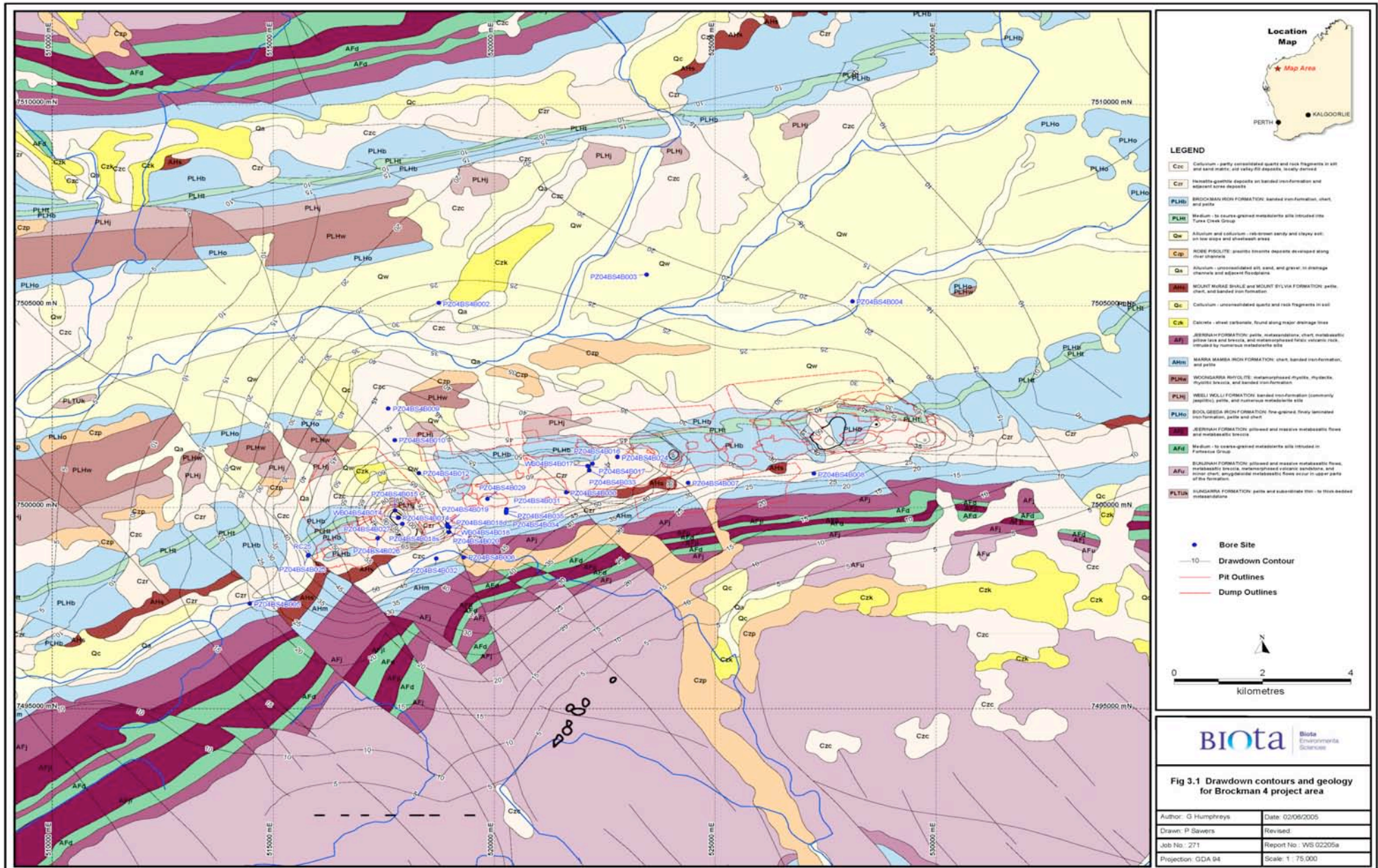


Figure 1.2: Extent of predicted groundwater drawdown in relation to geological formations in the BS4 project area (source: Biota 2005).

1.3 Purpose and Structure of this Document

This document has been prepared to fulfil proponent commitments contained in the BS4 Project Ministerial Statement 717:P5, P6 and P7, which require:

- “5. *Install sampling bores, incorporating slotted casing suitable for stygofauna sampling at alluvial creek systems in the valley north of the BS4 area (i.e. Proposed Boolgeeda borefield).*
6. *In the event that results from sampling of the bores referred to in Commitment 5* indicate that stygofauna will be impacted by the BS4 project, prepare a Subterranean Fauna Management Plan.*
7. *Make the plan prepared in Commitment 6 publicly available.”*

* Commitment 6 in Ministerial Statement 717 incorrectly refers to Commitment 4 (relating to land snails) instead of commitment 5. The correct commitment number reference has been cited above

This report has been prepared to demonstrate fulfilment of proponent commitments 5 to 7 in Ministerial Statement 717.

The sections of this document that address the specifics of these commitments are set out in cross-referenced form in Table 2.1.

Table 1.2: Structure of this stygofauna survey report in relation to Commitments 5, 6 and 7.

Commitment	Scope	Relevant section of this document
5	Install bores suitable for stygofauna sampling in the Boolgeeda Creek area.	2.3.1
6, clause 1	Carry out sampling of bores for stygofauna	4.1
6, clause 2	Review results of sampling to determine if a Subterranean Fauna Management Plan (SFMP) is required.	5.0
7	Make the SFMP publicly available (if SFMP required)	5.0

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

2.0 Methodology

2.1 Stygofauna Survey and Analysis Team

The design of the sampling programme, including site selection for the new bores and construction specifications, was completed jointly by Biota Environmental Sciences, Pilbara Iron. Stygofauna field sampling was undertaken in the Boolgeeda Creek locality, at the BS4 project area by Mr Garth Humphreys and Ms Jane Adcroft of Biota Environmental Sciences.

2.2 Stygofauna Sampling Methods and Data Management

Stygofauna sampling followed the same methodology to that applied to other stygofauna sampling work recently completed in the region, including the work undertaken at BS4 in February and April of 2005. The approach adopted was consistent with that outlined in EPA Guidance Statement Number 54 (EPA 2003).

Stygofauna were sampled from water bores by means of specially modified plankton haul nets. Sampling nets were constructed from 70 µm plankton mesh, with 100 mm aperture attached to a weighted catch jar. Each hole was dragged five times, excepting where excessive turbidity made this impractical. Once the net reached the bottom on the third haul, it was agitated gently to bring the benthos and any fauna present above the net before dragging the water column. On the surface, the net was flushed thoroughly with water bailed from the same hole and the resultant sample placed in a labelled plastic container within a shaded esky. A hygiene protocol was followed at the completion of each hole whereby nets and catch bottles were washed clean to address the risks of any specimens being moved between boreholes.

Site, sampling methods, borehole descriptions were recorded on customised datasheets for later entry into a dedicated Microsoft Access database.

2.3 Sampling Design and Effort

2.3.1 Borehole Site Selection and Installation

Eight additional locations were selected for targeted boreholes to be installed, such that they covered the extent of the area of groundwater drawdown in the Boolgeeda Creek locality. The number, spatial coverage and construction parameters of the new boreholes were discussed and agreed with the Department of Environment and Conservation (DEC) Woodvale Research Centre prior to field installation (Table 2.1). One of these bores could not be completed due to collapsing ground that prevented the casing being inserted, and the survey programme was supplemented by the inclusion of four existing bores (see Section 2.3.2). The location and spatial spread of the newly installed boreholes, in addition to existing holes in the Boolgeeda Creek area that were included for re-sampling, is shown in Figure 2.1.

The distribution of stygofauna is generally recognised as being related to rock and sediment types, groundwater quality and geological structure. Stygofauna habitat is generally best developed in karst, calcrete and alluvium, but fauna may also occur in non-karstic or consolidated terrains if suitable rock voids are present (Humphreys, 1999). The basement rocks underlying Boolgeeda valley comprise low permeability, tight upper Hamersley Group and Turee Creek Group metasediments, as demonstrated by very low bore yields and the inability to locate any significant water supply source in the area. These basement rock types are therefore highly unlikely to provide suitable void space to accommodate a stygal ecosystem.

In addition to these habitat considerations, sampling of nested bores in the region (which sample superficial and deeper aquifers), has shown that the most significant stygal communities occur in superficial aquifer systems and with fauna absent from deeper CID or basement aquifers (see Biota 2005a and 2006 for examples). Bores targeting deeper aquifers in the area were also sampled extensively in the original Brockman Syncline 4 stygofauna and none of these yielded fauna (Biota 2005b). Given these considerations, boreholes were deliberately targeted at the superficial aquifer along Boolgeeda Creek as the most prospective habitat unit for any stygofauna present.

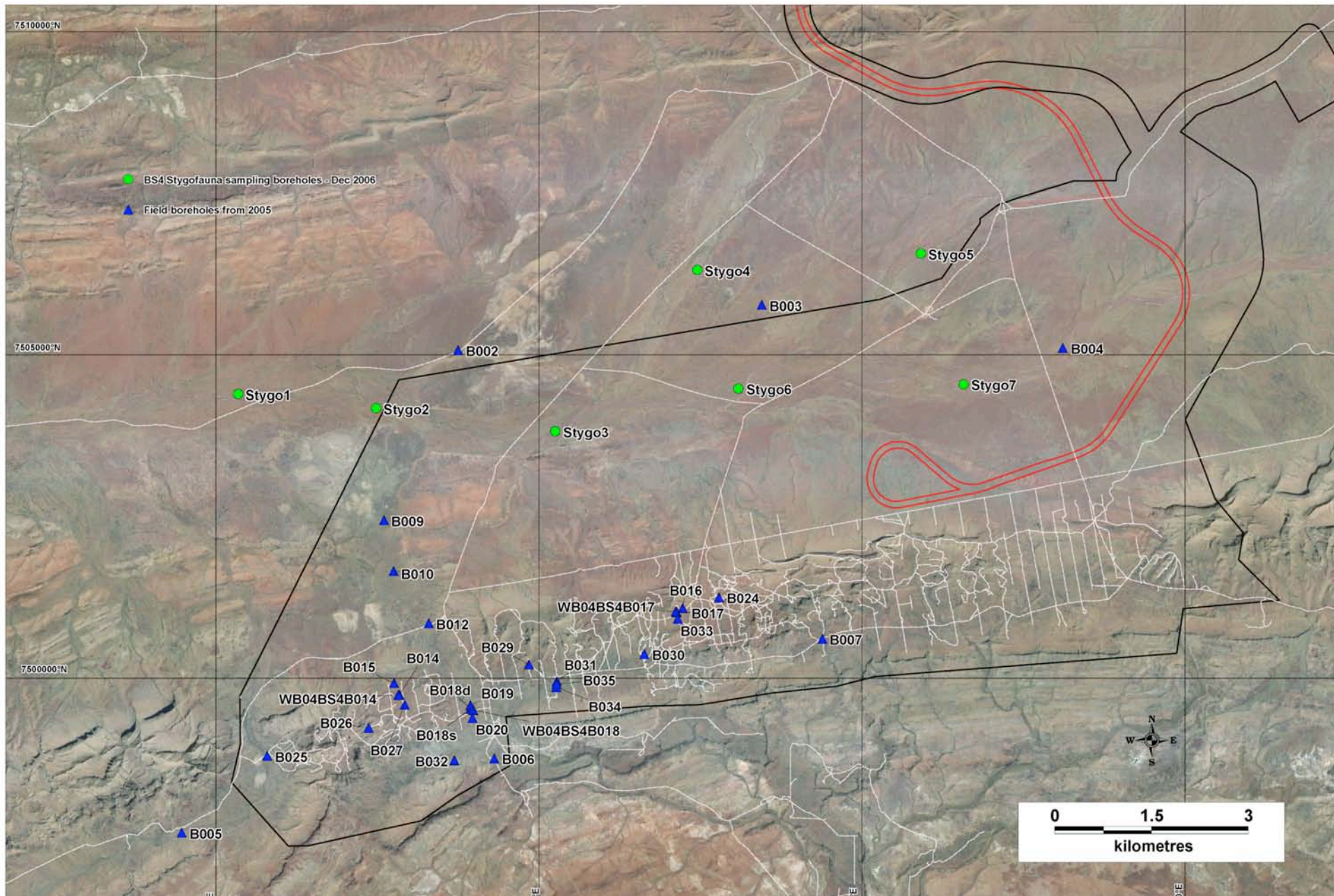


Figure 2.1: Location of boreholes sampled for stygofauna in the Boolgeeda Creek locality in the BS4 project area (specifically installed holes shown in green).

As the sampled boreholes were drilled specifically for fulfilment of Condition 717:P5 (Section 1.3), a period of settling time was allowed between drilling completion and sampling of the bore for stygofauna. This was both to allow the bore to settle and equilibrate with the surrounding aquifer, and to allow time for stygofauna to colonise the bore. The last bore was completed in November 2006, with field sampling undertaken in March 2007. This represents a period of three months (92 days) between installation and sampling; a period consistent with the collection of stygofauna from other newly drilled holes in alluvial and transmissive units.

2.3.2 Stygofauna Sampling Effort

Nine boreholes in total were sampled in the Boolgeeda Creek area as part of this study. Field sampling was completed on the 1st and 2nd of March, 2007.

The location and comments on sampling at each hole are provided in Table 2.2 below (see also Figure 2.1).

Table 2.1: Boreholes sampled for stygofauna in the BS4 project area during Phases I and II (easting and northings given in UTMs, WGS84 datum; source Biota (2005)).

Bore Name	Easting	Northing	February 05 Sampling	April 05 Sampling	March 07 Sampling
Stygo 1	515345	2504394			Nil
Stygo 2	517479	7504173			5 hauls
Stygo 3	520252	7503815			3 hauls
Stygo 4	522452	7506314			3 hauls
Stygo 5	525910	7506570			5 hauls
Stygo 6	523084	7504477			5 hauls
Stygo 7	526572	7504543			4 hauls
PZ04BS4B002	518748	7505072	3 hauls	3 hauls	5 hauls
PZ04BS4B003	523448	7505775	3 hauls	3 hauls	3 hauls
PZ04BS4B004	528107	7505109	2 hauls	2 hauls	5 hauls
PZ04BS4B005	514471	7497611	1 haul	1 haul	
PZ04BS4B006	519307	7498758	1 haul	1 hauls	
PZ04BS4B007	524388	7500610	2 hauls	2 hauls	
PZ04BS4B009	517601	7502448	1 haul	1 haul	
PZ04BS4B010	517750	7501660	2 hauls	2 hauls	
PZ04BS4B012	518295	7500852	Contaminated with hydrocarbons *	Not resampled	
PZ04BS4B014	517841	7499745	3 hauls	3 hauls	
WB04BS4B014	517825	7499742	Inaccessible, lid sealed	Not resampled	
PZ04BS4B015	517757	7499925	2 hauls	2 hauls	
PZ04BS4B016	522223	7501086	Inaccessible, pvc cap sealed in place	Not resampled	
PZ04BS4B017	522129	7501024	2 hauls	2 hauls	
WB04BS4B017	522115	7501030	3 hauls	3 hauls	
PZ04BS4B018s	518948	7499533	2 hauls	2 hauls	
PZ04BS4B018d	518948	7499523	2 hauls	2 hauls	
WB04BS4B018	518983	7499509	3 hauls	3 hauls	
PZ04BS4B019	518938	7499581	2 hauls	2 hauls	
PZ04BS4B020	518972	7499385	2 hauls	2 hauls	
PZ04BS4B024	522787	7501252	Blockage @ 90-100m,	Not resampled	
PZ04BS4B025	515791	7498801	2 hauls	2 hauls	
PZ04BS4B026	517364	7499233	1 haul	1 haul	
PZ04BS4B027	517922	7499591	3 hauls	3 hauls	
PZ04BS4B029	519847	7500213	3 hauls	3 hauls	
PZ04BS4B030	521628	7500374	3 hauls	3 hauls	
PZ04BS4B031	520275	7499954	2 hauls	2 hauls	
PZ04BS4B032	518690	7498731	2 hauls	2 hauls	
PZ04BS4B033	522148	7500920	3 hauls	3 hauls	
PZ04BS4B034	520268	7499864	3 hauls	3 hauls	
PZ04BS4B035	520272	7499912	1 haul; sample aborted due to safety hazard	3 hauls	

- Assumed to have been derived from drilling to establish this hole on 24th October 2004.

Table 2.2: Locations and sampling effort for boreholes surveyed for stygofauna (coordinates in AGD84 datum).

Borehole	Coordinates	Number of sample hauls	Comments
Stygo 1	515345E, 2504394N	Nil	Collapsing ground prevented completion
Stygo 2	517479E, 7504173N	5	Clear sample
Stygo 3	520252E, 7503815N	3	High turbidity
Stygo 4	522452E, 7506314N	3	High turbidity
Stygo 5	525910E, 7506570N	5	Clear sample
Stygo 6	523084E, 7504477N	5	Clear sample
Stygo 7	526572E, 7504543N	4	Partially blocked casing
PZ04BS4B002	518748E, 7505072N	5	Clear sample
PZ04BS4B003	523448E, 7505775N	3	High turbidity
PZ04BS4B004	528107E, 7505109N	5	Clear sample

3.0 Results

3.1 Survey Results

No stygofauna were recorded from any of the bores sampled in the Boolgeeda Creek locality. This result is consistent with the two earlier phases of stygofauna sampling of 27 bores in the BS4 area which also yielded very few or no stygofauna records (see Section 1.2; Biota 2005).

3.2 Subterranean Fauna Habitats

All bores sampled at Boolgeeda as part of this study intersected superficial alluvial formations; the geology type most prospective for stygofauna in the immediate area (Biota 2005). After new holes were initially drilled through this alluvium, they were dipped for groundwater and found to be dry (W. Dodson, pers. comm. 2005). Groundwater subsequently flowed slowly into the boreholes subsequent to this until there was eventually sufficient water available for stygofauna sampling. These observations do not suggest a major and highly transmissive alluvial aquifer that might be associated with core stygofauna habitat, and this is consistent with the lack of stygofauna collected during the survey.

As discussed in Biota (2005), superficial alluvial aquifers in the Pilbara can be hydrologically separated from the deeper aquifers that will be affected by the BS4 dewatering (Johnson and Wright 2001). This may account for the relatively slow rate of groundwater inflow into the bores at Boolgeeda and also indicates that the BS4 watertable drawdown (which will affect the basement aquifer; Hamersley Iron 2005) is likely to have minimal direct effect on this superficial unit in any event.

4.0 Discussion and Conclusion

This report demonstrates fulfilment of the Proponents' commitment to install additional boreholes in the Boolgeeda Creek area and sample these for stygofauna (Condition 717: P5 and P6; Table 1.1).

No stygofauna were recorded from any of the bores sampled and this result is consistent with both the outcomes of earlier, more extensive phases of stygofauna sampling in the BS4 project area and inferences that can be drawn from the available geological and hydrogeological information.

Given these findings, there appears to no value in expending additional effort and resources in any further sampling for stygofauna in the BS4 project area. The results indicate that a Subterranean Fauna Management Plan (SFMP) should not be required for the BS4 Project and therefore Condition 717: P7 (to make the SFMP publicly available; Table 1.1) should also not be required.

5.0 References

- Biota Environmental Sciences (2005a). Brockman Syncline 4 Project. Baseline Stygofauna Assessment. Unpublished report for Hamerley Iron, Perth.
- Biota Environmental Sciences (2005b). Yandi Junction South East (JSE) Baseline Stygofauna Survey. Unpublished report for Hamersley Iron, Perth.
- Biota Environmental Sciences (2006). Hope Downs Project Subterranean Fauna Assessment. Unpublished report for Pilbara Iron, Perth.
- EPA (2003). Guidance for the assessment of environmental factors (in accordance with the Environmental Protection Act 1986). Sampling of subterranean fauna in groundwater and caves. No. 54 Draft. Environmental Protection Authority, Western Australia, March 2003.
- Humphreys, W.F. (1999). Relict stygofaunas living in sea salt, karst and calcrete habitats in arid northwestern Australia contain many ancient lineages. In: *The other 99%. The conservation and biodiversity of invertebrates*. W. Ponder and D. Lunney (eds.) Transactions of the Royal Zoological Society of New South Wales, Mosman. Pp.219-227
- Hamersley Iron Pty Limited (2005). *Brockman Syncline 4 Iron Ore Project, Public Environmental Review*. August 2005.
- Johnson, S. L. and H. Wright (2001). Central Pilbara Groundwater Study. Water and Rivers Commission, Perth.

Appendix 1

Construction Details of New Bores Drilled at Boolgeeda Creek

Construction details for additional targeted boreholes in the Boolgeeda Creek locality in the BS4 project area

Site Name	Start	End	Total depth	Dia (inches)	Dia (mm)	Total depth	Casing type	Dia(mm)	Slotted interval	Airlift Yield
Stygo 1	26-Nov-06	26-Nov-06	42	6	152	Nil	-	-	-	RC hole
Stygo 2	26-Nov-06	26-Nov-06	42	6	152	40	CI9 uPVC	50	28-40	RC hole
Stygo 3	27-Nov-06	27-Nov-06	42	6	152	40	CI9 uPVC	50	34-40	RC hole
Stygo 4	27-Nov-06	27-Nov-06	42	6	152	40	CI9 uPVC	50	28-40	RC hole
Stygo 5	27-Nov-06	27-Nov-06	42	6	152	29	CI9 uPVC	50	17-29	RC hole
Stygo 6	27-Nov-06	28-Nov-06	42	6	152	40	CI9 uPVC	50	28-40	RC hole
Stygo 7	28-Nov-06	28-Nov-06	42	6	152	40	CI9 uPVC	50	28-40	RC hole