Biota Environmental Sciences

Yandicoogina Subterranean Fauna Assessment Phases I - V

Prepared for Rio Tinto Iron Ore

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Yandicoogina Subterranean Fauna Assessment

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1.0 Introduction

The Yandicoogina (Yandi) iron ore mine, currently operated by Pilbara Iron (PI) on behalf of Hamersley Iron (HI), which forms part of Rio Tinto Iron Ore (RTIO), is located approximately 90 km northwest of Newman in the Pilbara Region of Western Australia. The original Yandi mine started construction in 1997 and the first shipment of ore occurred in 1999. An expansion to existing mining developments was later proposed in 2005 in the form of Yandi Junction South-east (JSE). That first expansion area is situated near the confluence of three major creek systems in the area Marillana, Yandicoogina and Weeli Wolli, and included a new open-cut pit. The Yandi mining areas are located within the Channel Iron Deposits (CID) and are mostly below the water table.

The Ministerial Statement approving the Yandi JSE expansion included a Condition relating to subterranean fauna (Condition 695:M11), which identified the requirement for the preparation of a Subterranean Fauna Management Plan (SFMP). The SFMP was subsequently prepared by Biota Environmental Sciences (Biota 2006), and identified the requirement for further field sampling of stygofauna at Yandi and associated studies.

RTIO is currently seeking to sustain their mining operations at Yandi, which involves two new pit developments, located to the west and southwest of the existing operations (Figure 1.1):

- Yandicoogina Junction South West (JSW); and
- Oxbow.

A third future development prospect, Billiards deposit, is located to the east of the existing JSE operations and runs parallel to the Weeli Wolli Creek. However this site does not form part of the immediate proposal for the Yandi operations.

1.1 Subterranean Fauna Overview

Two broad categories of fauna are generally considered to comprise the true subterranean fauna:

1. Stygofauna: groundwater-dwelling, aquatic fauna (including stygobites; obligate groundwater dwellers); and
2. Troglofauna: obligate cave or karst-dwelling, terrestrial subterranean fauna occurring above the watertable.

Stygofauna are those fauna that inhabit groundwater, sometimes occurring very close to the surface. They tend to be highly specialised to, and obligate dwellers of, subterranean groundwater habitats ('stygobites' Humphreys 2000). Stygofauna are known to be present in a variety of rock types including karst (limestone), fissured rock (e.g. granite) and porous rock (e.g. alluvium) (Marmonier et al. 1993). The types of animals that have become stygal (groundwater-inhabiting) in Western Australia include platyhelminthes, oligochaetes, crustaceans, water mites and water beetles, (Humphreys 1999, Watts and Humphreys 1999). Much attention has been directed to the crustacean fauna, which includes ostracods, copepods, bathynellid syncarids, isopods and amphipods (Humphreys 1999, Watts and Humphreys 1999, Biota unpublished data).

Troglobites occur in the strata between the superficial soil layer and the watertable, where suitable habitat space is available. Troglobitic fauna has historically been collected primarily from karstic limestone systems in Western Australia (at Cape Range, Barrow Island and in the Kimberley; Harvey 1988, Humphreys 2001). Recent work along the Robe River has, however, also collected this fauna from vuggy and cavernous strata in pisolitic mesa formations (Biota 2006) as well as alluvium and colluvium deposits in the Pilbara (Biota unpublished data).

Troglobitic fauna species have the potential to have restricted distributions and as a result short-range endemism (*sensu* Harvey 2002) is common in this fauna. In the arid zone, the troglobitic fauna is generally considered to be relict rainforest litter fauna, having arisen from tropical fauna

lineages that descended into subterranean environments during the aridification of Australia (in the late Miocene; Humphreys 1993). This is inferred from affinities of the taxonomic groups represented amongst the troglofauna with other extant taxa in tropical climates. These groups include the Schizomida, Pseudoscorpiones, Araneae, Scolopendrida, Polydesmida, Diplura, Thysanura, Coleoptera and Blattodea (Humphreys 2001, Biota 2006).

1.2 Scope and Objectives of this Study

The objective of the study was to collect baseline data on stygal communities and potential effects of development in the Yandi area. Upon the completion of the site's Environment Management Plan and the Stygofauna Management Plan, latter phases also acted as compliance measures. In accordance with the SFMP, Management Action 2, bi-annual sampling must take place during the first two years of the JSE operation (Biota 2006).

To meet this requirement, and to inform the Yandi JSW and Oxbow Environmental Impact Assessment (EIA) studies, Biota Environmental Sciences (Biota) was commissioned to undertake sampling for RTIO's baseline, Ministerial and SFMP compliance requirements at Marillana Creek in the Yandi Junction central, JSE area, JSW, Oxbow and Billiards area.

The scope of the ongoing study is the continued collection of data relevant to the potential impacts on stygofauna, which are likely to arise from the ongoing implementation of the approved Yandi operations, and for future approvals along the Yandi CID. The specific aims of the work were to:

- sample available water monitoring sites (drill holes and production bores) within or near the project area for the presence of stygofauna;
- identify the stygofauna collected to species level wherever possible to place them into local and regional context;
- provide data to contribute to annual environmental compliance reporting, with the longer term objective of providing data to meet the completion requirements identified in the SFMP (Biota 2006); and
- Provide data to inform the EIA for future approvals, specifically JSW and Oxbow.

Given the opportunistic collection of a troglobitic specimen from Billiards deposit during stygofauna sampling, sampling this fauna was also undertaken as part of baseline documentation of the subterranean fauna.

The purpose of this report is the collation of all subterranean fauna data collected including all five phases of stygofauna sampling and single troglofauna phase in the Yandicoogina area to date.

1.3 Previous Relevant Studies

Previous studies at Yandi involved ad hoc sampling of relatively few bores, and the results of these earlier visits (one in 1998 conducted internally by Hamersley Iron, and another in 1999 conducted by Halpern Glick Maunsell) are not available. Additionally, some bores in the area have been sampled as part of the Department of Environment and Conservations (DEC) Pilbara Stygofauna Survey, however results are currently unavailable. For the purposes of this report, phases I – V refer to the work completed by Biota Environmental Sciences from 2003 onwards.

No prior troglofauna sampling had been completed in the area.

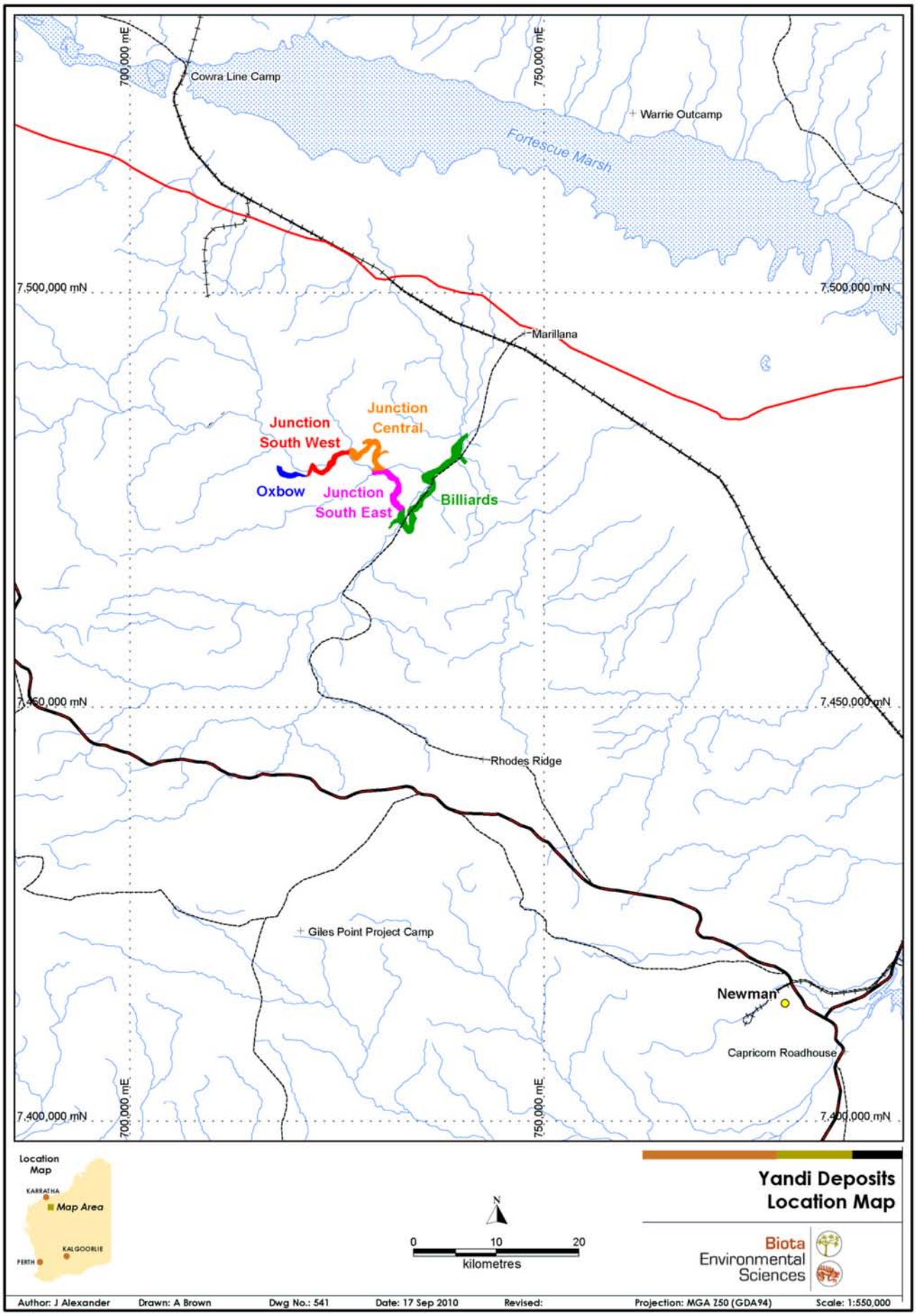

Figure 1.1: Locality map for Pilbara Iron's Yandi developments.

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2.0 Environment and Subterranean Fauna Habitat

2.1 Climatic Conditions

The climate at Yandi is typified by arid conditions with hot, wet summers and mild, dry winters. Average temperatures for the locality range from 42.7 °C in January to 2.9 °C in July (BOM, 2010; Figure 2.1). The majority of rainfall occurs in the summer months and is driven mostly by cyclonic activity. The average annual rainfall for the area is 322.7 mm with approximately half of this falling between December and February (Figure 2.2).

Marillana and Weeli Wolli creek generally only flow naturally after heavy rainfall events, however the discharge from neighbouring mines since 1992, coupled with discharge from RTIO Yandi operations, has resulted in a continuous flow through Weeli Wolli Creek in recent times.

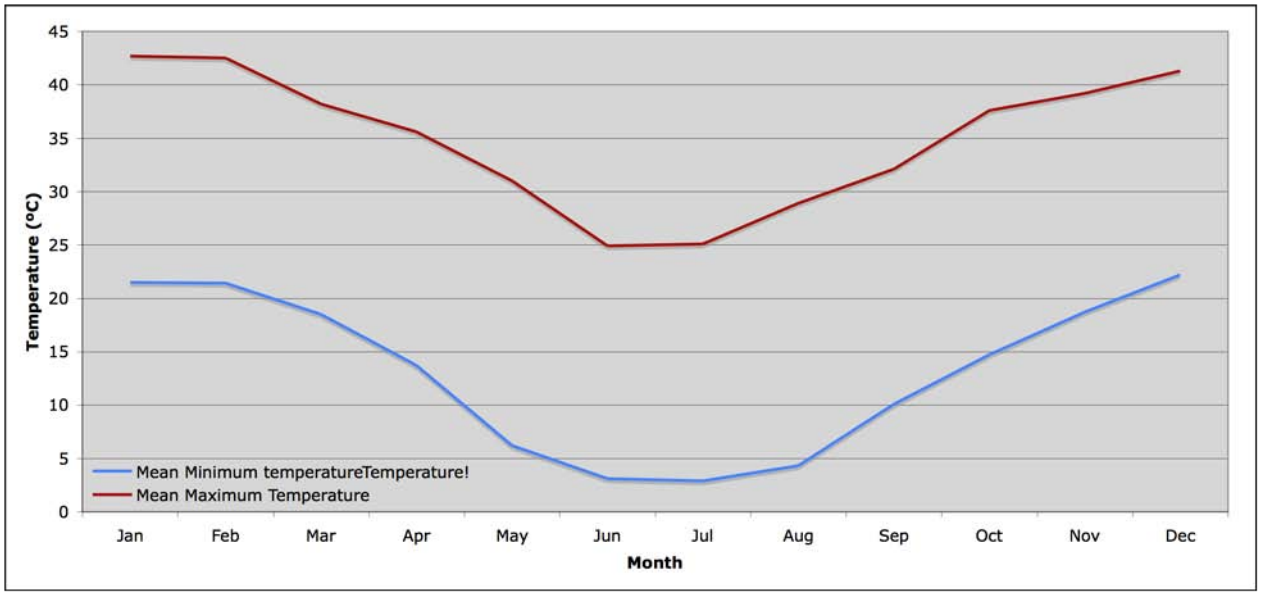

Figure 2.1: Long term average temperatures as recorded at Newman Airport (BOM, 2010).

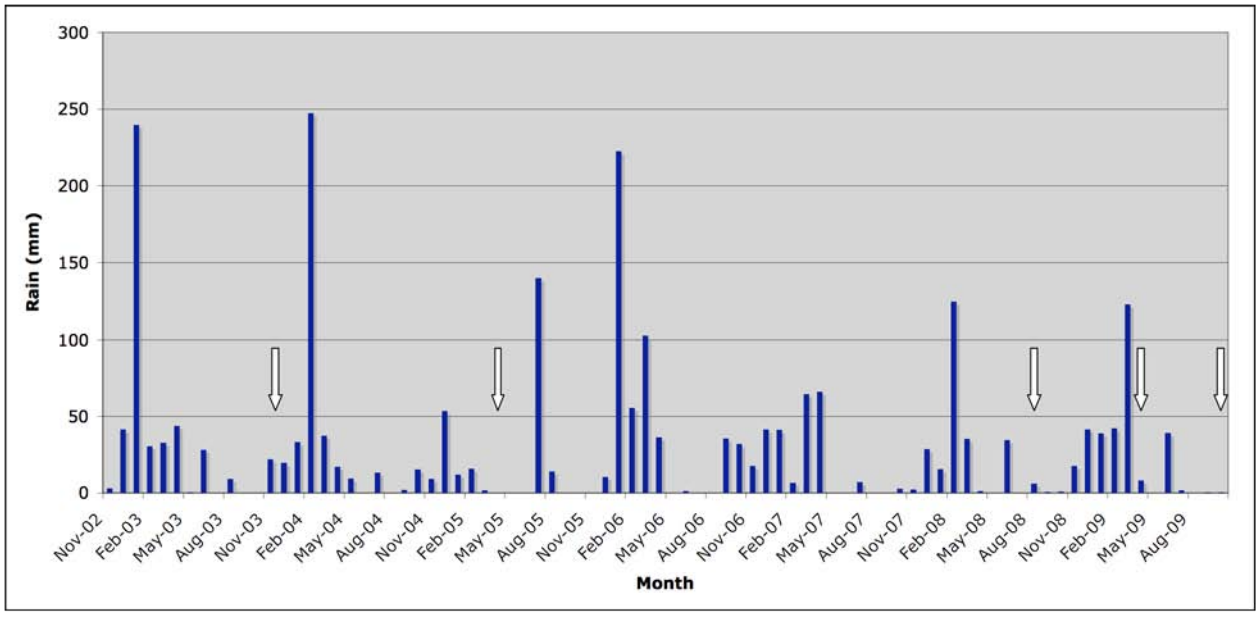

Figure 2.2: Total monthly rainfall (mm) at Newman Airport from one year prior to Phase I of sampling. Arrows indicate a phase of stygofauna sampling (BOM 2010).

2.2 Hydrology, Geology and Subterranean Fauna Habitat

The Channel Iron Deposit (CID) of RTIO's Yandi project area was eroded into bedrock of shale, dolerite and banded iron formation of the Weeli Wooli Geological Formation, which overlies the Brockman Iron Formation. The CID is mostly below the watertable and is overlain with varying depths of unconsolidated alluvium and colluvium. Other units include banded iron formation (BIF), chert, shale, minor dolerite and occasional CID clasts (Table 2.1, Figure 2.3).

Table 2.1: Geological units occurring within the RTIO Yandi project area (Thorne and Trendall 2001).

Unit Name	Description
Brockman Iron Formation (Plhb)	Banded Iron Formation, chert, mudstone, and siltstone; metamorphosed.
Weeli Wolli Formation (Plhj)	Banded iron-formation (commonly jaspilitic), pelite, and numerous metadolerite sills
Basal Conglomerate (BCC)	Pebble conglomerate with varying amounts of cobbles and larger fragments. The BCC is invariably present as the basal channel facies overlying basement
Limonitic Goethite Channel (LGC)	This material forms the footwall of the ore body. Typically hydrated/ altered material with well preserved to weakly preserved relict pisolitic textures and parent mineralogy. Lenses of unaltered to weakly hydrated/ altered material similar to the overlying GVL
Goethite Vitreous Upper (GVU)	Comprises the bulk of the above water table high grade CID. The GVU ranges from hard dense siliceous material that breaks with a conchoidal fracture to an earthy brown porous rock.
Goethite Vitreous Lower (GVL)	Comprises the bulk of the below water table high grade CID
Alluvium (Qa)	Unconsolidated silt, sand, and gravel; in drainage channels and adjacent floodplains
Colluvium (Qc)	Unconsolidated quartz and rock fragments in soil

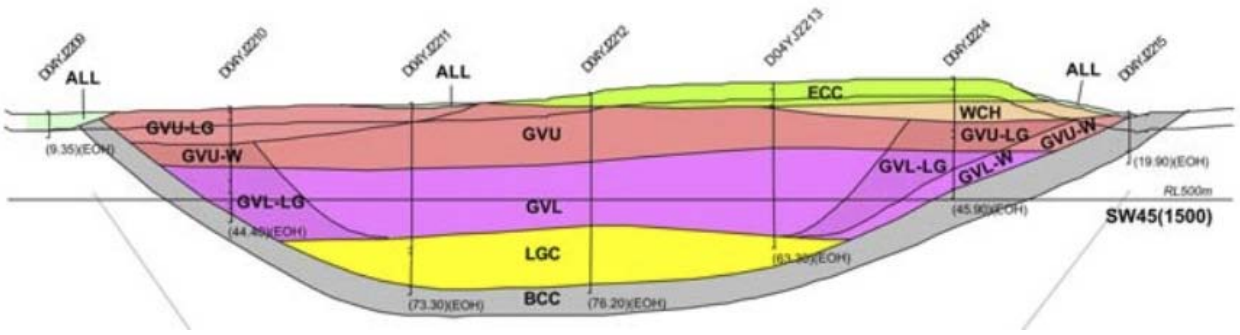

Figure 2.3: Cross section of the CID at JSW shows relative geological layering (figure supplied by RTIO).

Alluvial processes have shaped the surface topography with the existing streams winding between low-lying mesas and hills. The three major landforms that can be distinguished within the RTIO Yandi project area are the low stony hills, valleys and drainage lines.

The JSW deposit is crossed by the Marillana Creek, immediately upstream of the existing Junction Central (JC) mine site. Phil's Creek is a tributary of Marillana Creek, which it joins from the north near the western end of the JC pit. Oxbow is located upstream of JSW, to the southwest of Marillana Creek. Billiards deposit is located to the southwest of the Marillana Creek where it enters the RTIO Yandi mining lease area.

The overlying geology of both Marillana and Weeli Wolli creek systems are very similar consisting of a superficial layer of alluvial aquifer overlaying CID deposit (RTIO pers. comm. 2010). Schematics of cross sections from the system can be seen from Figures 2.4 to 2.7.

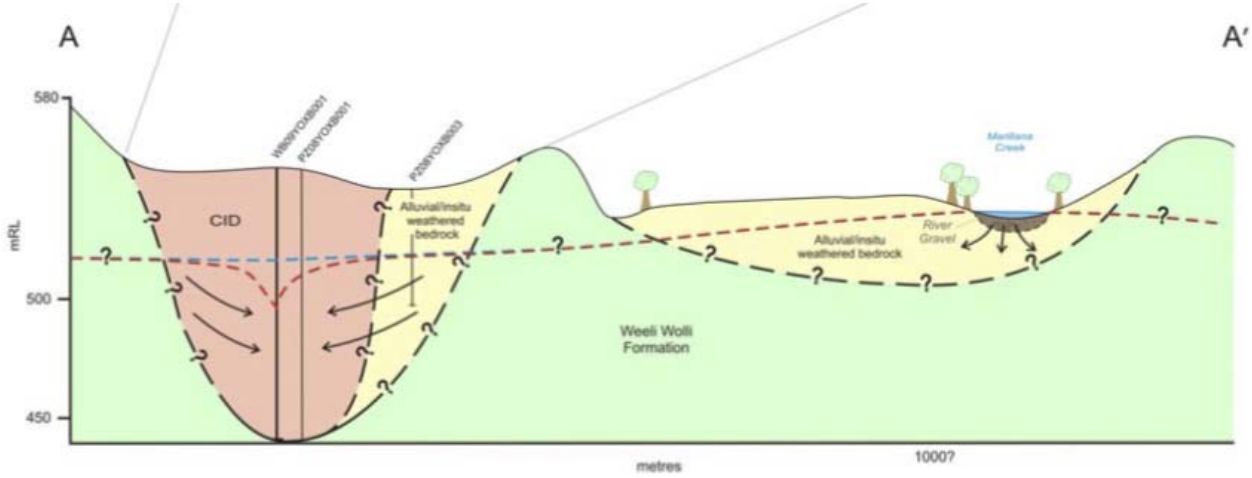

Figure 2.4: **Schematic cross section from Oxbow** (figure supplied by RTIO).

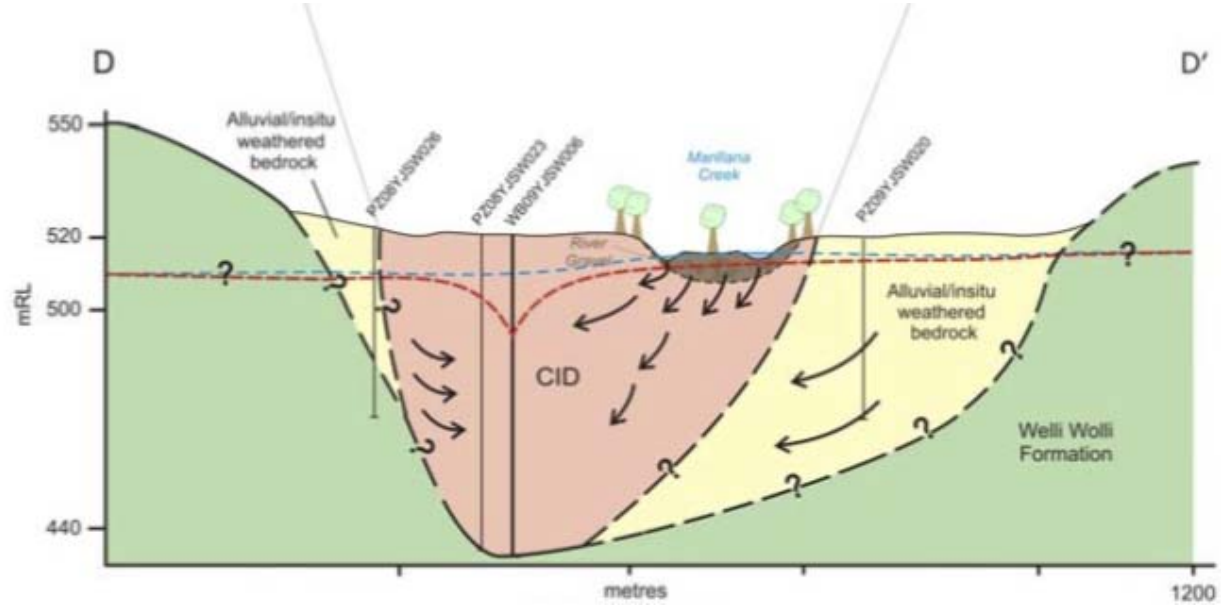

Figure 2.5: **Schematic cross section from JSW** (figure supplied by RTIO).

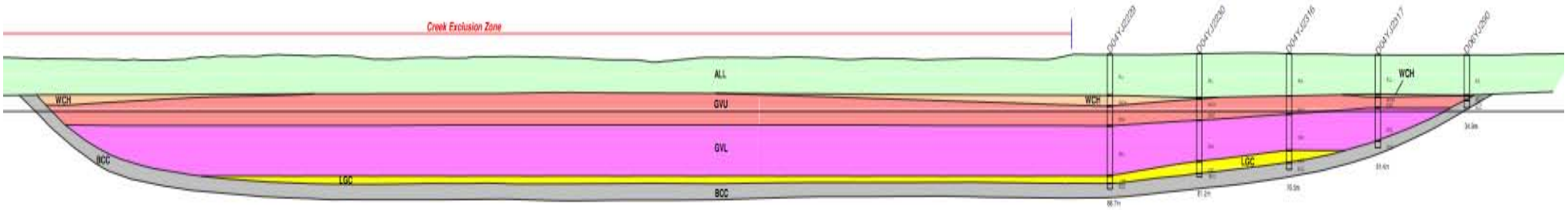

Figure 2.6: **Cross section of Billiards South Prospect northern boundary** (figure supplied by RTIO).

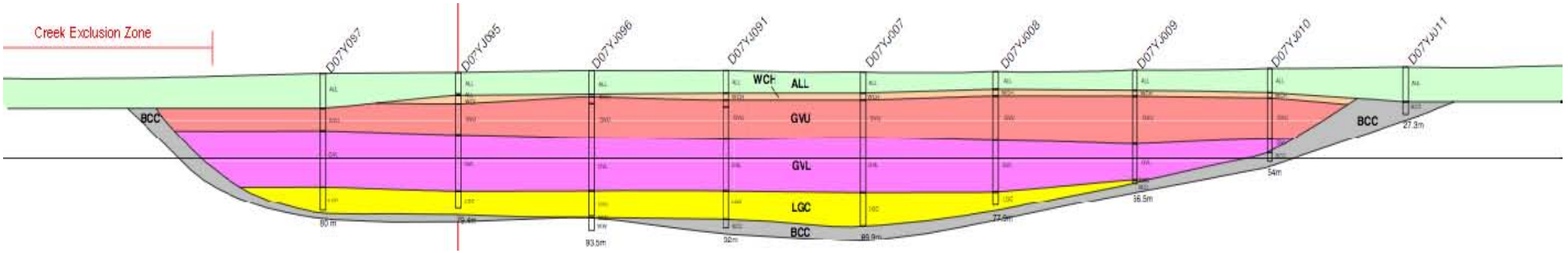

Figure 2.7: **Cross section of Billiards South Prospect southern boundary** (figure supplied by RTIO).

Prolonged discharge of dewatering output into the Marillana Creek has caused sections of both Marillana and Weeli Wolli creek, downstream from existing operations from PI and BHPBIO, to retain water for much more of the year than normal.

The suitability of any geological formation as habitat for subterranean fauna is predominantly limited by availability of space and potential for nutrient filtration. An additional requirement for troglobitic fauna is the ability to maintain levels of high humidity. Several geological units are recognised as being core habitat for subterranean fauna as they characteristically form fractures, caverns and vuggs, which allows for greater rate of fauna dispersal and nutrient penetration. These geologies include limestone karstic systems, calcrete, alluvium, gravels, limonite and dolomite (Marmonier et al. 1993, Humphreys 1999, Biota 2006).

The geology and hydrology of the superficial aquifer at Yandi is well suited for stygobitic fauna colonisation with a high percentage of the area available for sampling comprised of alluvium deposits. This shallow alluvial aquifer overlays a separate deeper aquifer where the CID is situated. These systems are recharged both directly and indirectly by rainfall, groundwater and surface water flow. The CID is primarily recharged by seepage in areas where the creek overlays the CID (RTIO 2010). A high water table and seasonally variable influx of water from storm events are also likely to aid in fauna dispersal.

To date all confirmed troglobitic specimens located at Yandicoogina have been located in shallow alluvium bores with less than 10 m to water table. Elsewhere in the Pilbara, troglobitic fauna have uncommonly been located in low-lying alluvium and colluvium deposits (Biota unpublished data). However, most of the alluvium deposits within the Yandicoogina project area are subject to seasonal inundation rendering the habitat unviable for a sustainable troglofauna population. It is therefore unclear at present what constitutes core habitat for troglobitic animals in the study area.

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3.0 Methodology

3.1 Survey Timing and Personnel

Biota has completed five phases of subterranean fauna sampling in the Yandi project area between 2003 and 2009. Survey dates and field personnel are as follows:

- Phase I : 3rd – 5th November 2003, Kyle Armstrong and Phil Runham;
- Phase II : 3rd – 7th April 2005, Phil Runham and Lee Mould;
- Phase III : 4th – 7th August 2008, Jason Alexander and Jessica Lynas;
- Phase IV : 14th – 17th April 2009, Jason Alexander and Tim Sachse; and
- Phase V : 5th – 12th October 2009, Jason Alexander, Jessica Cairnes, Jessica Lynas and David Keirle.

Following the discovery of troglobitic fauna during stygofauna sampling during phases III and IV, a single phase of troglofauna sampling was completed in conjunction with Phase 5, October 2009. Troglofauna traps were retrieved by Jessica Cairnes and David Keirle on the 9th of December, 2009.

The project was coordinated by Garth Humphreys and managed by Jason Alexander, both of Biota.

Jane McRae, Stuart Halse and Mike Scanlon of Bennelongia Environmental Consultants completed further taxonomic identifications on collected specimens, with Dr Mark Harvey of the Western Australian Museum (WAM) and Dr Ivana Karanovic, formerly of the WAM, completing more specialist identifications on some taxa. Adrian Pinder of the Department of Environment and Conservation (DEC) Science Division completed identifications of Phase I and II oligochaetes.

Dr Terrie Finston and Cara Francis, both formerly of the School of Animal Science at the University of Western Australia (UWA) completed molecular analysis of Phase I amphipods and isopods.

3.2 Stygobitic Fauna Sampling and Data Management

Stygofauna sampling within RTIO Yandicoogina project area followed a similar format to other stygofauna sampling projects undertaken previously in the Pilbara bioregion. Methodology and approach were consistent with those outlined in the EPA Guidance Statement 54 (EPA 2003) and Draft Guidance Statement 54a (EPA 2007).

Groundwater sampling was undertaken using modified plankton haul nets. These sampling nets were constructed from 70 μm plankton mesh, with 50 mm and 100 mm apertures attached to a weighted catch jar. Each bore was dragged a minimum of three times unless fauna were detected, in which case five hauls were completed. On the final haul the net was agitated gently, which acts to stir the benthos layer and mobilises any fauna present for more effective specimen collecting. On the surface, the net was flushed thoroughly with fresh water and the resulting sample placed in a uniquely labelled container and into a shaded esky in order to preserve the sample until sorting and identification.

Following the completion of a bore, the nets were thoroughly rinsed with water and inspected before using on another hole. This prevented cross-contamination of specimens between aquifers and boreholes.

Sorting and identification of specimens to order level was completed in an on-site laboratory under a dissecting microscope (Olympus SZ40 and SZ61, magnification up to 40x). Stygofauna specimens were tracked using Biota's standard tracking forms and preserved in 100% ethanol (which provides

for both morphological and molecular analysis). Specimens were sent to relevant experts for further identification to the lowest possible taxonomic level (Section 3.1).

3.2.1 Genetic Analysis

Genetic analysis of amphipod specimens was completed for Phase I samples only. DNA was extracted from one to two individuals from each of 12 bores sampled in the Yandi JSE project area. Eleven of these specimens representing eight bores were successfully amplified for the CO1 gene (four Impact bores and four Reference). Analyses were carried out to examine relationships among the specimens and to identify groupings indicative of species. The complete report on this work is provided as Appendix 2 of this document, with a summary of key findings presented in Section 4.1.7.1.

Collected Isopod specimens were also subject to genetic analysis completed by Cara Francis of the School of Animal Science, UWA (Section 4.1.7.3).

3.2.2 Stygobitic Fauna Species Accumulation

Two species accumulation curves were plotted, the first being the plot of actual observed species accumulation over phases (S{obs}) and the second a permutated, smoothed curve (UGE) (Ugland et al. 2003) that allows for asymptote predictions. Using the recorded data, non-parametric estimators were used to predict total species richness (S_{max}) of the stygal community.

3.3 Troglobitic Fauna Sampling and Data Management

Troglofauna were sampled by means of custom-built litter, colonisation traps suspended within drillholes in each of the various study sites. Within each hole sampled, a series of colonisation traps were suspended at intervals to allow more coverage of the column or to position traps adjacent to known cavities, if known.

Traps were constructed from 60 mm internal diameter PVC irrigation pipe cut to a length of 180 mm. Each trap had a series of 20mm holes drilled in the side and traps remained open at the upper end. Traps were installed such that they were in contact with the interior of the sampled drillhole once installed, facilitating fauna entry into the trap.

Leaf litter material was gathered locally from the ground surface in the project area, particularly from the bases of *Acacia* shrubs. The collected litter was soaked in water and irradiated in a microwave oven on maximum power setting (to kill any surface invertebrates present and assist in break-down). Litter was added to the traps wet and kept in sealed containers until immediately prior to insertion into the drillholes. The opening of each drillhole was sealed after the installation of the traps to maintain humidity and to minimise the input of surface fauna. At Yandi, traps were left in the ground for a total of 61 days (8.5 weeks) to allow sufficient time for troglofauna colonisation. Traps were then recovered and stored in labelled zip-lock bags, which aid in maintaining humidity, for the return to Perth for sorting.

In Perth, fauna specimens were recovered from the traps using specially designed Tullgren funnel units. Leaf litter from each trap was placed in a sieve over which an aluminium lamp containing a 25-watt globe was situated. This created a temperature of approximately 30°C at the surface of the leaf litter. A funnel situated below the leaf litter collects the fauna as they fall, directing them into an attached vial of 100% ethanol. Leaf litter was left in the Tullgren funnels for a period of 24 hours, after which time the leaf litter was dry and the bulked invertebrate sample removed.

Fauna specimens collected via Tullgren funnels were identified down to order or family level using dissecting microscopes (Olympus SZ40 and SZ61, magnification up to 40x). Fauna specimens were assigned a unique number based on borehole name and location and tracked on customised data sheets. Specimens were preserved in 100% ethanol, which allows for both morphological

and molecular analysis. Specimens of interest were submitted to the Western Australian Museum for further taxonomic identification.

3.4 Sampling Effort

3.4.1 Stygofauna

A total of 68 sites were sampled during five phases of sampling from the November 2003 to October 2009. Sites were chosen in conjunction with Pilbara Iron staff to give a good spatial coverage of the area, focusing on the areas surrounding the drainage areas. Numerous sites were sampled in multiple phases.

Table 3.1: Names and locations of sites sampled for stygobitic fauna during five phases (coordinates in zone 50, datum GDA94).

Bore Name	Easting (m E)	Northing (m N)	Phase					Comments
			I	II	III	IV	V	
99YJWB01	740705	7482617		√	√			
99YJWB02	732433	7472677		√	√	√	√	
99YJWB03	734711	7474442		√	√	√	√	
99YJWB04	735790	7477323		√	X	√	√	Headworks attached Phase III
Airport EA	729874	7480651	√	√				
B1	731070	7477776					√	
Camp YMCC	726744	7477949	√					
Discharge YMCD	730236	7478532	√	√				
D03YJ1636	731792	7477445		√				
D03YJ1647	731231	7478013		√	√			
D03YJ1667	731298	7477800		√	√	√	√	
D08YJ050	732887	7473094					√	
Fauna	726431	7483093		√	√	√	√	
JSE1	731262	7477960		√				
JSE2A	731262	7478074		√				
JSE3	732386	7477126		√	√			
JSE4	732318	7477053		√				
JSE6	732322	7476191		√	√			
JSE7	732102	7475828		√				
JSE8	731975	7475552		√				
JSE9	731769	7474933		√				
JSE10	731993	7474430		√				
JSE11	732326	7474375		√				
JSE12	732608	7474217		√				
JSE14	733707	7473602		√		√	√	
JSE15	733701	7473597		√				
JSE16	733899	7473935		√				
JSE31	732694	7473600			√	√	√	
JSE36	735937	7475846				√	√	
JSE37	736346	7477140				√	√	
JSE39	733145	7472585			√	√	√	
JSE61	731264	7475091				√	X	Bore destroyed Phase V
Marillana01	723792	7479113	√		√	√	√	
Marillana02	725082	7479990	√		√	√	√	
Marillana03	728209	7479045	√	√	√	√	√	
Marillana05	729890	7478482	√	√				
Marillana06	731182	7478693	√	√	√	√	√	
Marillana07	725592	7480218	√	√	√	√	√	
MB08YJPC021	726201	7480572					√	
MC4	730180	7478691					√	
MC10	730082	7478812			√	√	√	
MNEW1upstream	726009	7480355	√	√	√	√	√	
Plant	728677	7479732	√	√	√	√	X	Dry Phase V
PZ08YJSE003	730892	7478388					√	

Bore Name	Easting (m E)	Northing (m N)	Phase					Comments
			I	II	III	IV	V	
PZ08YJSW026	724728	7480567				√	√	
PZ08YJSW017	724263	7478750				√	√	
PZ08YJSW020	724976	7479538				√	√	
PZ08YJSW009	722534	7478167				√	√	
PZ08YJSW003	721670	7478287				√	√	
PZ08YJSW004	722689	7478744				√	√	
PZ08YOXB003	718308	7478847				√	√	
PZ08YOXB004	718788	7477937				√	√	
PZ08YOXB005	718514	7477670				√	√	
PZ08YOXB006	719936	7478158				√	√	
PZ08YOXB007	720681	7477777				√	√	
SA	729664	7479749	√	√				
SB	731263	7477933	√	√				
SC	731995	7474638	√	√				
W01YJ15D	726605	7480589	√	√	√			
W02YJ001	726535	7480876	√	√	√			
WB / YJ99	725805	7480628	√		√	√	√	
WSO04obs	729595	7479968			√			
WW1	732427	7472676		√				
WW2	733149	7472618		√	√	√	√	
WW3	733405	7473428		√	√	√	√	
WW4	734018	7474365		√	√	√	√	
YASC	731995	7479638	√	√				
YM119	738345	7479063				√	√	
		Total	**18**	**39**	**25**	**37**	**40**	

√ = Site successfully sampled
X = Attempted to sample, unsuccessful.

3.4.1.1 Phase I

A total of 18 sites were sampled for during the first phase of stygofauna sampling in November 2003. Bore details and locations are located in Table 3.1.

3.4.1.2 Phase II

Thirty-nine sites were sampled during the second phase of stygofauna sampling. This included 14 bores sampled previously during Phase I. Bore details and locations can be found in Table 3.1.

3.4.1.3 Phase III

A total of 25 sites were successfully sampled for stygofauna during phase III in August 2008. Bore details and locations can be found in Table 3.1.

3.4.1.4 Phase IV

Thirty-six sites were successfully sampled during Phase IV of sampling in April 2009. This phase included the first intensive sampling at the Yandi Junction South-West and Oxbow extensions. Of the bores sampled, 21 sites had been sampled previously. Bore details and locations can be found in Table 3.1.

3.4.1.5 Phase V

A total of 39 sites were sampled for stygofauna in October 2008. These included 36 sites that had been sampled previously. Bore details and locations can be found in Table 3.1.

3.4.2 Troglofauna

A total of 52 sites were sampled for troglofauna using colonisation habitat traps. Geological units targeted during sampling contained predominately unconsolidated material (alluvium and colluvium) as well as CID. At most sample sites groundwater level was close to the surface and restricted the depths at which traps could be placed. Fifty-eight traps were placed at Yandicoogina in October 2009.

Table 3.2: Names and locations of sites sampled for troglobitic fauna during the first phase of sampling (coordinates in zone 50, datum GDA94).

Site ID	Easting (m E)	Northing (m N)	Trap Number	Trap Depth	Comment
BFS475	733601	7471190	2	5, 10	
D03YJ1684	721822.79	7479143.49	1	10	
D03YJ1711	721731.58	7478090.89	1	10	
D03YJ1806	720657.2	7478048.69	1	10	
D04YJ1816	726208	7480912	1	5	
D04YJ1824	726030.03	7480804.96	2	10, 20	
D04YJ1830	726243.73	7480601.35	1	5	Blocked – unable to retrieve
D04YJ1894	724544.44	7480310.98	1	10	
D04YJ2084	724938	7480341.46	1	10	
D04YJ2121	724827	7479887	1	5	
D04YJ2190	724261	7479603	1	5	
D04YJ2255	735416.47	7475804.12	1	2.5	
D06YJ098	722987	7478472.31	1	10	
D06YJ102	723025.76	7478014.3	2	5, 10	
D06YJ170	723697	7478754	1	5	
D06YJ192	724293.1	7478866.31	1	5	
D06YJ222	736213.16	7475571.59	1	5	
D06YJ245	737027.11	7477587.43	1	2.5	
D06YJ261	722528.68	7478861.74	1	10	
D06YJ274	724791.92	7479348.78	1	5	
D06YJ375	736887	7478860	1	4	Troglomorphic cockroach observed on trap
D06YJ381	737592.78	7479283.2	1	5	
D06YJ390	738937	7480770	2	5, 10	
D07YJ071	732782.12	7472212.24	1	10	
D07YJ079	733420.86	7471573.15	1	10	
D07YJ083	734903.98	7474334.3	1	1	
D07YJ097	733987.18	7474123.5	1	5	
D07YJ114	733354.23	7472497.29	1	5	
D07YJ167	740135.11	7479284.18	2	5, 15	
D07YJ189	739075.69	7481755.56	2	5, 15	
D07YJ212	733209.2	7472067.63	1	10	
D07YJ218	732924.17	7471647.62	1	10	
D08YJ050	732887	7473094	1	10	
D08YJ106	725286.16	7480560.25	2	10, 15	
D08YJ113	725582.65	7480698.71	2	10, 20	
D08YJ139	736040	7478577	1	5	
D08YJ168	739149.32	7480272.77	1	10	Could not retrieve
D08YJ224	740846.49	7479990.22	2	10, 20	
D08YJ229	740844.05	7483102.17	2	10, 20	
D09YJ007	732288	7472987	2	10, 20	
D09YJ015	732288	7472704	2	10, 20	
DR08YJ023	738656.82	7479069.24	2	5, 10	Trap two in water
RC06YJ005	734692.58	7472567.34	2	5, 15	
RC06YJ007	736955.63	7476527.26	1	5	
RD06YJ391	734981	7474822	1	5	
RD09YJ096	733602	7473376	1	5	
RD09YJ163	734232	7472179	2	5, 15	
RD09YJ280	733952	7471259	2	5, 10	
RD09YJ382	733041	7472590	1	5	
Yandi un-named 01	734089	7472885	1	10	
Yandi un-named 02	735967	7478365	1	5	
YW-P16	731523.09	7472123.23	1	10	
		Total	**58**		

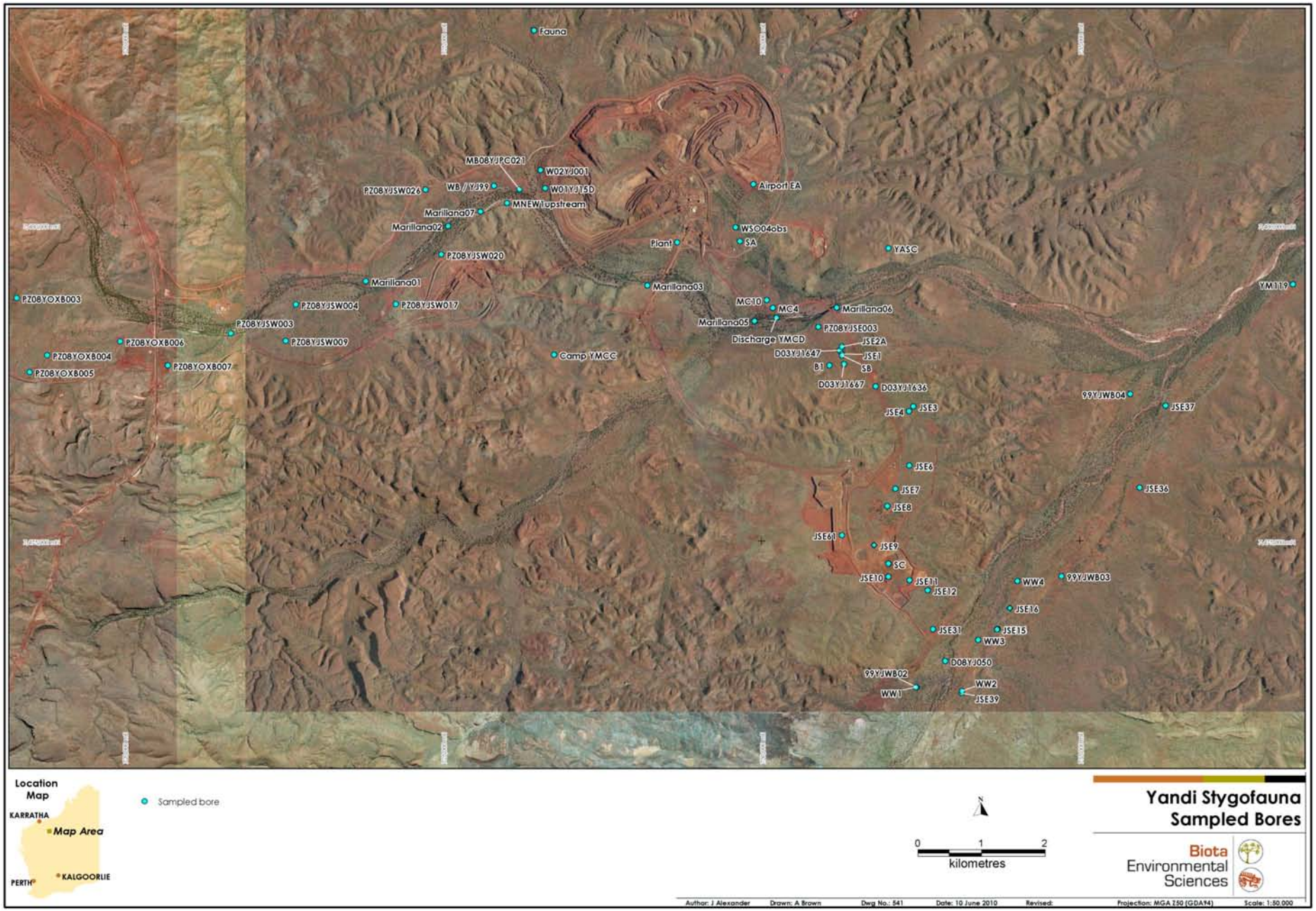

Figure 3.1: Locality of bores sampled for stygobitic fauna at Rio Tinto's Yandicoogina.

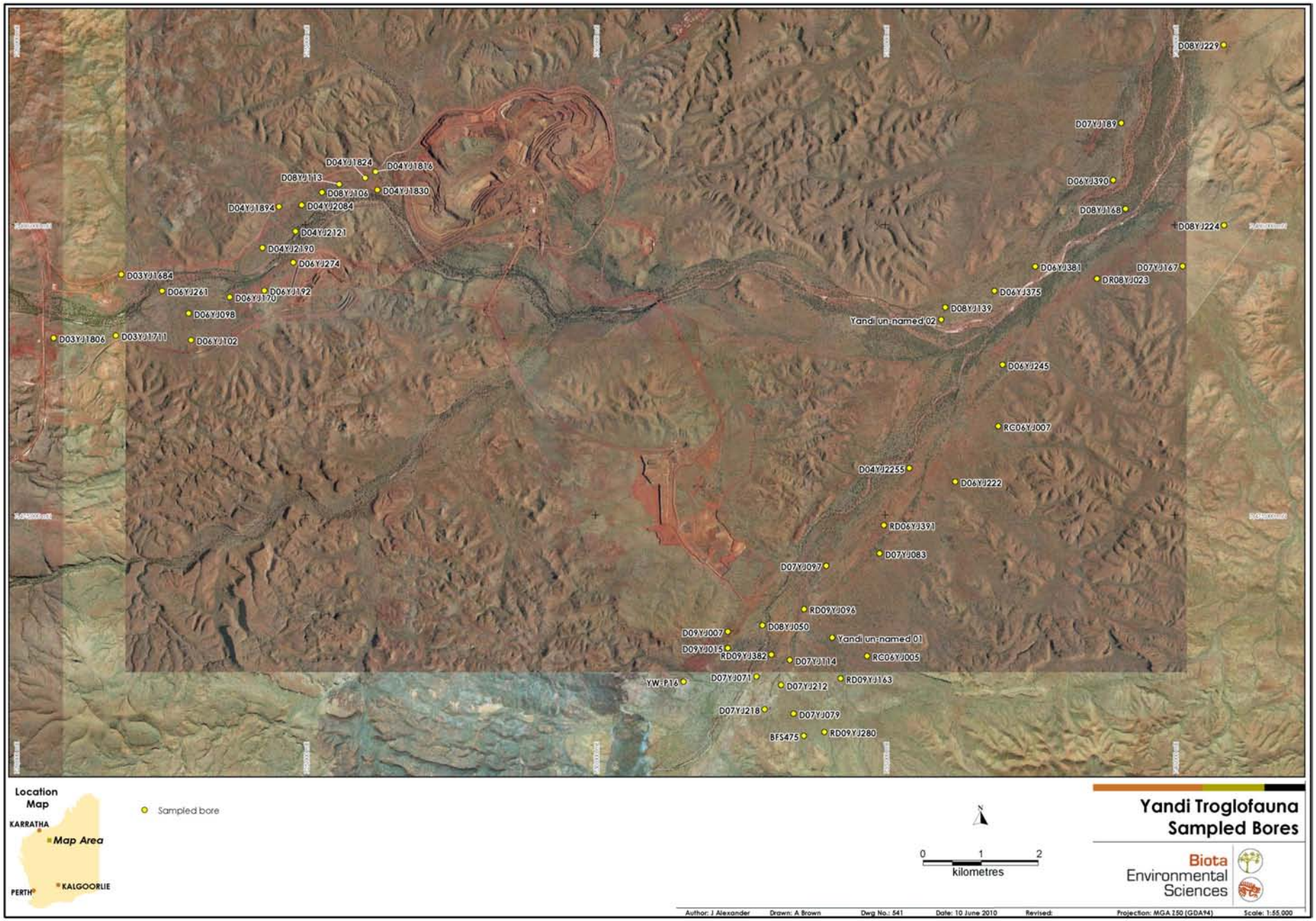

Figure 3.2: Location of sites sampled for Troglobitic fauna at Rio Tinto's Yandicoogina.

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4.0 Results

4.1 Stygofauna

4.1.1 Overview

A total of 3,695 specimens of stygobitic fauna were collected during five phases of sampling at RTIO Yandicoogina project area. Specimens represented six classes and at least nine orders. The largest contributor to faunal composition was the order Podocopida (class Ostracoda) with a total of 1,399 specimens, or 35.93 % of the total collection (Figure 4.1). The taxa Cyclopoida, Amphipoda, Isopoda and the Platyhelminthes made up a further 58.01 % of total specimens collected, with the remaining four taxa (Oligochaeta, Hydracarina, Harpacticoida and Bathynellacea) least recorded comprising a combined total of 6.06 %.

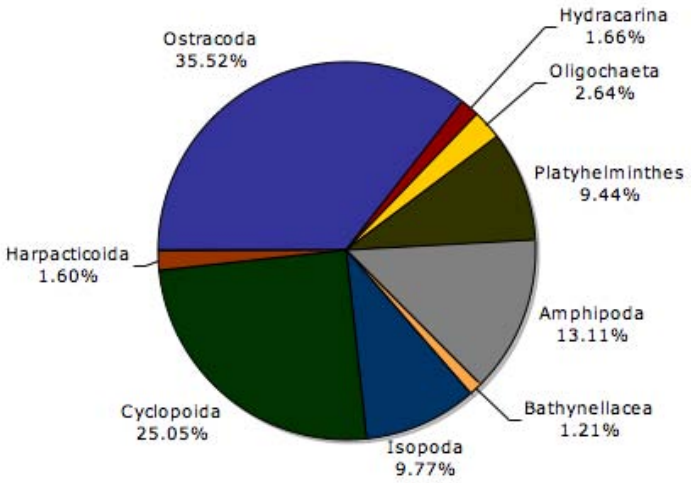

Figure 4.1: Proportional representation of taxa collected during the initial five phases of sampling.

Table 4.1: Summary of higher order taxa collected during all five phases of stygofauna sampling at Yandi.

Taxonomy			Total Individuals
Phylum	**Class**	**Order (common Name)**	
Crustacea	Malacostraca	Amphipoda (Landhoppers)	467
		Bathynellacea (Bathynellids)	43
		Isopoda (Slaters)	348
	Copepoda	Cyclopoida (Cyclopoids)	892
		Harpacticoida (Harpacticoids)	57
	Ostracoda	Podocopida (Ostracods)	1,399
Chelicerata	Arachnida	Hydracarina (Water Mites)	59
Annelida	Clitellata	Oligochaeta (Earthworms)	94
Platyhelminthes	Turbellaria	Indeterminate (Flatworms)	336
		Total	**3,695**

Collection data is further broken down into individual phases below.

4.1.2 Phase I

A total of 623 stygobitic fauna were collected during the first phase of sampling at Yandi in November 2003. These collections represented six classes and at least seven orders. The most commonly collected taxa belonged to the order Isopoda (187 specimens; 30.0 %), class Ostracoda (157 specimens; 25.2 %) and Turbellaria (126 specimens; 20.2 %) (Table 4.2). The water mites, or order Hydracarina, were the least commonly collected with six specimens recorded from four sites.

Table 4.2: Summary of higher order taxa collected during Phase I of sampling, November 2003.

Taxonomy			Total Individuals	No. of Sample Sites
Phylum	**Class**	**Order**		
Crustacea	Malacostraca	Amphipoda	78	6
		Isopoda	187	7
	Copepoda	Cyclopoida	26	4
	Ostracoda	Podocopida	157	10
Chelicerata	Arachnida	Hydracarina	6	4
Annelida	Clitellata	Oligochaeta	43	4
Platyhelminthes	Turbellaria	Indeterminate	126	7
		Total	**623**	

4.1.3 Phase II

In Phase II of stygofauna sampling a total of 326 specimens were collected from 39 sampling sites (Table 4.3). This included representatives from five classes and at least seven orders. The most commonly recorded taxa were the ostracods, with 182 specimens (55.8 % of total collections) from nine sampling sites.

Table 4.3: Summary of higher order taxa collected during Phase II of sampling, April 2005.

Taxonomy			Total Individuals	No. of Sample Sites
Phylum	**Class**	**Order**		
Crustacea	Malacostraca	Amphipoda	9	2
		Bathynellacea	40	1
		Isopoda	24	9
	Copepoda	Cyclopoida	8	4
	Ostracoda	Podocopida	182	9
Chelicerata	Arachnida	Hydracarina	23	6
Platyhelminthes	Turbellaria	Indeterminate	40	2
		Total	**326**	

4.1.4 Phase III

A total of 472 stygal specimens were collected during the Phase III survey, which included representatives from six classes and at least eight orders. The class Ostracoda was the most abundant group, with a total of 260 specimens from eight bores accounting for 55 % of the collected stygofauna (Table 4.4). Cyclopoid copepods were the second-most commonly collected with 78 specimens (16.5 %). A summary of the fauna collected during the Phase III sampling is provided in Table 4.4.

Table 4.4: Summary of higher order taxa collected during Phase III of sampling, August 2008.

Taxonomy			Total Individuals	No. of Sample Sites
Phylum	**Class**	**Order**		
Crustacea	Malacostraca	Amphipoda	47	9
		Isopoda	37	7
	Copepoda	Cyclopoida	78	9
		Harpacticoida	3	3
	Ostracoda	Podocopida	260	8
Chelicerata	Arachnida	Hydracarina	6	4
Annelida	Clitellata	Oligochaeta	3	1
Platyhelminthes	Turbellaria	Indeterminate	38	4
		Total	**472**	

The remains of a troglobitic arachnid (order Schizomida) were recovered from sample site WW3, which will be discussed further in Section 4.2.1.1.

4.1.5 Phase IV

Stygobitic fauna were located in 22 of the 35 successfully sampled sites during Phase IV, which included representatives from six classes and at least nine orders. The Class Ostracoda was the most commonly collected with a total of 552 specimens (41.9 % of total) from 13 sites with cyclopoid copepods making up another 38.1 % (503 specimens). The Order Bathynellacea contained the least representatives with 3 specimens (0.2 %) from three separate sites. A summary of fauna collected during Phase IV can be found in Table 4.5.

Table 4.5: Summary of higher order taxa collected during Phase IV of sampling, April 2009.

Taxonomy			Total Individuals	No. of Sample Sites
Phylum	**Class**	**Order**		
Crustacea	Malacostraca	Amphipoda	127	17
		Bathynellacea	3	3
		Isopoda	27	5
	Copepoda	Cyclopoida	503	21
		Harpacticoida	44	7
	Ostracoda	Podocopida	552	13
Chelicerata	Arachnida	Hydracarina	5	17
Annelida	Clitellata	Oligochaeta	5	2
Platyhelminthes	Turbellaria	Indeterminate	54	5
		Total	**1,320**	

The remains of a troglobitic arachnid (order Aranea) were recovered from site WW2 (see Section 4.2.1.2).

4.1.6 Phase V

A total of 1,011 stygobitic specimens were collected during Phase V of sampling in October 2009, which included representatives from six classes and at least eight orders (Table 4.6). The most commonly recorded class was the Ostracoda (293 specimens; 30.0 %), followed by the cyclopoid copepods (276 specimens; 27.3 %) and Amphipods (230 specimens; 22.7 %). The least commonly recorded taxa were the water mites (Hydracarina), with eight specimens coming from a single sampling site (MNEW1upstream; Appendix 1).

Table 4.6: Summary of higher order taxa collected during Phase V of sampling, October 2009.

Taxonomy			Total Individuals	No. of Sample Sites
Phylum	**Class**	**Order**		
Crustacea	Malacostraca	Amphipoda	230	17
		Isopoda	75	6
	Copepoda	Cyclopoida	276	19
		Harpacticoida	10	4
	Ostracoda	Podocopida	293	12
Chelicerata	Arachnida	Hydracarina	8	1
Annelida	Clitellata	Oligochaeta	41	5
Platyhelminthes	Turbellaria	Indeterminate	78	8
		Total	**1,011**	

The remains of a single troglobitic arachnid (order Pseudoscorpiones) were collected from sample site MNEW1upstream (see Section 4.2.1.3).

4.1.7 Annotated List of Stygobitic Fauna

4.1.7.1 Order Amphipoda

A total of 508 amphipod specimens were collected representing a single family and five species. Paramelitidae sp. 2 (DEC) (212 specimens) and *Chydaekata* sp. (151 specimens) were the most commonly recorded taxa, accounting for 71.5 % of all amphipods collected (Table 4.7). The species *Pilbarus millsi* was least commonly recorded with five specimens (1.0 %) collected from three sites. Two specimens were damaged and 127 specimens were juvenile and unable to be identified further.

Table 4.7: Summary of collected Amphipod specimens and their locations.

Taxonomy			Number collected	Sites collected from (total number of sites)
Order	**Family**	**Taxa (comments)**		
Amphipoda	Indeterminate	Amphipoda sp (damaged specimen)	1	Marillana07 (n= 1)
	Paramelitidae	*Chydaekata* sp.	151	99YJWB02, 99YJWB03, D08YJ050, Discharge, JSE2a, JSE6, JSE7, JSE8, JSE12, JSE14, JSE39, Marillana01, Marillana02, Marillana03, Marillana05, Marillana07, MNEW1upstream, Plant, PZ08YJSW003, WSO04obs, WW2, WW3, WW4 (N= 23)
		Maarka weeliwolli	11	Discharge, JSE14, Marillana03, Marillana07, MNEW1upstream, Plant, WW2, YM119 (n= 8)
		Maarka sp (damaged specimen)	1	JSE3 (n= 3)
		Paramelitidae sp. (juvenile specimens)	127	D08YJ050, JSE14, Marillana01, Marillana07, MB08YJPC021, MNEW1upstream, PZ08YJSW003, PZ08YOXB004, W02YJ001, WB/YJ99, YM119 (n= 11)
		Paramelitidae sp. 2 (DEC)	212	99YJWB02, D08YJ050, JSE2a, JSE14, JSE39, Marillana01, Marillana02, Marillana03, Marillana06, Marillana07, MNEW1upstream, Plant, PZ08YJSW003, PZ08YOXB004, WB/YJ99, WW2, WW3, YM119 (n= 18)
		Pilbarus millsi	5	99YJWB02, Marillana06, WW3 (n= 3)
		Total	**508**	

Most taxa identified have been recorded outside the project area with Paramelitidae sp.2 (DEC), *Pilbarus millsi* and the genus *Chydaekata* sp. having a wide-ranging distribution throughout the Pilbara Region (Biota unpublished Data, Finston et al. 2007). The wider distribution of taxa *Maarka* sp. weeliwolli is less well documented, however is unlikely to display short-range endemism based on aquifer connectivity and the distribution of the other paramelitids present in the study area.

Amphipod Genetic Analysis – Phase I

Eleven amphipods collected from the JSE area during Phase I (2003) of sampling were subject to molecular analysis. These amphipods were also compared with specimens from elsewhere in the

region. The dendrogram arising from this work confirmed that all specimens belonged to the family Paramelitidae (see Appendix 2).

Three species from the family Paramelitidae were defined from the genetic analysis consisting of:

- *Pilbarus millsi* - a widespread paramelitid species complex that shows regional variation in association with contemporary surface water catchments. *P. millsi* also shows close phylogeographic links with Weeli Wolli Springs, with the individuals found in Weeli Wolli and Marillana Creeks clearly belonging to the same species (sequence divergences from 0.2% - 2.3%; Appendix 2).
- *Chydaekata* sp. - sequence divergences ranging from 1% – 2.8% between specimens from the three locations and almost certainly belong to the same species.
- Paramelitidae sp. 2 (DEC) - shows some affiliation with specimens from Weeli Wolli, but sequence divergences are high (~24% – 25%), eliminating the possibility that they are the same species.

4.1.7.2 Order Bathynellacea

A total of 43 specimens of bathynellid syncarids were collected from four locations within the Yandi project area. These specimens represented two distinct genera (*Atopobathynella* and *Notobathynella*) and a single family, Parabathynellidae. Forty-two of the collected specimens belonged to the genus *Atopobathynella*, which were recorded from three sites (Table 4.8).

Table 4.8: Summary of collected bathynellid specimens and their locations.

Taxonomy			Number collected	Sites collected from (total number of sites)
Order	**Family**	**Taxa (comments)**		
Bathynellacea	Parabathynellidae	*Atopobathynella* sp.	42	PZ08YOXB006, SA, WW3 (n= 3)
		Notobathynella sp.	1	JSE14 (n= 1)
		Total	**43**	

Molecular and morphological species characterisation is ongoing in the previously poorly known Bathynellacea order and it is unlikely that species level identification for those specimens collected at Yandi will be available in the near future. The family Parabathynellidae, and in particular the genus *Atopobathynella*, are widespread throughout Western Australia (Cho et al. 2006).

4.1.7.3 Order Isopoda

Four taxa belonging to a single family, Tainisopidae, were collected during sampling within the Yandi project area. A total of 348 specimens were collected with 17 juvenile individuals unable to be identified to species level. *Pygolabis* sp. nov. 1 was most recorded with 175 (50.3 %) specimens from five sites and *Pygolabis weeliwolli* was recorded from 14 sites.

Table 4.9: Summary of collected isopod specimens and their locations.

Taxonomy			Number collected	Sites collected from (total number of sites)
Order	**Family**	**Taxa (comments)**		
Isopoda	Tainisopidae	*Pygolabis sp*. (juvenile)	17	JSE14, Marillana01, Marillana02, Marillana06, Marillana07, MNEW1upstream, Plant, WW3 (n= 8)
		Pygolabis weeliwolli	148	99YJWB02, 99YJWB04, Airport EA, Discharge, Fauna, JSE2a, Marillana05, MNEW1upstream, Plant, PZ08YJSW003, SB, WSO04obs, WW3, YM119 (n= 14)
		Pygolabis humphreysi	8	Marillana07 (n= 1)
		Pygolabis sp. nov. 1	175	Discharge, Marillana03, Marillana07, MNEW1upstream (n= 4)
		Total	**348**	

Plate 4.1: *Pygolabis weeliwolli* collected from Yandi project area.

The genus *Pygolabis* is widespread throughout the Pilbara region with *P. humphreysi* and *P. weeliwolli* located outside the project area along Weeli Wolli Creek (Biota unpublished data). Specimens of *Pygolabis* sp. nov. 1, which is considered morphologically distinct from *P. weeliwolli*, are currently with George Wilson (Australian Museum). Given aquifer conditions and *Pygolabis* characteristics it is unlikely that this undescribed species is confined to the Yandi Project area.

This preliminary genetic analysis completed on Phase I collections indicated two discrete taxa within the isopod specimens assessed, corresponding to *Pygolabis weeliwolli* and *Pygolabis* sp. nov. 1, which were also identified on the basis of morphology.

4.1.7.4 Class Copepoda

A total of 949 specimens of stygobitic copepod were collected. These specimens were representatives of 11 taxa and two families and two orders, Cyclopoida and Harpacticoida. Among the specimens were 25 juvenile copepodites that were unable to be morphologically identified to species level. The cyclopoid copepod *Diacyclops humphreysi humphreysi* was most commonly recorded with 744 (78.4 % of total copepods) specimens located across 24 sites.

Table 4.10: Summary of collected copepod specimens and their locations.

Taxonomy			Number collected	Sites collected from (total number of sites)
Order	**Family**	**Taxa (comments)**		
Cyclopoida	Indeterminate	cyclopoida sp (Juvenile)	2	Marillana07 (n= 1)
	Cyclopidae	*Diacyclops sp* (Juvenile)	22	Marillana02, MNEW1upstream, SB (n= 3)
		Diacyclops cockingi	10	Marillana06, Marillana07, MNEW1upstream, SB (n= 4)
		Diacyclops humphreysi humphreysi	744	99YJWB03, 99YJWB04, D03YJ1667, D08YJ050, JSE14, JSE36, JSE37, JSE39, Marillana01, Marillana02, Marillana03, Marillana06, Marillana07, MNEW1upstream, Plant, PZ08YJSW003, PZ08YOXB006, PZ09YJSW020, WB/YJ99, WSO04obs, WW2, WW3, WW4, YM119 (n= 24)
		Diacyclops humphreysi unispinosus	62	99YJWB02, WW2 (n= 2)
		Diacyclops sobeprolatus	37	B1, MB08YJPC021, PZ08YJSW003, 99YJWB02 (n= 4)
		Mesocyclops darwini	3	Marillana06 (n= 1)
		Metacyclops pilbaricus	5	PZ08YOXB004, PZ08YOXB006, W01YJ15D (n= 3)
		Microcyclops varicans	5	MNEW1upstream (n= 1)
		Goniocyclops sp.	2	PZ08YOXB004 (n= 1)

Taxonomy			Number collected	Sites collected from (total number of sites)
Order	Family	Taxa (comments)		
Harpacticoida	Canthocamptidae	Canthocamptidae sp (juvenile)	1	WSO04obs (n= 1)
		Canthocamptidae sp. B1	26	JSE14, Marillana07, Plant, WW2, WW3 (n= 5)
		Australocamptus sp.	2	Marillana02, WW3 (n= 2)
		Inermipes sp. B2	28	99YJWB02, 99YJWB04, JSE14, Plant, WW2, YM119 (n= 6)
		Total	**949**	

The class Copepoda, and in particular the order Cyclopoida, are frequently collected stygobitic fauna and have been well collected and documented in the Pilbara. All of the taxa identified to species level have been described from outside of the Yandi project area. Three of the remaining four taxa, Canthocamptidae sp. B1, *Australocamptus* sp. and *Inermipes* sp. B1, are located from site along both Marillana and Weeli Wolli Creek and as such, unlikely to display short range endemism within the project area. Further collections of the taxa *Goniocyclops* sp. would be necessary to advance distribution knowledge beyond the proposed Oxbow deposit (site PZ08YOXB004), however it is unlikely to have restricted distribution based on known Cyclopidae characteristics and distribution of fauna collected from the same sample site (*Metacyclops pilbaricus*, Paramelitidae sp. 2 (DEC)).

4.1.7.5 Order Oligochaeta

A total of 94 oligochaete specimens were collected from six taxa and three families (Table 4.11). Six of the collected specimens were juvenile and unable to identified to species. (Adrian Pinder pers. comm.) nr *Ainudrilus* sp. was most commonly recorded with all 43 specimens collected in Phase I from four sites.

Table 4.11: Summary of collected oligochaete specimens and their locations.

Taxonomy			Number collected	Sites collected from (total number of sites)
Order	Family	Taxa (comments)		
Oligochaeta	Enchytraeidae	Enchytraeidae (Juvenile)	3	Plant (n= 1)
		Enchytraeidae Pilbara sp. 1 (pss)	37	Marillana02, WW2 (n= 2)
		Enchytraeidae pilbara sp. 2 (pss)	5	Marillana02, MNEW1upstream, WW3 (n= 3)
	Phreodrilidae	Phreodrilidae with similar ventral chaetae (pss)	1	D08YJ050 (n= 1)
	Tubificidae	nr *Ainudrilus* sp.	43	Marillana05, Marillan07, Plant, W02YJ001 (n= 4)
		Pristina aequiseta	1	D08YJ050 (n= 1)
		Tubificidae sp. (Juvenile)	3	Plant (n= 1)
		Tubificidae morphospecies 1/1a (pss)	1	MNEW1upstream (1)
		Total	**94**	

Oligochaete worms are generally not thought to display short-range endemism and many of the collected taxa have been located elsewhere in the Pilbara (Biota unpublished data, DEC Pilbara Stygofauna Survey unpublished data).

4.1.7.6 Order Hydracarina

Fifty-nine water mite (Hydracarina) specimens were collected from 10 sites in the project area, including four indeterminate species that were either juvenile or damaged (Table 4.12). The genera *Recifella* and *Stygiolimnochares* were most commonly recorded from Marillana Creek comprising 50.8 % of total collected. Australian stygal Hydracarina are poorly studied and us such their status as short-range endemics is unknown.

As part of the Yandicoogina JSE Ministerial Statement (Condition 695; M11) and subsequent

Stygofauna Management Plan to "*establish additional data on the distribution of existing stygofauna species and communities, particularly the ostracod Gomphidella sp. and the water mite Recifella sp., to demonstrate there is no threat to the species*", additional data on the water mite genus *Recifella* sp. (nr P1, DEC code) has been collected and collated to improve species knowledge, including distribution. All specimens have been submitted to the Western Australian Museum for species description.

Table 4.12: Summary of collected Hydracarina specimens and their locations.

Taxonomy			Number collected	Sites collected from (total number of sites)
Order	**Family**	**Taxa (comments)**		
Hydracarina	Aturidae	*Axonopsella* sp. B1	14	Marillana06, Marillana07, MNEW1upstream, YM119 (n= 4)
	Arrenuridae	*Arrenurus* sp. 1	4	Marillana07, MNEW1upstream (n= 2)
		Arrenurus sp. 2	3	MNEW1upstream (n= 1)
	Axonopsidae	*Albia* sp.	1	MNEW1upstream (n= 1)
	Indeterminate	Hydracarina indet. (Damaged)	2	Marillana07, Plant (n= 2)
		Acarina sp. (Juvenile)	2	Marillana01 (n= 1)
	Limnesiidae	*Limnesia* sp. B1	2	MNEW1upstream (n= 1)
	Limnocharidae	*Stygiolimnochares* sp B1	10	Marillana06 (n= 1)
	Mideopsidae	*Mideopsinae* sp. (nr Penemidopsis)	1	Marillana06 (n= 1)
	Unionicolidae	*Recifella* sp. (nr P1, DEC code)	20	Discharge, JSE3, Marillana01, Marillana03, Marillana05, Marillana06, Marillana07, MNEW1upstream (n= 8)
		Total	**59**	

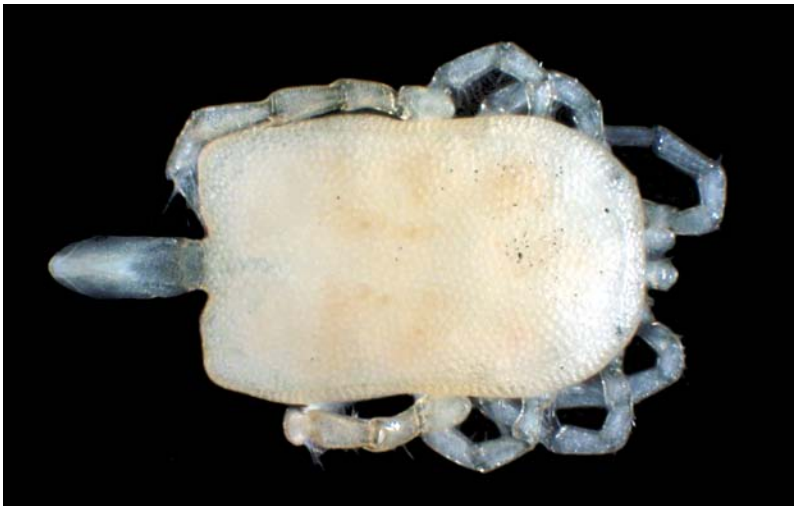

Plate 4.2: Male *Arrenurus* sp.1 hydracarina specimen collected from bore MNEW1upstream (Photo: J. McRae).

4.1.7.7 Class Ostracoda

The ostracods were the most abundant collections at Yandi with a total of 1,399 specimens collected from 24 sites (Table 4.13). *Meridiescandona facies* and *Notocandona boultoni* comprised 979 (70 %) specimens of the total collected with multiple species represented by a single specimen (*Gomphodella* Sp. A (BOS200), *Areacandona mulgae*, ?*Candonopsis* n. sp. and *Notocandona modesta*).

Table 4.13: Summary of collected Ostracoda specimens and their locations.

Taxonomy			Number collected	Sites collected from (total number of sites)
Order	**Family**	**Taxa (comments)**		
Ostracoda	Limnocytheridae	*Gomphodella hirsuta*	4	Marillana06, Marillana07, WW3 (n= 3)
		Gomphodella sp. (Juvenile)	1	Marillana07 (n= 1)
		Gomphodella sp. A (BOS200)	1	Marillana06 (n= 1)
		Gomphodella sp. "yandi"	41	Marillana01, Marillana05, MNEW1upstream, WW2 (n= 4)
	Candoninae	*Areacandona mulgae*	1	99YJWB03 (n= 1)
		?Candonopsis n. sp.	1	MNEW1upstream (n= 1)
		Meridiescandona facies	477	B1, Discharge, Fauna, JSE8, JSE14, Marillana01, Marillana02, Marillana03, Marillana05, Marillana06, Marillana07, MNEW1upstream, Plant, W02YJ001, WW2, WW3, WW4 (n= 17)
		Meridiescandona marillanae	178	B1, JSE4, Marillana07, SB, WW3 (n= 5)
		Meridiescandona lucerna	47	Marillana07, WW3, WW4, YM119 (n= 4)
		Meridiescandona sp. (indeterminate)	134	Discharge, Marillana01, Marillana02, Marillana05, MArillana06, Marillana07, MNEW1upstream, Plant, W02YJ001 (n= 9)
		Notocandona boultoni	502	99YJWB02, B1, Discharge, JSE14, Marillana01, Marillana03, Marillana06, Marillana07, MNEW1upstream, Plant, PZ08YJSW003, WW2, YM119, (n= 13)
		Notocandona modesta	1	B1 (n= 1)
		Pilbaracandona sp.	11	Discharge, Marillana07, MNEW1upstream (n= 3)
		Total	**1,399**	

As part of the Yandicoogina JSE Ministerial Statement (Condition 695; M11) and subsequent Stygofauna Management Plan, additional data on the Ostracod species *Gomphodella* sp. "yandi" has been collected and collated to improve species knowledge, including distribution. All specimens have been submitted to the Western Australian Museum for species description.

4.1.7.8 Phylum Platyhelminthes

A total of 336 platyhelminth worms were collected from 10 sites across the project area (Table 4.14). While superficially very similar morphologically, further work would be needed to identify to species level. Due to a lack of expertise in the area, it is unlikely that any species level resolutions will be forthcoming.

Table 4.14: Summary of collected platyhelminth specimens and their locations.

Taxonomy			Number collected	Sites collected from (total number of sites)
Class	**Order**	**Taxa (comments)**		
Turbellaria	Indeterminate	Turbellaria sp.	336	D08YJ050, Discharge, Marillana01, Marillana02, Marillana06, Marillana07, MC10, MNEW1upstream, PZ08YJSW003, W01YJ15D (n= 10)
		Total	**336**	

4.2 Troglofauna

Four specimens of troglofauna have been collected during stygofauna sampling during the last three phases:

- Phase III – a single schizomid (Order Schizomida) remains collected from Billiards site WW3 in August 2008;
- Phase IV – a single spider (Order Aranea) specimen collected from Billiards site WW2 in April 2009; and
- Phase V – a single pseudoscorpion (Order Pseudoscorpiones) specimen collected from JSW site MNEW1upstream

A total of 2,527 invertebrate specimens were collected using colonisation leaf-litter traps between October and December 2009. These specimens represented 14 orders from seven classes. The best collected taxa were the terrestrial order Acarina, or mites, which had 1,619 specimens (or 64.1 % of total) (Table 4.15). A single troglomorphic Blattodea (Cockroach) was observed on a trap retrieved from sites D06YJ375, but was not recovered in the laboratory.

Most specimens collected showed little evidence of troglomorphic characteristics (de-pigmented, elongated limbs or reduced eyes) and were judged to be epigean or surface dwelling. An exception to this is the presence of six polyxenid millipede specimens and a single pauropod specimen, which displayed some troglomorphic characters. For the purposes of this report, no further consideration will be given to those specimens considered not to be troglobitic or short-range endemic.

Table 4.15: Overview of specimens collected during Phase I troglofauna sampling at Yandi (species in bold indicate troglomorphic specimens).

Taxon			Total Individuals	Number of Sample Sites
Subphylum	**Class**	**Order (Common Name)**		
Annelida	Clitellata	Oligochaeta (Earthworm)	22	1
Chelicerata	Arachnida	Acarina (Mites)	1,619	43
		Aranea (Spiders)	1	1
Crustacea	Malacostraca	Isopoda (Slaters)	1	1
Uniramia	Collembola	Collembola (Springtails)	690	27
	Diplopoda	**Polyxenida (Pincushion Millipedes)**	**6**	**2**
	Insecta	Blattodea (Cockroaches)	5	1
		Coleoptera (Beetles)	4	3
		Diptera (Flies)	22	10
		Hemiptera (Bugs)	1	1
		Hymenoptera (Ants)	2	2
		Isoptera (Termites)	151	5
		Thysanura (Silverfish)	2	1
	Pauropoda	**Pauropod (Pauropods)**	**1**	**1**
		Total	**2,527**	

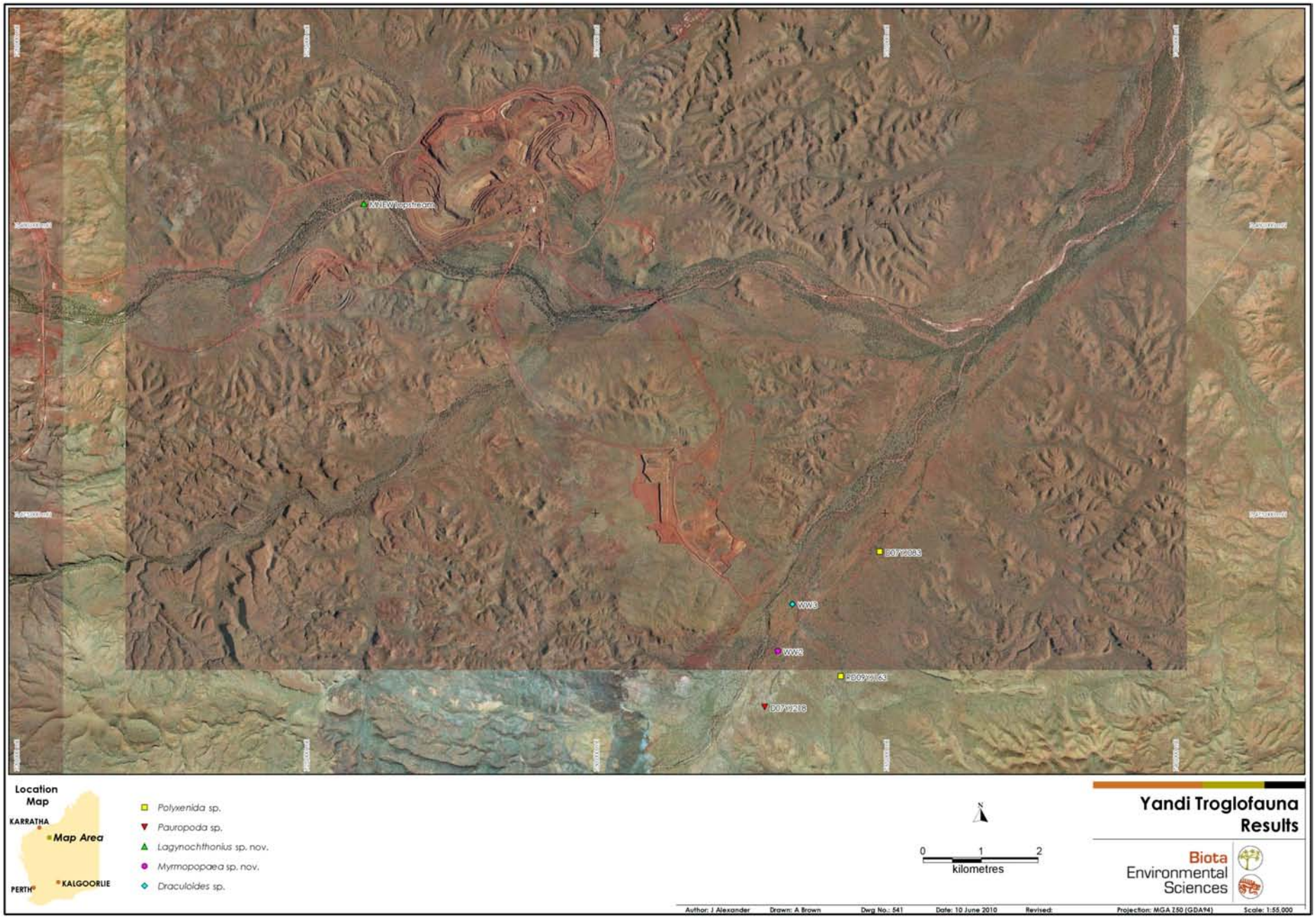

Figure 4.2: Troglobitic fauna collected from the Yandi project area.

4.2.1 Annotated List of Troglobitic Fauna

4.2.1.1 Order Schizomida

A single specimen from the order Schizomida was collected while sampling for stygofauna in August 2008. This specimen was identified as belonging to the genus *Draculoides* however because the specimen is damaged, species level identification is not possible. More collections will be needed in order to place the specimen into better context.

4.2.1.2 Order Araneae

A single mature, female spider specimen belonging to the order Araneae was collected from sample site WW2 while sampling for stygofauna in April 2009. This specimen was identified as a previously unrecorded taxon (M. Harvey pers. comm. 2009) belonging to the genus *Myrmopopaea* (*Myrmopopaea* sp. nov).

4.2.1.3 Order Pseudoscorpiones

A single troglobitic pseudoscorpion specimen belonging to the genus *Lagynochthonius* was collected from alluvial substrate at site MNEW1upstream. This mature, male specimen is a new species and further specimens would be required before the species is described.

This site MNEW1upstream is located in alluvium substrate in a river system, which is subject to seasonal flooding events. It is likely that troglobitic specimens in this area may have been dispersed from nearby source habitats.

4.2.1.4 Order Polyxenida

Six specimens of troglomorphic pincushion millipedes were collected from two sites at Yandi. The taxonomy of the Australian polyxenid fauna is very poorly known with only four described species (Framenau 2009). Two surface species occur in Western Australia, *Unixemus attemsi* and *U. mjoebergi* (Duy-Jacquemin and Condé 1967; Koch 1985). The latter species appears periodically in irruptive populations throughout the northern parts of the state (Koch 1985).

A total of six polyxenid specimens were collected from two sample sites (D07YJ083 and RD09YJ163) within the study area however, due to the poorly resolved taxonomy in this group, the specimens collected from the study areas cannot be distinguished at species level based on morphology.

Ongoing genetic analyses of Pilbara populations are being used to resolve uncertainty as to the status of the Polyxenid taxonomy. Populations elsewhere have demonstrated little short-range endemism and as such, for the purposes of this report, are considered unlikely to be troglobitic.

4.2.1.5 Order Pauropoda

These tiny arthropods are rarely collected and the Western Australian Museum collection has only a handful of specimens from widely scattered locations (Harvey and Framenau 2009). A single pauropod specimen was collected from sample site D07YJ218, within the Yandi project area.

The status of specimen from Yandi is uncertain. It is possible that some pauropod species in Western Australian represent SRE species, but other pauropod species are widely distributed around the world, suggesting that short- range endemism is not prevalent in this group. A full taxonomic treatment of the Western Australian specimens is necessary by a specialist before their status can be properly assessed.

5.0 Discussion

5.1 Stygofauna

Stygobitic fauna surveys collected a total of 46 taxa (excluding damaged and juvenile specimens; see Section 4.1), from a total of 18 families and nine orders. Species composition at Yandi followed the general trends elsewhere in the Pilbara, with crustaceans being the dominant groups (Table 4.1).

Many of the collected taxa have been previously described from locations outside the project area and have a large spatial distribution. Of the identifiable 48 taxa recorded, 30 taxa were located at multiple sample sites, and 20 taxa located at four or more sites.

Based on the results of the survey work completed at Yandi, 26 of the 46 taxa collected have been shown to have a distribution wider than that of the predicted dewatering area (See Appendix 3, Figures 5.4, 5.5 and 5.6). Of the remaining 20 taxa, a further nine have been previously collected or described from studies outside the Yandi project area and are therefore not at risk from proposed developments. The remaining 11 species are previously undescribed taxa known only from within the predicted drawdown area. Given the findings for other taxa and the general connectivity of aquifer habitats in the area, this is more likely to be an artefact of sampling than true distribution restriction.

Table 5.1: Taxa only recorded from sites within predicted drawdown contours.

Taxa	Site	Comment
Copepoda		
Goniocyclops sp.	PZ08YOXB004	The family cyclopidae are known to be wide ranging. Unlikely to be restricted to the drawdown area
Hydracarina		
Arrenurus sp. 1	Marillana07, MNEW1upstream	-
Arrenurus sp. 2	MNEW1upstream	-
Albia sp.	MNEW1upstream	-
Limnesia sp. B1	MNEW1upstream	-
Stygiolimnochares sp B1	Marillana06	-
Mideopsinae sp. (nr Penemidopsis)	Marillana06	-
Ostracoda		
Gomphodella sp. A (BOS200)	Marillana06	Unlikely to be restricted to the drawdown area
?Candonopsis n. sp.	MNEW1upstream	Unlikely to be restricted to the drawdown area
Pilbaracandona sp.	Discharge, Marillana07, MNEW1upstream	Unlikely to be restricted to the drawdown area
Platyhelminthes		
Turbellaria sp.	D08YJ050, Discharge, Marillana01, Marillana02, Marillana06, Marillana07, MC10, MNEW1upstream, PZ08YJSW003, W01YJ15D	Class Turbellaria known from elsewhere in the Pilbara. Taxonomic resolution unlikely in the near future.

Of the 11 taxa recorded from the drawdown area, six belong to the class Hydracarina. Included in this class is the taxon *Recifella* sp. (P1, DEC code), which while recorded from multiple Impact sites, has also been located from reference site Marillana03 (Figure 5.4 – 5.6). Ministerial Conditions for the previous JSE approval (695; M11) stipulated that adequate effort should be spent in locating fauna outside the impact area "*particularly the ostracod Gomphodella sp. and water mite Recifella sp., to demonstrate there is no threat to these species*". All *Recifella sp*. specimens have been forwarded to the Western Australian Museum for morphological analysis and species description.

It is likely that these species of stygal mites occur more widely than the predicted impact area at Yandi especially given *Axonopsella* sp. B1 has been recorded from both drawdown and reference sites. However, the distribution patterns of stygal water mites are less well documented in the Pilbara. Given the level of connectivity along the alluvial substrate as well as the significant seasonal water movement through the area, especially during cyclonic activity, short-range endemism among stygal mites at the scale of the Oxbow and JSW proposal is unlikely.

For the remaining copepod and ostracod taxa, it is unlikely that these will be confined to project dewatering zones. Both groups contain species located both in similar reference sites as well as dewatering zones (for example *Diacyclops humphreysi humphreysi* and *Gomphodella* sp. yandi), which indicates a level of connectivity between sites. It is likely the other species of the same genera are distributed at least throughout the local catchment. Due to the lack of taxonomic framework for the phylum Platyhelminthes, it is not possible at this stage to determine species distributions. The class Turbellaria however has been recorded from elsewhere in the Pilbara including Bungaroo Valley and from the DEC Pilbara Stygofauna Survey (Eberhard et al. 2008). A regional molecular study will be required to resolve distributions to species level.

As part of the existing SFMP, stygofauna sampling will be ongoing until stygal communities are adequately documented and the species accumulation curve has become asymptotic. It is recommended during future phases that, in addition to pre-selected sites within the impact area of the drawdown contours, effort be made to select additional sampling sites outside the area of impact. These sites should focus predominantly, but not be limited to, available bores adjacent to Marillana Creek northwest of Oxbow, Yandicoogina Creek and Weeli Wolli Creek, extending north and south of Billiards.

Data will be consolidated and compared with collections from future phases to document trends in species composition and distribution for a better understanding of the effects of direct habitat removal on stygal populations in the area.

5.1.1.1 Marillana and Weeli Wolli Creek habitat connectivity

Drilling and geophysical surveys have indicated that the alluvial deposits, which based on observed collection and bore hole information, are considered to be the primary habitat for stygofauna at Yandi. These deposits are connected throughout Marillana and Weeli Wolli Creeks, suggesting there is no geological or geographical restrictions placed on colonising stygobitic fauna. The depth and volume of saturated alluvia varies throughout the system however there appears to be no significant barriers between the two river systems. An example of this connectivity can be seen from supplied cross sections from Oxbow, JSW and Billiards deposits (Section 2.2). Additionally, A selection of drill logs (Appendix 4) from the CID and creek systems indicate the varying depths and connectivity of stygobitic habitat. Note the presence of similar geologies and the presence of varying depths of continuous alluvial deposit.

It is unlikely that species within the systems would display short-range endemic characteristics, considering the unrestricted nature of the primary habitat, particularly in light of the large volumes of water that flow seasonally through the creeks. It is more likely that recorded species restrictions are a result of sampling effect.

5.1.2 Stygobitic Fauna Species Accumulation

The species accumulation curve for the stygobitic fauna collected during the Phases I – V indicates that while new species are recorded every phase of sampling, the curve is slowly reaching its asymptote. This indicates a reduced rate at which additional new species are likely to be recorded with continued survey effort (Figure 1.1). It should be noted that statistical accuracy of this preliminary species accumulation curve will increase with further sampling phases. Damaged and juvenile specimens were excluded from the species accumulation curve so as not to adversely affect final curve values and subsequent S_{max} values.

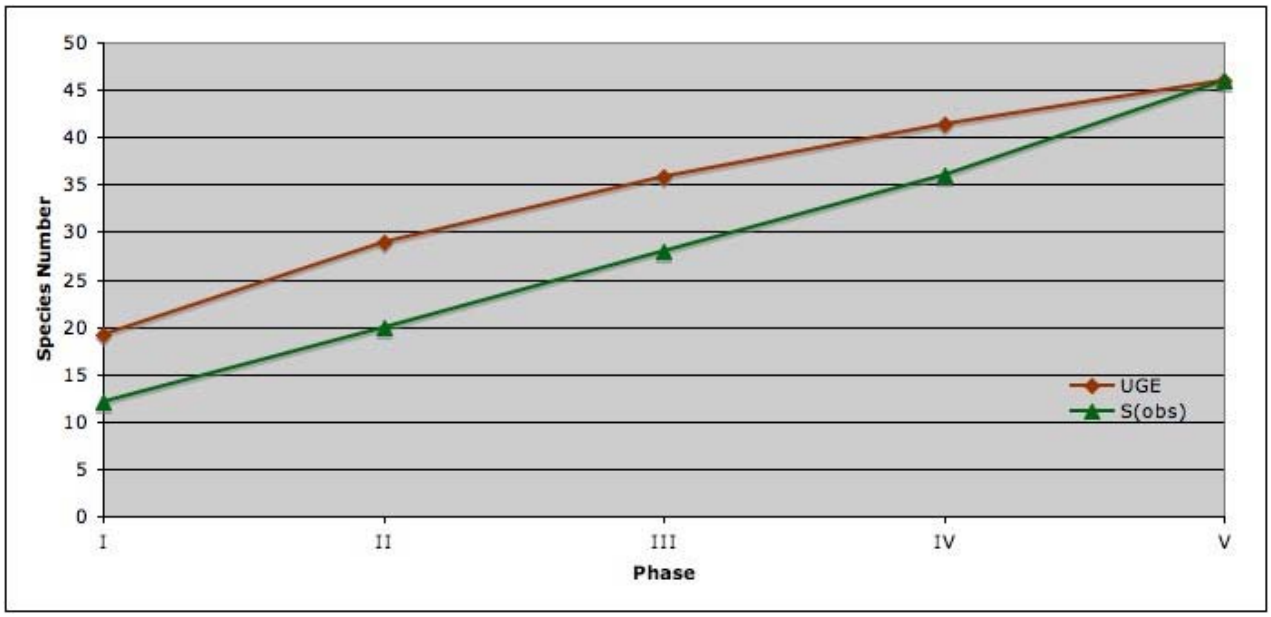

Figure 5.1: Sample-based (UGE) and randomised (S{obs}) species accumulation curves for all stygobitic fauna collected during the first five phases at Yandi.

The S_{max} values range from 54.3 to 64.4 species with a mean S_{max} of 59.3 species (Table 5.2). These estimates appear consistent with the trajectory of the species accumulation curve (Figure 5.1) where it can be seen from the S(obs) curve that species number has increased by 18 species in the last two phase (Phases IV and V).

Table 5.2: Observed and estimated stygobitic fauna species richness at the Yandi project area.

Observed species total	46

Richness Estimator	**Estimated S_{max}**
Jacknife1	64.4
Bootstrap	54.3

5.1.3 Potential Impacts on Stygobitic Fauna

There are primary and secondary impacts that have the potential to adversely affect stygobitic fauna populations,. Primary impacts are those that directly impact on the availability of viable habitat for use by subterranean fauna, whereas secondary impacts inhibit the ability of fauna to survive in previously viable habitat.

Primary impacts on subterranean fauna during Yandi mining operations have the potential to reduce the availability of stygofauna habitat by the direct removal (mining) of the alluvium to access the deeper Channel Iron Deposit. Dewatering of groundwater, causing alluvial substrates to dry out can also reduce habitat availability. Direct removal of primary alluvial habitat can be reduced within project boundaries by avoiding disturbances to river stratigraphy, where possible.

Cross sections of proposed JSW and Oxbow mining pits (Figures 5.2 and 5.3) indicate the amount of submerged habitat that will remain at the peak of mining. Approximately 12 m of BCC, 15 m of LGC and up to 3 m of GVL (Table 2.1, Figure 2.3) will remain from the base of the pit post mining. Additionally, approximately 15 m of BCC and up to 3 m of GVL and GVU will remain from the sides of the pit. These geologies characteristically have varying porosity (RTIO pers. comm. 2010) and could provide secondary habitat for stygobitic fauna post mining.

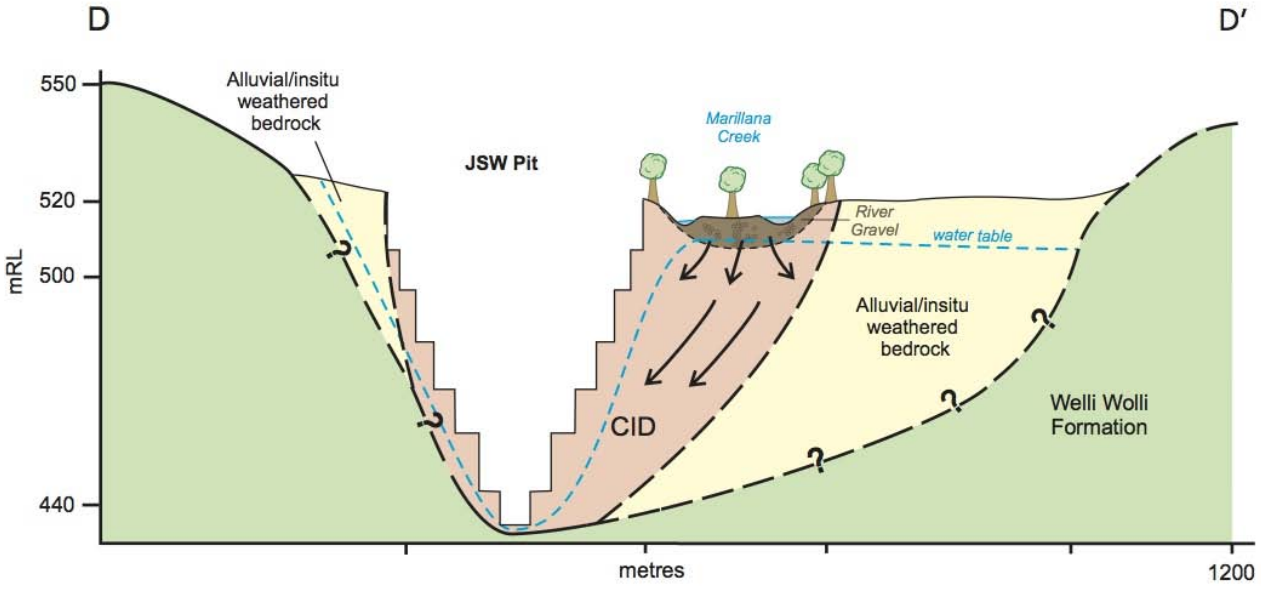

Figure 5.2: **Cross section of proposed JSW pit outline** (figure supplied by RTIO).

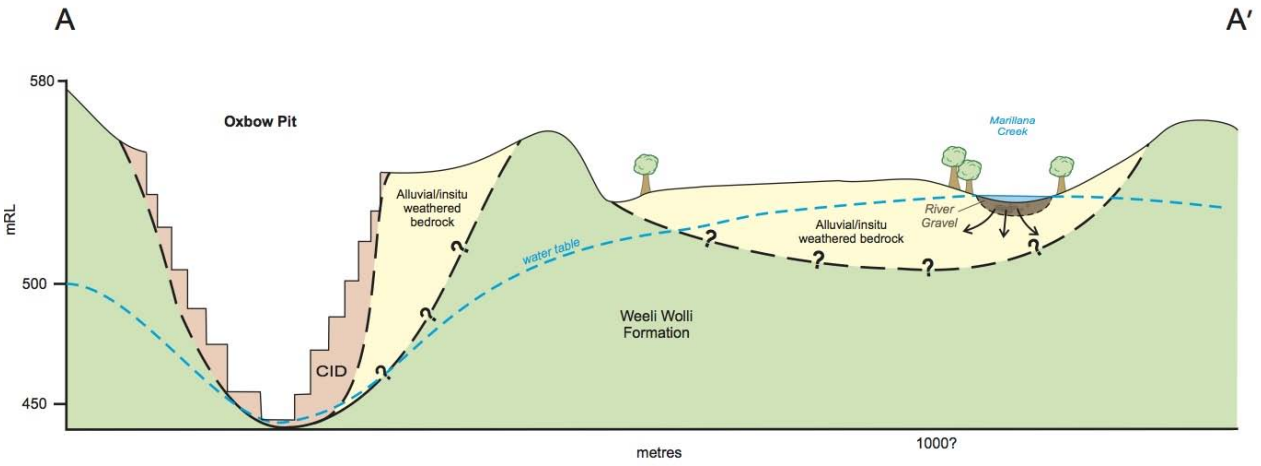

Figure 5.3: **Cross section of proposed Oxbow pit outline** (figure supplied by RTIO).

It can also be seen from these cross sections that areas of saturated alluvial substrate will be left adjacent to mining operations and will act as primary habitat.

5.1.3.1 Proposed groundwater drawdown for life of operations

Groundwater modelling completed by Rio Tinto has indicated that groundwater drawdown will result in a cone of depression running the length of the channel iron deposit and surrounding existing mining operations (Figures 5.4 – 5.6). Re-injection of excess discharge water will result in a rise of the water table around the Billiards prospect as well as at various sites along Marillana Creek. Operation measurements indicate that that there is no change to water quality between areas of dewatering and water re-injection, or from a result of the re-injection process (RTIO pers. comm. 2010). This influx of water would not be predicted to have detrimental effect on stygobitic populations in the Billiards reinjection area and as such sample sites from these areas are considered to be Reference sites for the purposes of this report.

As development in the area progresses, dewatering will change focus to reflect stages of mining. A temporal model of dewatering and groundwater re-injection, encompassing the closure of Junction Central and JSE, and the proposed developments of JSW and Oxbow, can be seen in Figures 5.4, 5.5 and 5.6. Areas of negative drawdown values indicate areas where rises in the watertable will occur due to groundwater discharge and reinjection.

The 2014 drawdown contours (Figure 5.4) indicate the initial dewatering efforts associated with JSW deposit as well as continuing dewatering at JC and JSE. Proposed dewatering in 2020 (Figure 5.5) indicates initial dewatering at the Oxbow development however a reduction at JC. Additionally, dewatering has increased at JSW. Dewatering and reinjection in 2022 has remained relatively unchanged except for a slight increase in dewatering at Oxbow. Groundwater re-injection throughout the entire timeframe is occurring to various degrees at Billiards and south of JC along Marillana Creek. Projections indicate that JC, JSE and JSW dewatering will have terminated by 2028 under the current proposal (RTIO pers. comm. 2010).

The figures described above show that areas of stygofauna habitat would be maintained as reference areas throughout the life of operations along both Marillana and Weeli Wolli Creeks. These reference areas act as refugia for stygofauna and should be strictly preserved. On mine closure and rehabilitation, these refuge areas will also aid in recolonisation of surrounding areas. Annual sampling including all reference sites will be a good indication as to the validity of refuge populations. Additionally, ongoing water chemistry profiling will aid in continuation and maintenance of water quality.

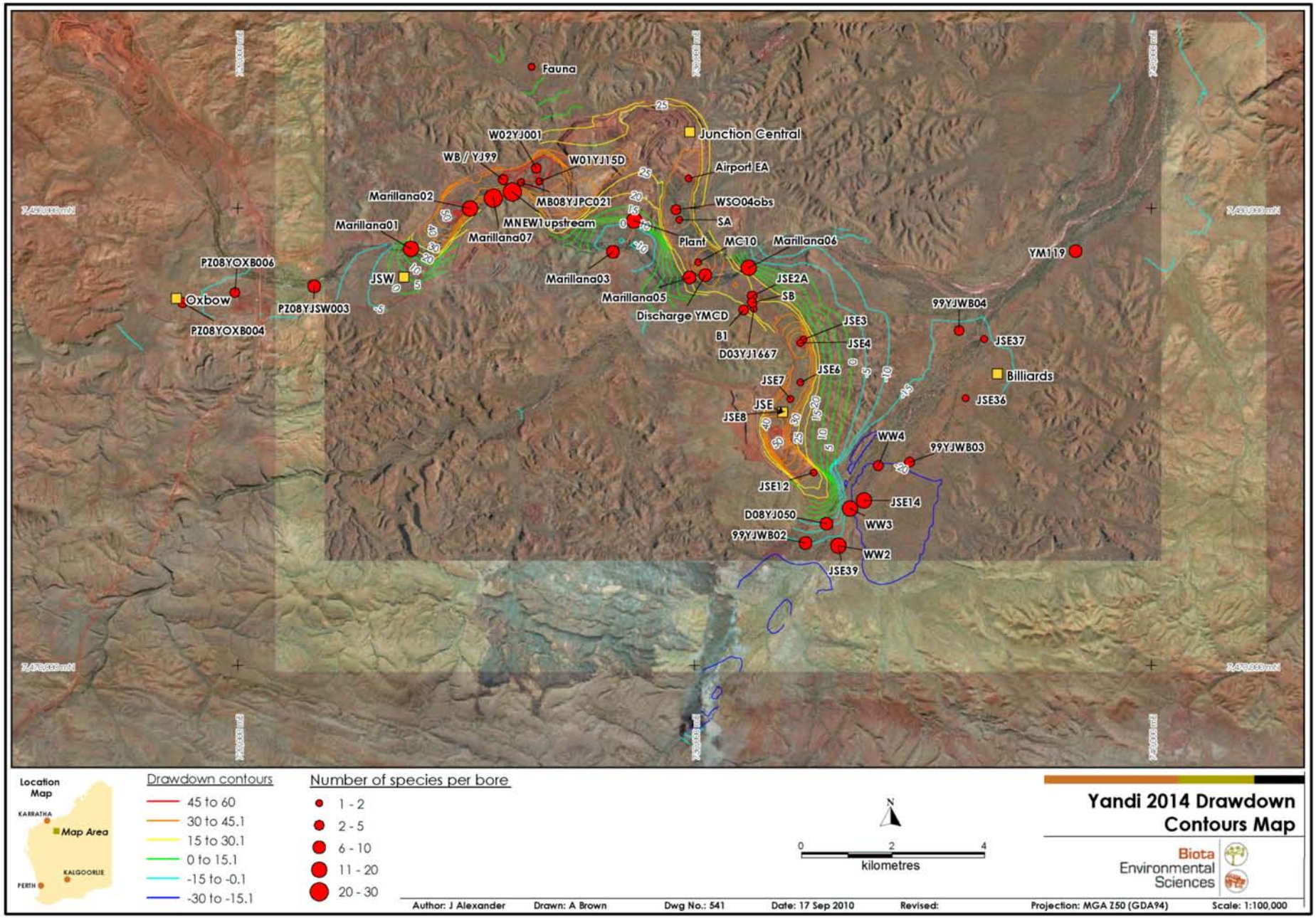

Figure 5.4: Proposed drawdown contours for Yandi mining operations for 2014.

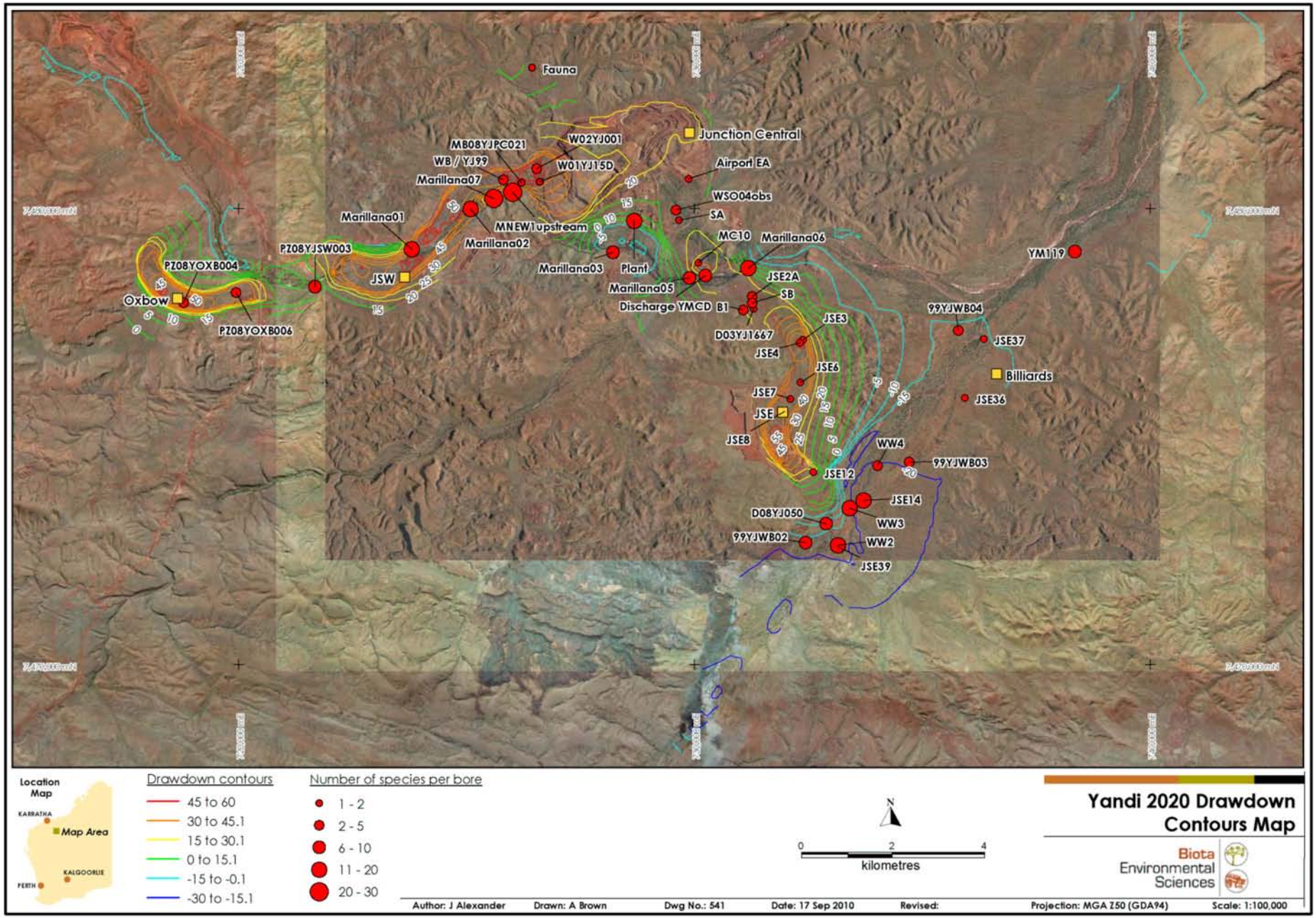

Figure 5.5: Proposed drawdown contours for Yandi mining operations for 2020.

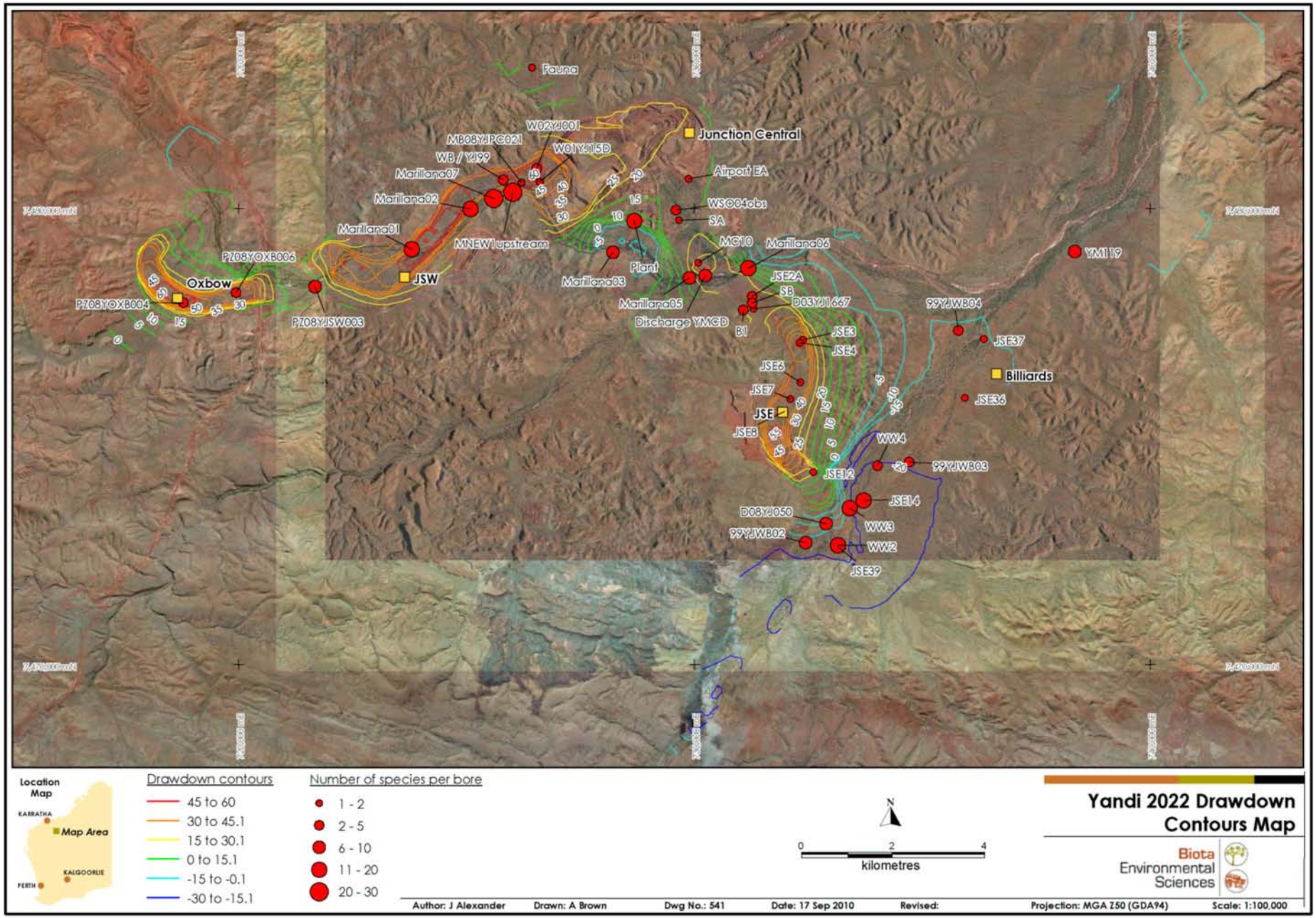

Figure 5.6: Proposed drawdown contours for Yandi mining operations for 2022.

In addition to the primary impacts, that result in direct loss of habitat, other indirect factors can affect the viability of habitat for stygobitic fauna. These can include:

- Erosion run-off and Sedimentation of the water-table

  Erosion run-off and sedimentation can be caused by loose sediment being washed down into the groundwater from infrastructure and ground disturbances such as clearing or blasting. This has the potential to modify groundwater physical parameters, such as the availability of dissolved oxygen and groundwater turbidity, which can lead to the decline in subterranean fauna. Additionally, excess sedimentation can fill alluvial voids and reduce the amount of available habitat space.

- Groundwater pollution

  Pollution run-off such as chemical pollutant spills, unlined landfills and direct discharge of waste or different quality water into streams or aquifers (Sket 1999) have the potential to alter physicochemical parameters in groundwater and can be harmful for subterranean fauna.

- Changes to nutrient filtration
  Food often enters the subterranean environment via seepage and groundwater run-off from the surface and in the form of plant roots and mats. These food webs depend on diffuse and continual input of small amounts of dissolved organic and inorganic matter (Poulson and Lavoie 2000). This level of run-off is usually small however has the potential to fluctuate seasonally and with cyclonic activity.

  An increase in nutrient runoff into the system can potentially harm stygobitic fauna by causing an increase in bacterial activity that can deplete oxygen in the water leading to fauna death (Poulson and Lavoie 2000).

- Changes to groundwater recharge

  Land clearing and landscape alteration have the potential to alter the amount of water and nutrients penetrating through to the watertable. Subsequently, this can act to alter water flow through the system and can change faunal composition within habitat. An increase or decrease of water flow through the Yandi area has the potential to alter nutrient and sediment flow through the groundwater. In severe cases, recharge reduction can lead to an increase in salinity.

- Salinisation of groundwater systems post mining
  There is the potential, depending on final closure procedures, that open voids left to refill with groundwater may become increasingly saline due to evaporation processes unless the system is flushed through regularly. Such salinisation may have the effect of:

  a) altering stygal community compositions in favor of those species more tolerant to brackish water; or

  b) rendering groundwater inhabitable for stygobitic fauna.

The potential impacts of decreased water level should be reduced through project design together with best environmental management practice and procedures. This will be addressed in the PER to be prepared for the Yandi project and related environmental management plans.

5.2 Troglofauna

As can be seen by the results of the single-phase troglofauna sampling (Section 4.2), no confirmed troglobitic taxa were recorded in the Yandi project area. Only three taxa of troglobitic fauna were collected as by-catch of stygobitic fauna sampling and of the taxa collected, both *Draculoides* sp. and *Myrmopopaea* sp. nov, were located outside of proposed mining area.

Lagynochthonius sp. nov. from sample site MNEW1upstream adjacent to the proposed JSW pit, is the only confirmed troglobite from within Impact area. Dewatering is not thought to have detrimental effects on troglobitic fauna populations as tests elsewhere in the Pilbara (at Pilbara Irons operations) indicate that lowering the water table has minimal effect, if any, on subterranean humidity levels, and potentially can increase habitat availability. Inversely, water reinjection has the potential to reduce troglibitic fauna habitat. However, due to the nature of Marillana and Weeli Wolli Creek seasonal fluctuations, it is unlikely that collected specimens occur in high concentrations in the alluvium at Yandi.

The greatest limiting factor in troglofauna habitat at Yandicoogina is seasonal flooding events, which completely submerge the alluvium deposits. At the time of sampling at sites of known troglobitic specimen collections, the watertable ranged between approximately 10 m (Site WW2), 3 m (WW3) and 3.5 m (site MNEW1upstream) below surface level. This represents a relatively thin band of available habitat, which disappears entirely during major cyclonic events and consequent watertable rise. Therefore, while providing habitat on periodic basis, the alluvial substrate would appear unlikely to support a stable, viable population of troglobites over the long term. It is likely that collected specimens may have been recorded at these sites as a result of dispersal from nearby source habitats in other geological formations located above the water level of major regional flood and recharge events.

As primary troglobitic fauna habitat is not a target of mining activities and given that alluvium deposits will be disturbed only sporadically throughout the Marillana, Yandicoogina and Weeli Wolli Creek systems, the risk of serious adverse effects from mining operations to populations is low.

Depending on the method of closure and rehabilitation, the potential for impact on troglobitic fauna populations can occur on termination of active mining operations. One method of rehabilitation involves leaving the pits as standing bodies of water, which can lead to salinisation in slower moving groundwater systems. The second approach involves backfilling the pits and associated voids using bedrock material surrounding the site, including the hills and higher lying areas. This second approach has the potential to remove stable habitat that is not seasonally affected and, subsequently, remove isolated source populations of troglobitic fauna, impacting greatly on diversity. For this reason it is recommended that either alternative sources of material for backfilling are required or that the pits are modified as surface water pools which are part of the river systems.

Due to the low risk of direct and indirect impact on troglobitic fauna it is our recommendation that an intensive troglofauna sampling regime would not be required as part of mining approvals. However, any further suspected troglobitic or troglomorphic fauna recorded as by catch should be lodged with the WA Museum to aid in accumulation of taxonomic knowledge.

5.3 Recommendations and Direction

A number of recommendations can be made from the sampling efforts conducted within the Yandi area.

1. Ongoing water chemistry profiling will aid in continuation and maintenance of water quality to be completed in-house.
2. Effort should be made to maintain areas containing primary stygobitic habitat along Marillana and Weeli Wolli Creek systems as reference sites. These areas should be included in future sampling effort.
3. Every effort should be made to reduce primary impacts by minimising the impact of mining directly through creek stratigraphy, as far as practicable.
4. While sampling throughout the life of mine would be required ensure the continued survival of stygobitic diversity, a less intensive sampling regime would be required once species accumulation curve has reached asymptote.
5. Increased effort should be expended in locating viable sites along the existing creek system outside of primary impact areas. If none are available, it should be considered that additional drilling is necessary.

Formal description of the taxa *Recifella* sp. and *Gomphodella* sp. are ongoing and will be completed in 2011. Effort be given to ongoing taxonomic work of those specimens of which taxonomic framework is lacking, such as Platyhelminth worms. Molecular analysis of these specimens would be beneficial not only for the Yandi project but also all future proposals where stygobitic fauna are an issue.

5.4 Mine Closure and Rehabilitation Options

Methods of closure for the Yandi pits can have considerable effect on the longevity of subterranean fauna populations in the area. Historically, the following "minimal performance level" objectives were produced from the original closure plan in 1999:

- Maintenance of water quality limits for stock watering downstream (as measured at Waterloo Bore);
- Limit the extent and intensity of drawdown impacts on creek and phreatophytic vegetation to within 1-2 km of the pit; and
- Limit the potential for saline development of in-pit water to <15,000 mg/L.

RTIO has produced several mine closure plans that involve the use of backfilling or partial backfilling of existing pits. Currently the preferred method is the creation of a channel and altering the existing creek system to follow the CID deposit. There are currently a number of issues with this plan including the shortfall of viable backfill substrate for pit voids and the ability of the proposed channel to cope with highly erosive forces during large flood events. The retention of JC and Oxbow as modified pit voids is a solution to this, with enough backfill substrate available to fill JSE and JSW pits. Junction Central in particular is being investigated as a seasonal storage and release mechanism, which is intended to simulate seasonal flooding events if required.

In regard to stygobitic fauna, there are several key issues that can arise from incorrect habitat rehabilitation. These can include:

- lack of void spaces due to incorrect substrate backfill;
- lack of void space due to silt and sediment run-off from surrounding habitat;
- the production of standing water which can stagnate or become saline;
- nutrient enrichment from surface reducing water quality due to lack of buffering vegetation; and
- changes in hydrology throughout the system.

In the Pilbara to date there has been very little rehabilitation work completed specifically in regards to viable subterranean fauna habitat. It is likely these impacts can be reduced with careful rehabilitation planning. Stygofauna sampling should be ongoing for a period of time during and post rehabilitation to ensure stygal communities are comparable to those pre-mining. Water quality monitoring should be ongoing for an extended period after rehabilitation.

Given the presence of troglobitic fauna within the low-lying alluvium, it is recommended that any hills removed for backfill purposes will be subject to environmental assessment and troglofauna sampling. This would identify the risk of the substrate as primary habitat for troglobitic fauna.

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Appendix 1

Raw Fauna Collection Data
Phases I - V

Phase	Bore Name	Easting (m E)	Northing (m N)	Field Specimen ID	#	Identification	Notes
1	Discharge	730236	7478532	Ostracoda	*2*	Meridiescandona sp.	
1	Discharge	730236	7478532	Ostracoda	*2*	Pilbaracandona sp.	
1	Discharge	730236	7478532	Isopoda	*35*	Pygolabis sp. No. 1	Differences in telson morphology separated these specimens from *Pygolabis* sp. (nr Wilson Sp. 3).
1	Discharge	730236	7478532	Platyhelminth	*5*	Turbellaria	
1	Marillana01	723792	7479113	Ostracoda	*38*	Meridiescandona sp.	
1	Marillana01	723792	7479113	Platyhelminth	*5*	Turbellaria	
1	Marillana02	725082	7479990	Amphipoda	*16*	Chydaekata sp.	A taxonomically difficult genus, possible synonymous with *Pilbarus millsi* (see Section 4.1). Many juveniles amongst the specimens.
1	Marillana02	725082	7479990	Ostracoda	*47*	Meridiescandona sp.	
1	Marillana02	725082	7479990	Platyhelminth	3	Turbellaria	
1	Marillana03	728209	7479045	Isopoda	*27*	Pygolabis sp. No. 1	
1	Marillana05	729890	7478482	Ostracoda	*12*	Gomphodella sp.	Specimens belong to a species not represented amongst the taxa currently being described by Dr Ivana Karanovic
1	Marillana05	729890	7478482	Ostracoda	*4*	Meridiescandona sp.	
1	Marillana05	729890	7478482	Oligochaeta	12	nr Aindrilus sp.	
1	Marillana05	729890	7478482	Isopoda	*11*	Pygolabis sp. nr. Wilson Sp. 3	These specimens appear to correspond to *Pygolabis* sp. 3 ('Weeli Wolli') of Wilson's working key for this group (Plate 3.2). This species is currently being described.
1	Marillana06	731182	7478693	Ostracoda	*2*	Meridiescandona sp.	
1	Marillana06	731182	7478693	Cyclopoida	*1*	Mesocyclops darwini	This species has been described from collections elsewhere in the region
1	Marillana06	731182	7478693	Hydracarina	*3*	Recifella sp.	Species level identifications yet to be completed
1	Marillana06	731182	7478693	Platyhelminth	17	Turbellaria	
1	Marillana07	725592	7480218	Cyclopoida	*4*	Diacyclops cockingi	This species has been described from collections elsewhere in the region
1	Marillana07	725592	7480218	Hydracarina	1	Hydracarina indet.	
1	Marillana07	725592	7480218	Ostracoda	*2*	Meridiescandona sp.	
1	Marillana07	725592	7480218	Oligochaeta	8	*nr Aindrilus sp.*	
1	Marillana07	725592	7480218	Amphipoda	24	Paramelitidae sp. 2	These specimens correspond to a morphotype nominal species collected as part of the ongoing CALM regional survey

Phase	Bore Name	Easting (m E)	Northing (m N)	Field Specimen ID	#	Identification	Notes
1	Marillana07	725592	7480218	Ostracoda	*7*	*Pilbaracandona sp.*	
1	Marillana07	725592	7480218	Isopoda	*86*	*Pygolabis sp. No. 1*	
1	Marillana07	725592	7480218	Platyhelminth	71	Turbellaria	
1	MNEW1upstream	726009	7480355	Hydracarina	*1*	*Arrenurus sp. nov.*	Male specimen of a previously uncollected taxon, elongate proboscis
1	MNEW1upstream	726009	7480355	Amphipoda	*1*	*Chydaekata sp.*	
1	MNEW1upstream	726009	7480355	Cyclopoida	*2*	*Diacyclops sp. indet.*	Juveniles
1	MNEW1upstream	726009	7480355	Ostracoda	*33*	*Meridiescandona sp.*	
1	MNEW1upstream	726009	7480355	Amphipoda	31	*Paramelitidae sp. 2*	
1	MNEW1upstream	726009	7480355	Ostracoda	*2*	*Pilbaracandona sp.*	
1	MNEW1upstream	726009	7480355	Isopoda	*18*	*Pygolabis sp. No. 1*	
1	MNEW1upstream	726009	7480355	Platyhelminth	24	Turbellaria	
1	Plant	728677	7479732	Amphipoda	*1*	*Chydaekata sp.*	
1	Plant	728677	7479732	Hydracarina	1	Hydracarina indet.	Species level identifications yet to be completed
1	Plant	728677	7479732	Ostracoda	*1*	*Meridiescandona sp.*	
1	Plant	728677	7479732	Oligochaeta	13	*nr Aindrilus sp.*	
1	Plant	728677	7479732	Isopoda	*4*	*Pygolabis sp. indet.*	Female and immature specimens only.
1	SB	731263	7477933	Cyclopoida	*19*	*Diacyclops sp. indet.*	
1	SB	731263	7477933	Isopoda	*6*	*Pygolabis sp. nr. Wilson Sp. 3*	
1	W01YJ15D	726605	7480589	Platyhelminth	1	Turbellaria	
1	W02YJ001	726535	7480876	Ostracoda	*5*	*Meridiescandona sp.*	
1	W02YJ001	726535	7480876	Oligochaeta	10	*nr Aindrilus sp.*	
1	W02YJ001	726535	7480876	Amphipoda	1	Paramelitidae sp. indet.	Too damaged to identify any further
1	WB/YJ99	725805	7480628	Amphipoda	4	Paramelitidae sp. 2	
2	99YJWB02	732433	7472677	Isopoda	1	*Pygolabis weeli wolli*	female
2	99YJWB04	735790	7477323	Isopoda	1	*Pygolabis weeli wolli*	subadult male
2	Airport	729874	7480651	Isopoda	1	*Pygolabis weeli wolli*	female
2	D03YJ1636	731792	7477445	Collembola	1	Collembola	
2	D03YJ1636	731792	7477445	Centipede	1	Scolopendridae	Terrestrial
2	D03YJ1667	731298	7477800	Isopoda	1	Armadillidae	fragments, not troglobitic
2	Discharge	730236	7478532	Platyhelminthes	26	Indeterminate	
2	Discharge	730236	7478532	Ostracoda	*6*	*Meridiescandona facies*	
2	Discharge	730236	7478532	Ostracoda	35	*Notocandona boultoni*	
2	Discharge	730236	7478532	Isopoda	*5*	*Pygolabis weeli wolli*	subadult male, female and juvs
2	Discharge	730236	7478532	Hydracarina	1	*Recifella sp. 1*	male
2	Fauna	726431	7483093	Ostracoda	1	*Meridiescandona facies*	
2	JSE1	731262	7477960	Collembola	1	Collembola	
2	JSE12	732608	7474217	Amphipoda	1	*Chydakata sp.*	
2	JSE14	733707	7473602	Collembola	1	Collembola	
2	JSE14	733707	7473602	Ostracoda	1	*Meridiescandona facies*	

Phase	Bore Name	Easting (m E)	Northing (m N)	Field Specimen ID	#	Identification	Notes
2	JSE2A	731262	7478074	Amphipoda	1	*Chydakata sp.*	
2	JSE2A	731262	7478074	Amphipoda	7	Paramelitidae sp. 2 (PSS)	(PSS) refers to DEC code as species being collected from pilbara stygofauna survey
2	JSE2A	731262	7478074	Isopoda	2	*Pygolabis weeli wolli*	male and female
2	JSE3	732386	7477126	Hydracarina	2	*Recifella sp. 1*	male and female
2	JSE4	732318	7477053	Ostracoda	42	*Meridiescandona marillanae*	
2	JSE8	731975	7475552	Ostracoda	1	*Meridiescandona facies*	
2	Marillana03	728209	7479045	Isopoda	9	*Pygolabis nsp. 1*	is not a described species, has very short indented telson, small size and differences in the appendix masculina. (called sp 1 when collected from yandi in 2003)
2	Marillana05	729890	7478482	Ostracoda	1	*Gomphodella nr yandi*	Note - valve only. yandi is Murchison species but looks same
2	Marillana05	729890	7478482	Ostracoda	24	*Meridiescandona facies*	
2	Marillana05	729890	7478482	Isopoda	1	*Pygolabis weeli wolli*	male
2	Marillana05	729890	7478482	Hydracarina	1	*Recifella sp. 1*	female
2	Marillana06	731182	7478693	Ostracoda	1	coleoptera	no head or legs
2	Marillana06	731182	7478693	Copepoda	2	*Diacyclops cockingi*	
2	Marillana06	731182	7478693	Ostracoda	3	*Gomphodella sp. A*	Calling it sp. BOS200 - undescribed featureless species
2	Marillana06	731182	7478693	Platyhelminthes	14	Indeterminate	
2	Marillana06	731182	7478693	Ostracoda	1	*Meridiescandona facies*	
2	Marillana06	731182	7478693	Ostracoda	1	*Meridiescandona facies*	valve
2	Marillana06	731182	7478693	Copepoda	1	*Mesocyclops darwini*	
2	Marillana06	731182	7478693	Ostracoda	2	*Notocandona boultoni*	vavles
2	Marillana06	731182	7478693	Ostracoda	28	*Notocandona boultoni*	
2	Marillana06	731182	7478693	Hydracarina	7	*Recifella sp. 1*	
2	Marillana06	731182	7478693	Hydracarina	10	*Stygiolimnochares sp B1*	
2	Marillana07	725592	7480218	Hydracarina	1	*Arrenurus sp nov yandi*	male, same species as animal collected from bore MNEW1-14 3/11/2003. has very small eye spots
2	MNEW1upstream	726009	7480355	Hydracarina	1	*Arrenurus sp nov yandi*	female
2	MNEW1upstream	726009	7480355	Copepoda	3	*Diacyclops cockingi*	
2	Plant	728677	7479732	Isopoda	2	*Pygolabis weeli wolli*	male and female
2	SA	729664	7479749	Bathynellacea	40	*Atopobathynellas*	
2	SB	731263	7477933	Copepoda	1	*Diacyclops cockingi*	
2	SB	731263	7477933	Ostracoda	1	*Meridiescandona marillanae*	
2	SB	731263	7477933	Isopoda	2	*Pygolabis weeli wolli*	males
2	W01YJ15D	726605	7480589	Copepoda	1	*Metacyclops pilbaricus*	

Phase	Bore Name	Easting (m E)	Northing (m N)	Field Specimen ID	#	Identification	Notes
2	W02YJ001	726535	7480876	Acarina	1	Acariformes	terrestrial mite
2	W02YJ001	726535	7480876	Ostracoda	35	*Meridiescandona facies*	
3	Fauna	726431	7483093	Isopoda	1	*Pygolabis weeli wolli*	female
3	Marillana01	723792	7479113	Amphipoda	9	*Chydakata sp.*	(1 gravid female)
3	Marillana01	723792	7479113	Cyclopoida	5	*Diacyclops humpreysi x humphreysi*	
3	Marillana01	723792	7479113	Ostracoda	8	*Gomphodella yandi*	
3	Marillana01	723792	7479113	Hydracarina	2	Hydracarina sp	juveniles with eyes
3	Marillana01	723792	7479113	Platyhelminthes	16	Indeterminate	Specimens at Biota
3	Marillana01	723792	7479113	Ostracoda	30	*Meridiescandona facies*	
3	Marillana01	723792	7479113	Ostracoda	6	*Notocandona boultoni*	
3	Marillana01	723792	7479113	Amphipoda	1	Paramelitidae sp. 2 (DEC code)	
3	Marillana01	723792	7479113	Isopoda	1	*Pygolabis sp.*	juvenile
3	Marillana01	723792	7479113	Hydracarina	3	*Recifella sp (nr P1, DEC code)*	
3	Marillana02	725082	7479990	Harpacticoida	1	*Australocamptus sp.*	female not like any formally described WA sp
3	Marillana02	725082	7479990	Amphipoda	1	*Chydakata sp.*	
3	Marillana02	725082	7479990	Cyclopoida	1	Diacyclops sp	juv
3	Marillana02	725082	7479990	Oligochaeta	3	Enchytraeidae Pilbara sp 2 (DEC code)	
3	Marillana02	725082	7479990	Ostracoda	23	*Meridiescandona facies*	
3	Marillana06	731182	7478693	Oligochaeta	2	*Bezzia sp.*	not oligochaete, ceratopogonidae. Not stygal
3	Marillana06	731182	7478693	Cyclopoida	5	*Diacyclops humpreysi x humphreysi*	
3	Marillana06	731182	7478693	Ostracoda	1	*Gomphodella hirsuta*	
3	Marillana06	731182	7478693	Platyhelminthes	7	Indeterminate	
3	Marillana06	731182	7478693	Hydracarina	1	Mideopsinae sp. (nr Penemidopsis)	whole animal on slide with palps
3	Marillana06	731182	7478693	Ostracoda	1	*Notocandona boultoni*	
3	Marillana06	731182	7478693	Amphipoda	3	Paramelitidae sp. 2 (DEC code)	
3	Marillana06	731182	7478693	Isopoda	1	*Pygolabis sp.*	juvenile
3	Marillana07	725592	7480218	Amphipoda	4	*Chydakata sp.*	
3	Marillana07	725592	7480218	Copepoda	2	cyclopoida	juveniles
3	Marillana07	725592	7480218	Ostracoda	2	*Gomphodella hirsuta*	valves, warts at base of hairs obvious
3	Marillana07	725592	7480218	Platyhelminthes	3	Indeterminate	
3	Marillana07	725592	7480218	Amphipoda	1	*Maarrka sp. ' ms name*	Damaged
3	Marillana07	725592	7480218	Ostracoda	14	*Meridiescandona facies*	
3	Marillana07	725592	7480218	Ostracoda	34	*Notocandona boultoni*	
3	Marillana07	725592	7480218	Amphipoda	1	Paramelitidae sp. 2 (DEC code)	
3	Marillana07	725592	7480218	Isopoda	1	*Pygolabis sp.*	juvenile
3	Marillana07	725592	7480218	Hydracarina	1	*Recifella sp (nr P1, DEC code)*	
3	MNEW1upstream	726009	7480355	Amphipoda	4	*Chydakata sp.*	
3	MNEW1upstream	726009	7480355	Cyclopoida	6	*Diacyclops humpreysi x humphreysi*	

Phase	Bore Name	Easting (m E)	Northing (m N)	Field Specimen ID	#	Identification	Notes
3	MNEW1upstream	726009	7480355	Ostracoda	3	*Gomphodella yandi*	some valves present that may be G hirsuta or juv G yandi
3	MNEW1upstream	726009	7480355	Platyhelminthes	12	Indeterminate	
3	MNEW1upstream	726009	7480355	Amphipoda	2	*Maarka wolli' ms name*	
3	MNEW1upstream	726009	7480355	Ostracoda	56	*Notocandona boultoni*	
3	MNEW1upstream	726009	7480355	Isopoda	4	*Pygolabis sp.*	juvenile
3	MNEW1upstream	726009	7480355	Hydracarina	1	*Recifella sp (nr P1, DEC code)*	
3	Plant	728677	7479732	Amphipoda	7	*Chydakata sp.*	
3	Plant	728677	7479732	Copepoda	4	*Diacyclops humpreysi x humphreysi*	
3	Plant	728677	7479732	Amphipoda	1	*Maarrka wolli' ms name*	
3	Plant	728677	7479732	Ostracoda	4	*Meridiescandona facies*	
3	Plant	728677	7479732	Ostracoda	8	*Notocandona boultoni*	
3	Plant	728677	7479732	Amphipoda	3	Paramelitidae sp. 2 (DEC code)	
3	Plant	728677	7479732	Isopoda	1	*Pygolabis weeli wolli*	female
3	WSO04obs	729595	7479968	Harpacticoida	1	Canthocamptidae sp	juvenile
3	WSO04obs	729595	7479968	Amphipoda	2	*Chydakata sp.*	
3	WSO04obs	729595	7479968	Cyclopoida	6	*Diacyclops humpreysi x humphreysi*	
3	WSO04obs	729595	7479968	Isopoda	20	*Pygolabis weeli wolli*	males and females
3	WW2	733149	7472618	Amphipoda	3	*Chydakata sp.*	
3	WW3	733405	7473428	Ostracoda	4	*? Mediescandona marillana*	no males and may be within the variation of M facies
3	WW3	733405	7473428	Copepoda	1	Canthoacmptidae (nr australocamptus sp.)	female
3	WW3	733405	7473428	Copepoda	43	*Diacyclops humpreysi x humphreysi*	
3	WW3	733405	7473428	Schizomida	1	Draculoides sp.	female
3	WW3	733405	7473428	Ostracoda	1	*Gomphodella hirsuta*	
3	WW3	733405	7473428	Nematoda	1	Indeterminate	
3	WW3	733405	7473428	Ostracoda	12	*Meridiescandona facies*	
3	WW3	733405	7473428	Amphipoda	4	Paramelitidae sp. 2 (DEC code)	
3	WW3	733405	7473428	Isopoda	9	*Pygolabis weeli wolli*	males and females
3	WW4	734018	7474365	Cyclopoida	6	*Diacyclops humpreysi x humphreysi*	
3	WW4	734018	7474365	Ostracoda	5	*Meridiescandona facies*	
4	99YJWB02	732433	7472677	Amphipoda	6	*Chydaekata sp.*	
4	99YJWB02	732433	7472677	Amphipoda	1	Collembolla	
4	99YJWB02	732433	7472677	Amphipoda	2	Paramelitidae sp.	
4	99YJWB02	732433	7472677	Amphipoda	1	Paramelitidae sp. 2	
4	99YJWB03	734711	7474442	Ostracoda	1	*Areacandona mulgae*	female
4	99YJWB03	734711	7474442	Amphipoda	1	*Chydaekata sp.*	
4	99YJWB03	734711	7474442	Cyclopoida	1	*Diacyclops humphreysi humphreysi*	
4	99YJWB04	735790	7477323	Cyclopoida	7	*Diacyclops humphreysi humphreysi*	
4	99YJWB04	735790	7477323	Harpacticoida	5	*Inermipes sp B2*	

Phase	Bore Name	Easting (m E)	Northing (m N)	Field Specimen ID	#	Identification	Notes
4	D03YJ1667	731298	7477800	Copepoda	50	*Diacyclops humphreysi humphreysi*	
4	JSE14	733707	7473602	Harpacticoida	1	Canthocamptidae sp B1	
4	JSE14	733707	7473602	Amphipoda	1	*Chydaekata sp.*	
4	JSE14	733707	7473602	Cyclopoida	17	*Diacyclops humphreysi humphreysi*	
4	JSE14	733707	7473602	Harpacticoida	8	*Inermipes* sp B2	
4	JSE14	733707	7473602	Ostracoda	2	*Meridiescandona facies*	
4	JSE14	733707	7473602	Bathynellaceae	1	*Notobathynella* sp.	small, mature dissected on slide
4	JSE14	733707	7473602	Ostracoda	26	*Notocandona boultoni*	
4	JSE14	733707	7473602	Amphipoda	1	Paramelitidae sp.	juvenile
4	JSE14	733707	7473602	Amphipoda	3	Paramelitidae sp. 2	
4	JSE14	733707	7473602	Isopoda	1	*Pygolabis sp.*	female
4	JSE36	735937	7475846	Cyclopoida	1	*Diacyclops humphreysi humphreysi*	
4	JSE37	736346	7477140	Cyclopoida	1	*Diacyclops humphreysi humphreysi*	
4	JSE39	733145	7472585	Amphipoda	1	*Chydaekata sp.*	
4	JSE39	733145	7472585	Cyclopoida	23	*Diacyclops humphreysi humphreysi*	
4	JSE39	733145	7472585	Amphipoda	2	Paramelitidae sp. 2	
4	Marillana01	723792	7479113	Cyclopoida	21	*Diacyclops humphreysi humphreysi*	
4	Marillana01	723792	7479113	Ostracoda	1	*Gomphodella yandi*	
4	Marillana01	723792	7479113	Ostracoda	90	*Meridiescandona facies*	all female, shell correct
4	Marillana01	723792	7479113	Amphipoda	1	Paramelitidae sp. 2	
4	Marillana01	723792	7479113	Platyhelminthes	2	Turbellaria	
4	Marillana03	728209	7479045	Cyclopoida	2	*Diacyclops humphreysi humphreysi*	
4	Marillana03	728209	7479045	Hydracarina	1	Hydracarina	1 deuteronymph with eyes not stygal
4	Marillana03	728209	7479045	Ostracoda	2	*Meridiescandona facies*	in mite vial, males, dissected, soft part match, shell reticulated as well as spotted
4	Marillana03	728209	7479045	Amphipoda	1	Paramelitidae sp. 2	
4	Marillana06	731182	7478693	Hydracarina	1	*Axonopsella* sp B1	
4	Marillana06	731182	7478693	Copepoda	4	*Diacyclops humphreysi humphreysi*	
4	Marillana06	731182	7478693	Ostracoda	5	*Meridiescandona facies*	male dissected
4	Marillana06	731182	7478693	Copepoda	1	*Mesocyclops darwini*	
4	Marillana06	731182	7478693	Ostracoda	3	*Notocandona boultoni*	
4	Marillana06	731182	7478693	Amphipoda	2	Paramelitidae sp. 2	
4	Marillana06	731182	7478693	Isopoda	2	Paramelitidae sp. 2	labled as isopod
4	Marillana06	731182	7478693	Platyhelminthes	2	Turbellaria	
4	Marillana07	725592	7480218	Hydracarina	2	*Axonopsella* sp B1	
4	Marillana07	725592	7480218	Copepoda	1	Canthocamptidae sp B1	male
4	Marillana07	725592	7480218	Amphipoda	10	*Chydaekata* sp.	
4	Marillana07	725592	7480218	Copepoda	1	*Diacyclops humphreysi humphreysi*	
4	Marillana07	725592	7480218	Ostracoda	60	*Meridiescandona facies/marillana*	facies shell and CB2 absent, marillana hemipenis

Phase	Bore Name	Easting (m E)	Northing (m N)	Field Specimen ID	#	Identification	Notes
4	Marillana07	725592	7480218	Ostracoda	40	*Notocandona boultoni*	
4	Marillana07	725592	7480218	Platyhelminthes	6	Turbellaria	
4	MNEW1upstream	726009	7480355	Hydracarina	1	*Albia* sp B1	Male with highly modified legIV
4	MNEW1upstream	726009	7480355	Hydracarina	10	*Axonopsella* sp B1	male leg IV not modified.
4	MNEW1upstream	726009	7480355	Amphipoda	4	*Chydaekata* sp.	
4	MNEW1upstream	726009	7480355	Cyclopoida	70	*Diacyclops humphreysi humphreysi*	
4	MNEW1upstream	726009	7480355	Oligochaeta	1	Enchytraeidae Pilbara sp. 2	
4	MNEW1upstream	726009	7480355	Ostracoda	9	*Gomphodella yandi*	
4	MNEW1upstream	726009	7480355	Hydracarina	1	*Limnesia* sp B1	male in poor condition
4	MNEW1upstream	726009	7480355	Ostracoda	42	*Meridiescandona facies*	
4	MNEW1upstream	726009	7480355	Cyclopoida	5	*Microcyclops varicans*	
4	MNEW1upstream	726009	7480355	Ostracoda	25	*Notocandona boultoni*	
4	MNEW1upstream	726009	7480355	Amphipoda	1	Paramelitidae nr sp. 2 (DEC)	
4	MNEW1upstream	726009	7480355	Amphipoda		Paramelitidae sp.	juvenile
4	MNEW1upstream	726009	7480355	Platyhelminthes	43	Turbellaria	
4	Plant	728677	7479732	Copepoda	20	Canthocamptidae sp B1	
4	Plant	728677	7479732	Amphipoda	5	*Chydaekata sp.*	
4	Plant	728677	7479732	Copepoda	110	*Diacyclops humphreysi humphreysi*	Harp. & Cyclo.
4	Plant	728677	7479732	Oligochaeta	3	Enchytraeidae	immature x 2
4	Plant	728677	7479732	Copepoda	1	*Inermipes* sp B2	
4	Plant	728677	7479732	Amphipoda	1	*Maarka wolli'* ms name	
4	Plant	728677	7479732	Ostracoda	~50	*Meridiescandona facies*	dissected male, hemipenis match
4	Plant	728677	7479732	Ostracoda	~40	*Notocandona boultoni*	
4	Plant	728677	7479732	Amphipoda	24	Paramelitidae sp.	
4	Plant	728677	7479732	Amphipoda	12	Paramelitidae sp. 2	
4	Plant	728677	7479732	Oligochaeta	3	Tubificidae	mangled posterior only x 1
4	PZ08YJSW003	721670	7478287	Amphipoda	11	*Chydaekata sp.*	
4	PZ08YJSW003	721670	7478287	Copepoda	~35	*Diacyclops humphreysi humphreysi*	
4	PZ08YJSW003	721670	7478287	Ostracoda	1	*Notocandona boultoni*	male, dissected
4	PZ08YJSW003	721670	7478287	Amphipoda	5	Paramelitidae sp.	
4	PZ08YJSW003	721670	7478287	Amphipoda	5	Paramelitidae sp. 2	
4	PZ08YJSW003	721670	7478287	Isopoda	19	*Pygolabis weeliwolli*	
4	PZ08YJSW003	721670	7478287	Platyhelminthes	1	Turbellaria	
4	PZ08YOXB004	718788	7477937	Cyclopoida	2	*Metacyclops pilbaricus*	
4	PZ08YOXB004	718788	7477937	Amphipoda	1	Paramelitidae sp.	
4	PZ08YOXB004	718788	7477937	Amphipoda	1	Paramelitidae sp. 2	
4	PZ08YOXB006	719936	7478158	Bathynellaceae	1	*Atopobathynella* sp.	
4	PZ08YOXB006	719936	7478158	Cyclopoida	60	*Diacyclops humphreysi humphreysi*	
4	PZ08YOXB006	719936	7478158	Cyclopoida	1	*Metacyclops pilbaricus*	
4	WB/YJ99	725805	7480628	Cyclopoida	7	*Diacyclops humphreysi humphreysi*	
4	WB/YJ99	725805	7480628	Amphipoda	3	Paramelitidae sp.	juvenile and damaged

Phase	Bore Name	Easting (m E)	Northing (m N)	Field Specimen ID	#	Identification	Notes
4	WB/YJ99	725805	7480628	Amphipoda	4	Paramelitidae sp. 2	
4	WW2	733149	7472618	Amphipoda	5	*Chydaekata* sp.	
4	WW2	733149	7472618	Cyclopoida	20	*Diacyclops humphreysi humphreysi*	
4	WW2	733149	7472618	Harpacticoida	6	*Inermipes* sp B2	
4	WW2	733149	7472618	Amphipoda	1	*Maarka wolli'* ms name	
4	WW2	733149	7472618	Ostracoda	4	*Meridiescandona facies*	female, shell match
4	WW2	733149	7472618	Ostracoda	7	*Notocandona boultoni*	
4	WW2	733149	7472618	Aranea	1	Oonopidae sp	Troglofauna. Mature female
4	WW3	733405	7473428	Bathynellaceae	1	*Atopobathynella* sp.	juvenile only 6 legs
4	WW3	733405	7473428	Copepoda	2	Canthocamptidae sp B1	male and female
4	WW3	733405	7473428	Amphipoda	5	*Chydaekata* sp.	
4	WW3	733405	7473428	Amphipoda	1	Coccoidea	not stygal
4	WW3	733405	7473428	Copepoda	28	*Diacyclops humphreysi humphreysi*	
4	WW3	733405	7473428	Ostracoda	2	*Meridiescandona facies*	in syncarid vial
4	WW3	733405	7473428	Ostracoda	~70	*Meridiescandona marillana*	male dissected, clearly marillana on shell and hemipenis
4	WW3	733405	7473428	Isopoda	3	*Pygolabis* sp.	juveniles and female
4	WW4	734018	7474365	Amphipoda	1	*Chydaekata* sp.	
4	WW4	734018	7474365	Copepoda	~30	*Diacyclops humphreysi humphreysi*	
4	WW4	734018	7474365	Ostracoda	7	*Meridiescandona lucerna*	dissected male, hemipenis and shell match
4	YM119	738345	7479063	Hydracarina	1	*Axonopsella* sp B1	
4	YM119	738345	7479063	Cyclopoida	7	*Diacyclops humphreysi humphreysi*	
4	YM119	738345	7479063	Harpacticoida	1	*Inermipes* sp B2	male
4	YM119	738345	7479063	Ostracoda	19	*Meridiescandona lucerna*	
4	YM119	738345	7479063	Ostracoda	36	*Notocandona boultoni*	
4	YM119	738345	7479063	Amphipoda	2	Paramelitidae sp.	juvenile and damaged
4	YM119	738345	7479063	Amphipoda	1	Paramelitidae sp. 2	
4	YM119	738345	7479063	Isopoda	2	*Pygolabis weeliwolli*	male and juvenile
5	99YJWB02	732433	7472677	Amphipoda	2	*Chydaekata* sp.	2 harpacticoid copepod contaminants
5	99YJWB02	732433	7472677	Cyclopoida	2	*Diacyclops humphreysi unispinosus*	
5	99YJWB02	732433	7472677	Cyclopoida	3	*Diacyclops* nr *sobeprolatus*	has short dorsal caudal setae like humphreysi
5	99YJWB02	732433	7472677	Amphipoda	2	*Inermipes* sp B2	
5	99YJWB02	732433	7472677	Harpacticoida	1	*Inermipes* sp. B2	
5	99YJWB02	732433	7472677	Ostracoda	10	*Notocandona boultoni*	
5	99YJWB02	732433	7472677	Amphipoda	2	Paramelitidae sp.2 (DEC)	
5	99YJWB02	732433	7472677	Amphipoda	1	*Pilbarus millsi*	
5	99YJWB04	735790	7477323	Cyclopoida	1	*Diacyclops humphreysi humphreysi*	
5	99YJWB04	735790	7477323	Harpacticoida	5	*Inermipes* sp. B2	

Phase	Bore Name	Easting (m E)	Northing (m N)	Field Specimen ID	#	Identification	Notes
5	B1	731070	7477776	Cyclopoida	8	*Diacyclops* nr *sobeprolatus*	has short dorsal caudal setae like humphreysi
5	B1	731070	7477776	Ostracoda	2	*Meridiescandona facies*	
5	B1	731070	7477776	Ostracoda	1	*Meridiescandona marillanae*	
5	B1	731070	7477776	Ostracoda	1	*Notocandona boultoni*	
5	B1	731070	7477776	Ostracoda	1	*Notocandona modesta*	
5	B1	731070	7477776	Amphipoda	2	Paramelitidae sp.2 (DEC)	
5	D03YJ1667	731298	7477800	Cyclopoida	22	*Diacyclops humphreysi humphreysi*	
5	D08YJ050	732887	7473094	Amphipoda	5	*Chydaekata* sp.	
5	D08YJ050	732887	7473094	Cyclopoida	4	*Diacyclops humphreysi humphreysi*	
5	D08YJ050	732887	7473094	Amphipoda	8	Paramelitidae sp.	juvenile
5	D08YJ050	732887	7473094	Amphipoda	2	Paramelitidae sp.2 (DEC)	
5	D08YJ050	732887	7473094	Oligochaeta	1	Phreodrilidae with similar ventral chaetae (pss)	immature
5	D08YJ050	732887	7473094	Oligochaeta	1	*Pristina aequiseta*	
5	D08YJ050	732887	7473094	Platyhelminthes?	2	Turbellaria sp.	
5	Marillana01	723792	7479113	Amphipoda	9	*Chydaekata* sp.	
5	Marillana01	723792	7479113	Isopoda	1	*Chydaekata* sp.	
5	Marillana01	723792	7479113	Copepoda	1	*Diacyclops humphreysi humphreysi*	
5	Marillana01	723792	7479113	Ostracoda	11	*Meridiescandona facies*	
5	Marillana01	723792	7479113	Ostracoda	1	*Notocandona boultoni*	
5	Marillana01	723792	7479113	Amphipoda	4	Paramelitidae sp	3 juveniles + 1 with U3 missing
5	Marillana01	723792	7479113	Amphipoda	4	Paramelitidae sp.2 (DEC)	
5	Marillana01	723792	7479113	Isopoda	1	*Pygolabis* sp.	juvenile
5	Marillana01	723792	7479113	Platyhelminthes	15	Turbellaria sp.	
5	Marillana02	725082	7479990	Isopoda	1	*Chydaekata* sp.	
5	Marillana02	725082	7479990	Cyclopoida	35	*Diacyclops humphreysi humphreysi*	
5	Marillana02	725082	7479990	Oligochaeta	2	Enchytraeidae pilbara sp. 1 (pss)	
5	Marillana02	725082	7479990	Ostracoda	50	*Meridiescandona facies*	
5	Marillana02	725082	7479990	Noteridae	1	*Notomicrus tennellus*	not stygofauna, surface water beetle
5	Marillana02	725082	7479990	Amphipoda	3	Paramelitidae sp.2 (DEC)	1 Collembola contaminant
5	Marillana02	725082	7479990	Isopoda	2	*Pygolabis* sp.	juvenile
5	Marillana02	725082	7479990	Platyhelminthes	2	Turbellaria sp.	
5	Marillana03	728209	7479045	Amphipoda	4	*Chydaekata* sp.	
5	Marillana03	728209	7479045	Cyclopoida	6	*Diacyclops humphreysi humphreysi*	
5	Marillana03	728209	7479045	Ostracoda	1	*Notocandona boultoni*	
5	Marillana03	728209	7479045	Amphipoda	9	Paramelitidae sp.2 (DEC)	
5	Marillana06	731182	7478693	Ostracoda	3	*Meridiescandona facies*	
5	Marillana06	731182	7478693	Ostracoda	5	*Notocandona boultoni*	
5	Marillana06	731182	7478693	Amphipoda	8	Paramelitidae sp.2 (DEC)	
5	Marillana06	731182	7478693	Amphipoda	3	*Pilbarus millsi*	

Phase	Bore Name	Easting (m E)	Northing (m N)	Field Specimen ID	#	Identification	Notes
5	Marillana06	731182	7478693	Platyhelminthes	6	Turbellaria sp.	
5	Marillana07	725592	7480218	Ostracoda	1	*? Gomphodella* sp.	Juvenile animal, think it is probably a Gomphodella (and therefore G. yandi) but not sure
5	Marillana07	725592	7480218	Amphipoda	1	Amphipoda *sp*.	missing posterior end from L6
5	Marillana07	725592	7480218	Amphipoda	2	*Chydaekata* sp.	
5	Marillana07	725592	7480218	Cyclopoida	21	*Diacyclops humphreysi humphreysi*	
5	Marillana07	725592	7480218	Ostracoda	25	*Meridiescandona facies*	
5	Marillana07	725592	7480218	Ostracoda	1	*Meridiescandona lucerna*	
5	Marillana07	725592	7480218	Ostracoda	70	*Notocandona boultoni*	
5	Marillana07	725592	7480218	Amphipoda	79	Paramelitidae sp.	juvenile
5	Marillana07	725592	7480218	Isopoda	8	*Pygolabis* sp.*(*nr *humphreysi)*	inc males
5	Marillana07	725592	7480218	Platyhelminthes	29	Turbellaria sp.	
5	MB08YJPC021	726201	7480572	Cyclopoida	5	*Diacyclops* nr *sobeprolatus*	has short dorsal caudal setae like humphreysi
5	MB08YJPC021	726201	7480572	Amphipoda	2	Paramelitidae sp.	juvenile
5	MC10	730082	7478812	Platyhelminthes	1	Turbellaria sp.	
5	MNEW1upstream	726009	7480355	Hydracarina	1	*Arrenurus* sp 1	1 male
5	MNEW1upstream	726009	7480355	Hydracarina	3	*Arrenurus* sp 2	3 females, do not think they are same species as male as much smaller
5	MNEW1upstream	726009	7480355	Ostracoda	1	*Candonopsis ? n. sp.*	F. reticulate valves. Arch more ant than C tenuis. No medial seta on T3, basal sets present on T2
5	MNEW1upstream	726009	7480355	Amphipoda	4	*Chydaekata* sp.	
5	MNEW1upstream	726009	7480355	Cyclopoida	51	*Diacyclops humphreysi humphreysi*	
5	MNEW1upstream	726009	7480355	Ostracoda	6	*Gomphodella yandi*	
5	MNEW1upstream	726009	7480355	Hydracarina	1	*Limnesia* sp B1	female in poor condition (assume same sp as collected before do not have specimen to compare)
5	MNEW1upstream	726009	7480355	Ostracoda	9	*Meridiescandona facies*	
5	MNEW1upstream	726009	7480355	Pseudoscorpiones	1	*Lagynochthonius* sp.	Given to WAM
5	MNEW1upstream	726009	7480355	Ostracoda	40	*Notocandona boultoni*	
5	MNEW1upstream	726009	7480355	Amphipoda	17	Paramelitidae sp.	juvenile
5	MNEW1upstream	726009	7480355	Amphipoda	4	Paramelitidae sp.2 (DEC)	
5	MNEW1upstream	726009	7480355	Isopoda	1	*Pygolabis* sp (nr weeliwolli)	male, much shorter telson and shorter teeth on the appendix masculina, subadult?
5	MNEW1upstream	726009	7480355	Hydracarina	3	*Recifella* sp (nr P1, DEC code*)*	2 females, 1 male
5	MNEW1upstream	726009	7480355	Oligochaeta	1	Tubificidae morphospecies 1/1a (pss)	
5	MNEW1upstream	726009	7480355	Platyhelminthes	16	Turbellaria sp.	

Phase	Bore Name	Easting (m E)	Northing (m N)	Field Specimen ID	#	Identification	Notes
5	PZ08YJSW003	721670	7478287	Amphipoda	1	*Chydaekata* sp.	
5	PZ08YJSW003	721670	7478287	Copepoda	21	*Diacyclops* nr *sobeprolatus*	has short dorsal caudal setae like humphreysi
5	PZ08YJSW003	721670	7478287	Ostracoda	14	*Notocandona boultoni*	
5	PZ08YJSW003	721670	7478287	Amphipoda	2	Paramelitidae sp.	No U3
5	PZ08YJSW003	721670	7478287	Amphipoda	8	Paramelitidae sp.2 (DEC)	
5	PZ08YJSW003	721670	7478287	Isopoda	54	*Pygolabis weeliwolli*	
5	PZ08YJSW003	721670	7478287	Platyhelminthes	7	Turbellaria sp.	
5	PZ08YOXB004	718788	7477937	Cyclopoida	2	*Goniocyclops* sp.	
5	PZ08YOXB004	718788	7477937	Cyclopoida	1	*Metacyclops pilbaricus*	
5	PZ08YOXB004	718788	7477937	Amphipoda	7	Paramelitidae sp.	juvenile
5	PZ08YOXB004	718788	7477937	Amphipoda	3	Paramelitidae sp.2 (DEC)	
5	PZ09YJSW020	724976	7479538	Copepoda	6	*Diacyclops humphreysi humphreysi*	
5	WB/YJ99	725805	7480628	Cyclopoida	13	*Diacyclops humphreysi humphreysi*	
5	WB/YJ99	725805	7480628	Amphipoda	14	Paramelitidae sp.2 (DEC)	
5	WW2	733149	7472618	Harpacticoida	2	Canthocamptidae sp B1	female
5	WW2	733149	7472618	Amphipoda	7	*Chydaekata* sp.	
5	WW2	733149	7472618	Unknown 1	2	copepod naupuli	
5	WW2	733149	7472618	Cyclopoida	60	*Diacyclops humphreysi unispinosus*	
5	WW2	733149	7472618	Oligochaeta	35	Enchytraeidae Pilbara sp. 1 (pss)	
5	WW2	733149	7472618	Ostracoda	1	*Gomphodella yandi*	
5	WW2	733149	7472618	Ostracoda	7	*Meridiescandona facies*	
5	WW2	733149	7472618	Ostracoda	4	*Notocandona boultoni*	
5	WW2	733149	7472618	Amphipoda	5	Paramelitidae sp.2 (DEC)	
5	WW3	733405	7473428	Cyclopoida	10	*Diacyclops humphreysi humphreysi*	
5	WW3	733405	7473428	Oligochaeta	1	Enchytraeidae pilbara sp. 2 (pss)	
5	WW3	733405	7473428	Ostracoda	13	*Meridiescandona lucerna*	
5	WW3	733405	7473428	Amphipoda	4	Paramelitidae sp.2 (DEC)	
5	WW3	733405	7473428	Amphipoda	1	*Pilbarus millsi*	
5	WW3	733405	7473428	Isopoda	9	*Pygolabis weeliwolli*	
5	WW4	734018	7474365	Cyclopoida	4	*Diacyclops humphreysi humphreysi*	
5	YM119	738345	7479063	Amphipoda	1	*Maarka wolli*	
5	YM119	738345	7479063	Ostracoda	7	*Meridiescandona lucerna*	
5	YM119	738345	7479063	Ostracoda	8	*Notocandona boultoni*	

Appendix 2

Phase I; Amphipod Genetic Analysis Report

Objective
Specimens of amphipods were collected from sites at Yandi at Marillana Creek in the Fortescue River basin to:

- assess the number of species likely to be in the collection;
- compare the Yandi specimens to those collected at other sites in the Pilbara and assess their relationships.

Executive summary

Methods
Amphipods were collected from 20 bores during two sampling phases at Yandi. Genetic distances between unique genetic types (haplotypes) were measured using uncorrected p-distances (total percentage of nucleotides different between sequences). To account for polymorphism within lineages, the net genetic diversity of Nei (1987) was calculated to give a 'corrected' distance between lineages.
Neighbour-joining (NJ) of uncorrected p-distances was used to construct a phylogenetic tree. The robustness of the branching pattern was assessed using 500 bootstrap iterations. Three specimens of Nedsia from the family Melitidae were used as outgroups. As part of a separate study, some specimens were screened using Chydaekata-specific microsatellite markers (Finston et al, 2009). A positive amplification product would indicate the specimen was Chydaekata.

Results
The phylogenetic analysis shows the presence of seven well-supported lineages (A-G; Figure 1). The lineages differed from one another by between 11.9 and 22.8% net sequence divergence (Table 2). The specimens from Yandi occurred in four distinct, well-supported genetic lineages (A, D, F, G; Figure 1). Lineage A formed a well-supported clade with Chydaekata acuminata from Ethel Gorge, and many specimens were identified morphologically as Chydaekata sp. Specimens belonging to this lineage were found at 15 of the 20 bores (Table 1). In addition, 80 specimens were identified as Chydaekata using the microsatellite markers (Table 1). Lineage D was found in three bores (Table 1). Lineage G corresponded to the recently described species Maarrka weeliwollii (Finston et al., 2010), but lineage F (specimen jse3-05-1-a) was genetically distinct from the other specimens of M. weeliwollii (Figure 1). Specimen jse3-05-a differed from other specimens of M. weeliwollii by between 12.9 and 13.6% sequence divergence (Table 3). In contrast, the remaining specimens of M. weeliwollii differed from one another by between 1.1 and 3.4% sequence divergence (Table 3). The Yandi specimens of Maarrka differed from M. etheli by between 18.6 and 19.5% sequence divergence (Table 2).

Conclusions
The high level of sequence divergence between the Yandi lineages indicates that they belong to distinct species. Two lineages found at Yandi (A, G) correspond to previously recognised genera, Chydaekata and Maarrka, respectively. Lineage B does not correspond to any previously recognised species and likely represents a new species.

Lineages F and G show more genetic divergence than is typically seen with species and may indicate the presence of two species of this genus at Yandi. Whether or not the lineages are considered separate species, they show significant differentiation. Using a standard molecular clock for arthropods (Brower, 1994), the two lineages have been isolated for approximately five million years. Further morphological examination is

necessary to determine if there are diagnostic characters associated with the genetic lineages, which would support the recognition of two species.

In summary there are at least three species of amphipods at Yandi: Chydaekata sp., Maarrka weeliwollii, and Paramelitidae sp. 1. In addition, a fourth species, represented by lineage F, may be present at Yandi.

References

Brower, A.V.Z., 1994. Rapid morphological radiation and convergence among races of the butterfly Heliconius erato inferred from patterns of mitochondrial DNA evolution. Proceedings of the National Academy of Sciences USA. 91: 6491-6495.

Finston, T. L. , Lukehurst, S. S., Fitzpatrick, G.L. 2009. Characterisation of microsatellite loci in the groundwater amphipod *Chydaekata* sp. (Malacostraca: Paramelitidae). Conservation Genetics Resources. DOI: 10.1007/s12686-009-9152-2

Finston, T.L. Johnson, M.S., Eberhard, S.M., Cocking, J.S., McRae, J. M., Halse, S.A., Knott, B. 2010. New genus and species of groundwater amphipods from the Pilbara, Western Australia: a combined molecular and morphological approach. Records of the Western Australian Museum (in review)

Nei, M. (1987) DNA polymorphism within and between populations. In: Molecular Evolutionary Genetics. pp.254-286. Columbia University Press New York, NY.

Table 1. Species designations for amphipods collected at Yandi during two sampling phases (November 2003, April 2003). * indicates some specimens were recognised using Chydaekata-specific markers.

Borehole	N	Notes	molecular ID
99YJWB02	1		Chydaekata
Airport (EA)	1		4 Chydaekata*
Discharge (YMCD)	24		5 Chydaekata, 1 Maarrka weeliwollii
JSE1-05-1			8 Chydaekata*
JSE 3*	18		1 Maarrka sp.
JSE 4*	24		
JSE 6*	2		1 Chydaekata
JSE 7*	5		3 Chydaekata
JSE 8*	27		1 Chydaekata
JSE 14*	14	One V large spec.	1 Chydaekata
JSE 16*	2		1 Maarrka weeliwollii
Marillana 2 (M2)			24 Chydaekata*
Marillana 3 (M3)	33		4 Chydaekata, 2 Maarrka weeliwollii
Marillana 5 (M5)	22		24 Chydaekata*
Marillana 6 (M6)	23		1 Chydaekata, 1 Paramelitidae sp. 1
Marillana 7 (M7)	2	Large Spec.	7 Chydaekata*
Mnew1	2		30 Chydaekata*
Plant	1		1 Maarrka weeliwollii, 3 Chydaekata*
Camp			Paramelitidae sp. 1
WB	1		Paramelitidae sp. 1

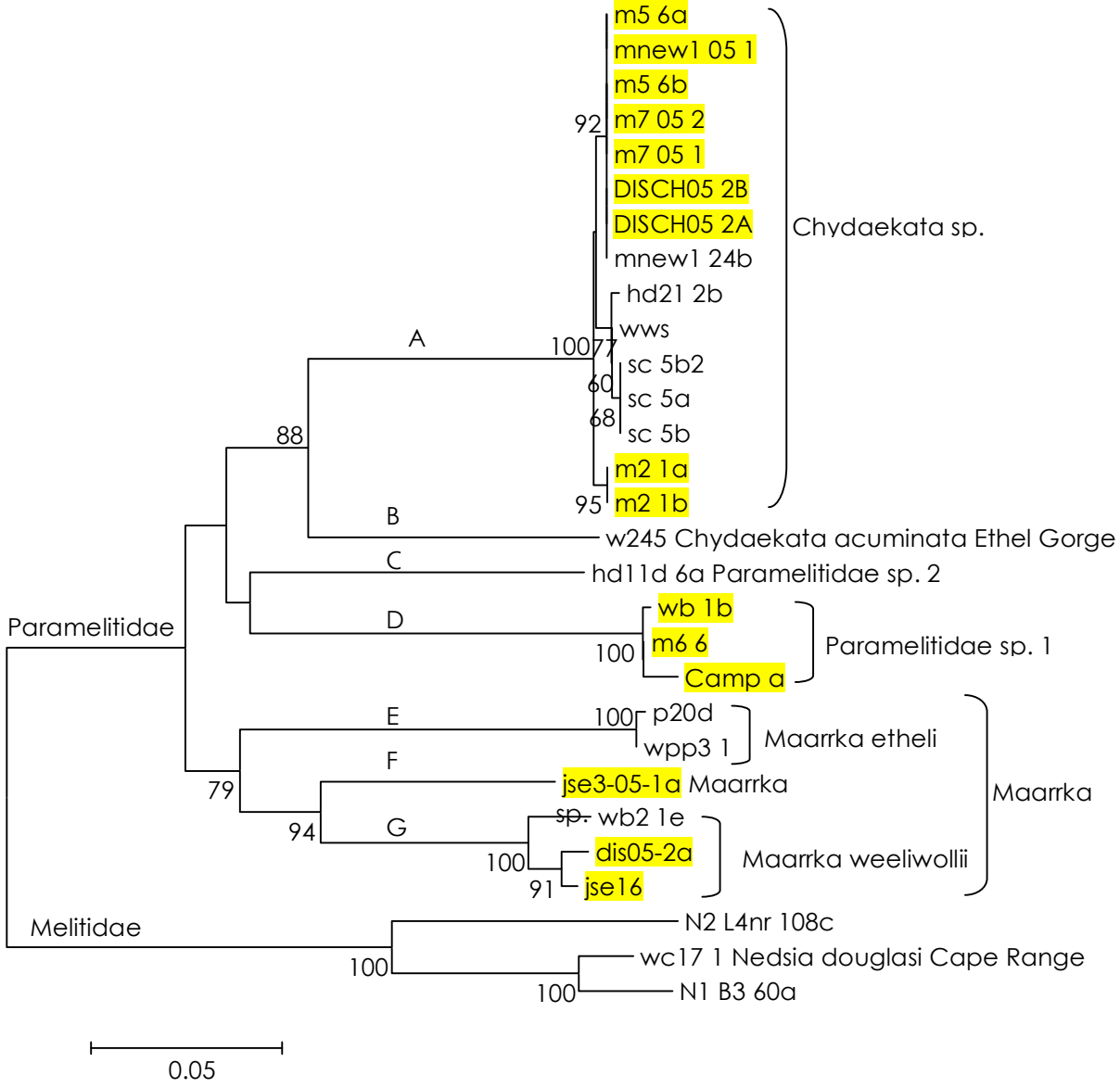
Table 2. Net sequence divergence between lineages as shown in Figure 1.

	A	B	C	D	E	F	G
[A] Chydaekata sp							
[B] C. acuminata	15.2						
[C] Paramelitidae sp. 2	19.0	20.6					
[D] Paramelitidae sp. 1	20.6	22.4	19.0				
[E] Maarrka etheli	22.9	21.3	20.2	22.8			
[F] Maarrka sp	20.3	21.1	20.0	23.3	19.3		
[G] M. weeliwolliii	20.4	16.9	18.3	22.2	17.5	11.9	

Table3. Uncorrected p-distances between haplotypes of Maarrka from Yandi, Weeli Wolli Creek and Ethel Gorge. Distances between jse3-05-1a and other Maarrka specimens at Yandi are highlighted in yellow; distances between Maarrka specimens at Yandi excluding jse3-05-1a.

	Maarrka sp.	Maarrka weeliwollii			Maarrka etheli	
	jse3-05-1a	wb2-1a	Dis05-2a	Jse16	P20d	Wpp3-1
jse3-05-1a						
wb2-1a	12.9					
Dis05-2a	12.9	2.7				
Jse16	13.6	3.4	1.1			
P20d	19.5	19.3	18.6	18.8		
Wpp3-1	19.3	19.0	18.4	18.6	0.2	

Figure 1. Neighbour joining tree of uncorrected distances between specimens of amphipods. Lineages are labeled A-G as in text and Table 2. Yandi specimens are highlighted in yellow. Specimens of Nedsia are used as outgroups, and specimens of Chydaekata acuminata, Maarrka etheli and an undescribed paramelitid species from Hope Downs are included as reference sequences.



Appendix 3

Taxa Collected in Relation to Drawdown and Reference Areas

Taxa	Reference sites	Drawdown Sites	Comments
Amphipoda			
Chydaekata sp.	99YJWB02, 99YJWB03, JSE14, JSE39, WW2, WW3, WW4	D08YJ050, Discharge, JSE2a, JSE6, JSE7, JSE8, JSE12, Marillana01, Marillana02, Marillana03, Marillana07, MNEW1upstream, WSO04obs	Not yet identified to species. Not restricted to drawdown area.
Maarka weeliwolli	JSE14, WW2, YM119	Discharge, Marillana03, , Marillana07, MNEW1upstream, Plant	Not yet identified to species. Not restricted to drawdown area.
Paramelitidae sp. 2 (DEC)	99YJWB02, JSE14, JSE39, WW2, WW3, YM119	D08YJ050, JSE2a, Marillana01, Marillana02, Marillana03, Plant, Marillana06, Marillana07, MNEW1upstream, Marillana03, Plant, PZ08YJSW003, PZ08YOXB004, WB/YJ99	Not restricted to project area.
Pilbarus millsi	99YJWB02, WW3	Marillana06	Not restricted to project area.
Bathynellacea			
Atopobathynella sp.	WW3	PZ08YOXB006, SA	Unlikely to be restricted to impact area.
Notobathynella sp.	JSE14	-	Not yet identified to species. Not restricted to drawdown area.
Isopoda			
Pygolabis weeliwolli	99YJWB02, 99YJWB04, WW3, YM119	Airport EA, Discharge, JSE2a, Fauna, Marillana05, MNEW1upstream, Plant, PZ08YJSW003, SB, WSO04obs	Not restricted to project area
Pygolabis humphreysi	-	Marillana07	Not restricted to project area
Pygolabis sp. nov. 1	Marillana03	Discharge, Marillana07, MNEW1upstream	Not yet identified to species. Not restricted to drawdown area.
Copepoda			
Diacyclops cockingi	-	Marillana06, Marillana07, MNEW1upstream, SB	Not restricted to project area.
Diacyclops humpreysi humphreys	99YJWB03, 99YJWB04, JSE14, JSE36, JSE37, JSE39, WW2, WW3, WW4, YM119	D03YJ1667, D08YJ050, Marillana01, Marillana02, Marillana03, Plant, Marillana06, Marillana07, MNEW1upstream, PZ08YJSW003, PZ08YOXB006, PZ09YJSW020, WB/YJ99, WSO04obs	Not restricted to project area.
Diacyclops humpreysi unispinosus	99YJWB02, WW2	-	Not restricted to project area.
Diacyclops sobeprolatus	99YJWB02	B1, MB08YJPC021, PZ08YJSW003	Not restricted to project area.
Mesocyclops darwini	-	Marillana06	Not restricted to project area.
Metacyclops pilbaricus	PZ08YOXB004, PZ08YOXB006, W01YJ15D	-	Not restricted to project area.
Microcyclops varicans	-	MNEW1upstream	Not restricted to project area.
Goniocyclops sp.	-	PZ08YOXB004	Not identified to species.
Canthocamptidae sp. B1	JSE14, WW2, WW3	Marillana07, Plant	Not restricted to drawdown area.
Australocamptus sp.	WW3	Marillana02	Not restricted to drawdown area.
Inermipes sp. B2	99YJWB02, 99YJWB04, JSE14, WW2, YM119	Plant	Not restricted to drawdown area.
Oligochaeta			
Enchytraeidae Pilbara sp. 1 (pss)	WW2	Marillana02	Not restricted to project area.
Enchytraeidae pilbara sp. 2 (pss)	WW3	Marillana02, MNEW1upstream	Not restricted to project area.

Phreodrilidae with similar ventral chaetae (pss)	-	D08YJ050	Not restricted to project area.
Nr Ainudrilus sp.	-	Marillana05, Marillan07, Plant, W02YJ001	Not restricted to drawdown area.
Pristina aequiseta	-	D08YJ050	Not restricted to project area.
Tubificidae morphospecies 1/1a (pss)	-	MNEW1upstream	Not restricted to project area.
Hydrachnidia			
Axonopsella sp. B1	YM119	Marillana06, Marillana07, MNEW1upstream,	Not yet identified to species. Not restricted to drawdown area.
Arrenurus sp. 1	-	Marillana07, MNEW1upstream	Not identified to species.
Arrenurus sp. 2	-	MNEW1upstream	Not identified to species.
Albia sp.	-	MNEW1upstream	Not identified to species.
Limnesia sp. B1	-	MNEW1upstream	Not identified to species.
Stygiolimnochares sp B1	-	Marillana06	Not identified to species.
Mideopsinae sp. (nr Penemidopsis)	-	Marillana06	Not identified to species.
Recifella sp. (nr P1, DEC code)	-	Discharge, JSE3, Marillana01, Marillana03, Marillana05, Marillana06, Marillana07, MNEW1upstream	Not identified to species.
Ostracoda			
Gomphodella hirsuta	WW3	Marillana06, Marillana07	Described from outside the project area
Gomphodella sp. A (BOS200)	-	Marillana06	Not identified to species.
Gomphodella sp. "yandi"	WW2	Marillana01, Marillana05, MNEW1upstream	Not yet identified to species. Not restricted to drawdown area.
Areacandona mulgae	99YJWB03	-	Described from outside the project area
?Candonopsis n. sp.	-	MNEW1upstream	Not identified to species.
Meridiescandona facies	JSE14, WW2, WW3, WW4	B1, Discharge, Fauna, JSE8, Marillana01, Marillana02, Marillana03, Marillana05, Marillana06, Marillana07, MNEW1upstream, Plant, W02YJ001,	Described from outside the project area.
Meridiescandona marillanae	WW3	B1, JSE4, Marillana07, SB	Described from outside the project area
Meridiescandona lucerna	WW3, WW4, YM119	Marillana07	Described from outside the project area
Notocandona boultoni	99YJWB02, JSE14, WW2, YM119	B1, Discharge, Marillana01, Marillana03, Marillana06, Marillana07, MNEW1upstream, Plant, PZ08YJSW003,	Described from outside the project area
Notocandona modesta	-	B1	Described from outside the project area
Pilbaracandona sp.	-	Discharge, Marillana07, MNEW1upstream	Not identified to species.
Platyhelminthes			
Turbellaria sp.	-	D08YJ050, Discharge, Marillana01, Marillana02, Marillana06, Marillana07, MC10, MNEW1upstream, PZ08YJSW003, W01YJ15D	Not identified to species.

Appendix 4

Drill Log Data Supplied by RTIO

Well Completion Details - PZ08YOXB005

HOLE DETAILS
PROJECT: Yandicoogina
LOCATION: Oxbow
DATE COMMENCED: 14-Sept-08
DATE COMPLETED: 17-Sept-08

DRILLING DETAILS
DRILLING COMPANY: Nudrill Pty Ltd
DRILLER: Ross Pendelbury
DRILLING METHOD: Air/Hammer
HYDROGEOLOGIST(s): Emma McGiven

LOCATION
GRID NAME: MGA94 Zone 50
EASTING: 718513.86
NORTHING: 7477669.84
ELEVATION: 547.85 mRL (TOC)

Well Notes: Hole diameter 12 inch hammer 0-11.3m, 7&7/8 inch hammer 11.3-50m.

Depth (mbgl)	Geology	Lithology	Lithological Description	Field Notes	Well Design	Well Construction
0 – 5	ALL		ALLUVIUM: BIF, reg/grey, sub rounded. Some pisolite material, magnetic. Green/grey chert, opaque, sub angular. Minor red shale. Loose material.			+0.7 - 11.3 m Steel 219 mm (8") collar cemented
5 – 10	No Sample		NO SAMPLE: No sample as collar blew out due to loose material or cavity.			
10 – 15	ALL		BIF: Red/grey BIF, sub angular chips. Minor yellow brown clay. Green chert band from 14-16m.	Intial WL 16.36 mbtoc (18/9/08)		+0.5 - 20 m, Cl12, 50 mm PVC blank casing
15 – 20						
20 – 25	WW Fm		CHERT: Grey, opaque chert with rare green chert, sub angular. BIF, blue/grey/red. Light brown clay.			20 - 50 m, Cl12, 50 mm PVC slotted casing, 1 mm aperture
25 – 30						
30 – 35	WW Fm		CHERT: Grey/green/white chert. Minor red and orange shale. Minor red/grey BIF. Red siliceous shale from 38-40m. Minor orange clay 40-42m.	Airlift of bore 0.4 L/s.		
35 – 40						
40 – 45	WW Fm		BIF: Dark grey, siliceous fresh BIF. Red BIF. Grey/white chert. Minor red siliceous shale and grey/green shale.	Field chemistry: pH = 8.49, EC = 992 uS/cm, temp = 25.7 C.		19 -50 m Gravel pack (graded 3.2-6.4 mm)
45 – 50						

Well Completion Details - WB08YJSW002

HOLE DETAILS

PROJECT: Yandicoogina
LOCATION: Junction South West
DATE COMMENCED: 5-Nov-08
DATE COMPLETED: 14-Nov-08

DRILLING DETAILS

DRILLING COMPANY: Nudrill Pty Ltd
DRILLER: Lee Martin/Shaun McGinley
DRILLING METHOD: Air/Hammer
HYDROGEOLOGIST(s): Emma McGiven

LOCATION

GRID NAME: MGA94 Zone 50
EASTING: 722354.82
NORTHING: 7478542.66
ELEVATION: 539.14 mRL (TOC)

Well Notes: Hole diameter 24 inch air/roller 0-6 m, 17.5 inch air/hammer 6-90 m.

Depth (mbgl)	Geology	Lithology	Lithological Description	Field Notes	Well Design	Well Construction
0	ALL		ALLUVIUM: Yellow brown, hard BIF, hydrated CID, vitreous, pisolitic with limonitic clay.			+0.1 - 5.9 m Steel 508 mm (20") collar cemented
5	CID		ALLUVIUM: Cream/white clay and laterised, hydrated BIF.			+0.2 - 17.5 m, 324 mm (12") steel blank casing
10	CID		GVU: Grey vitreous goethite matrix with clast supported hematite goethite peloids. Hard, subangular with minor yellow/cream clay throughout.	Intial WL 19.49 mbtoc (19/11/08)		
15						
20						
25						
30	CID		GVL: Yellow to grey, hard, angular hematite goethite peloids in a vitreous / limonitic goethite matrix.	Gravel 32 x 500 kg bags		
35						17.5 - 65.5 m, 324 mm (12") steel slotted casing, 3 mm aperture, 9.2 mm wall thickness
40						
45				Airlift of bore after construction 37 L/s. Airlifted for 4hrs.		
50						
55						0 to 89.5 m graded gravel (3.2 to 6.4 mm)
60	CID		LGC: Yellow /grey, hard limonitie and goethite, denatured in places. Limonitic clay present.			
65						65.5 - 77.5 m, 324 mm (12") stainless steel screen casing
70	CID		BCC: Yellow/grey, subangular, hard, BIF and chert. Limonitic clay and CID present.	Field chemistry: pH = 7.86, EC = 948 uS/cm, temp = 25.6 C.		
75						77.5 - 83.5 m, 324 mm (12") steel slotted casing, 3 mm aperture, 9.2 mm wall thickness
80	WW Fm		WW: Grey/Brown, fresh, hard, angular, BIF and chert. Shale and clay present.			
85						83.5 - 89.5 m, 324 mm (12") steel blank casing
90						89.5 - 90 m Natural packing

Well Completion Details - PZ08YJSW009

HOLE DETAILS

PROJECT: Yandicoogina
LOCATION: Junction South West
DATE COMMENCED: 23-Sept-08
DATE COMPLETED: 25-Sept-08

DRILLING DETAILS

DRILLING COMPANY: Nudrill Pty Ltd
DRILLER: Andrew McInerney
DRILLING METHOD: Air/Hammer
HYDROGEOLOGIST(s): Emma McGiven

LOCATION

GRID NAME: MGA94 Zone 50
EASTING: 722533.54
NORTHING: 7478166.54
ELEVATION: 532.86 mRL (TOC)

Well Notes: Hole diameter 12 inch hammer 0-5.3 m, 7&7/8 inch hammer 5.3-50 m.

Depth (mbgl)	Geology	Lithology	Lithological Description	Field Notes	Well Design	Well Construction
0	ALL		ALLUVIUM: Brown Alluviual. BIF, angular to subangular, hard, bedded meso banding. Minor quartz present and chert. BIF quite silicious, minor pisolites.			+0.7 - 5.3 m Steel 219 mm (8") collar cemented
10	BIF		ALLUVIUM: Light brown laterite weathered BIF. Bedded silicious BIF, sub angular, hard. Quartz present, minor white clay. Unmineralised saprolite (weathered BIF).	Intial WL 12.3 mbtoc (30/9/08)		
15	CLAY		ALLUVIUM: Cream/white, light brown moderately stiff clay. Soil and highly weathered BIF. 22-24m 10-20% quartz.	Airlift of bore ~0.5 L/s.		+0.5 - 22 m, Cl12, 50 mm PVC blank casing
20						
25	BIF		WW: BIF, blue/grey, magnetic. Minor red BIF. Minor shale.	Field chemistry: pH = 7.76, EC = 1223 uS/cm, temp = 29.5 C.		22 - 46 m, Cl12, 50 mm PVC slotted casing, 1 mm aperture
30						
35						15- 46 m Gravel pack (graded 3.2-6.4 mm)
40				Gravel 3 x 500 kg bags		
45						46-50 m Natural packing
50						

Well Completion Details - PZ08YJSW017

HOLE DETAILS

PROJECT: Yandicoogina
LOCATION: Junction South West
DATE COMMENCED: 2-Oct-08
DATE COMPLETED: 4-Oct-08

DRILLING DETAILS

DRILLING COMPANY: Nudrill Pty Ltd
DRILLER: Andrew McInerney
DRILLING METHOD: Air/Hammer
HYDROGEOLOGIST(s): Glenn Kirkpatrick

LOCATION

GRID NAME: MGA94 Zone 50
EASTING: 724262.5
NORTHING: 7478749.68
ELEVATION: 535.37 mRL (TOC)

Well Notes: Hole diameter 12 inch hammer 0-5.3 m, 7&7/8 inch hammer 5.3-50 m.

Depth (mbgl)	Geology	Lithology	Lithological Description	Field Notes	Well Design	Well Construction
0	ALL		ALLUVIUM: hard, siliceous, pebble chip size with meso banding. Minor chert			+0.7 - 5.3 m Steel 219 mm (8") collar cemented
5	ALL		ALLUVIUM: hard, with minor hydrated pitted fracture surfaces. Quartz present, minor clay			
10	ALL		ALLUVIUM: hard, with jaspilitic BIF, minor moderately stiff clay	Airlift of bore ~2 L/s.		+0.5 - 20 m, Cl12, 50 mm PVC blank casing
15				Intial WL 19.24 mbtoc (11/10/08)		
20						20 - 50 m, Cl12, 50 mm PVC slotted casing, 1 mm aperture
25	WW Fm		WW: hard platy chips with minor chert	Field chemistry: pH = 7.83, EC = 987 uS/cm, temp = 25.4 C.		
30						
35	WW Fm		WW: Fe stained soft yellow clay present	Gravel 4 x 500 kg bags		6.5- 50 m Gravel pack (graded 3.2-6.4 mm)
40						
45	WW Fm		DOLERITE: pitted, siliceous medium grained with alteration on fracture surfaces.			
50						

Well Completion Details - PZ09YJSW020

HOLE DETAILS
PROJECT: Yandicoogina
LOCATION: Junction South West
DATE COMMENCED: 4-April-09
DATE COMPLETED: 5-April-09

DRILLING DETAILS
DRILLING COMPANY: Nudrill Pty Ltd
DRILLER: Richard Attard
DRILLING METHOD: Mud/Rotary
HYDROGEOLOGIST(s): Niall Inverarity

LOCATION
GRID NAME: MGA94 Zone 50
EASTING: 724985.01
NORTHING: 7479552.8
ELEVATION: 519.95 mRL (TOC)

Well Notes: Hole diameter 12 inch hammer 0-5.3 m, 6 inch mud/rotary 5.3-50 m.

Depth (mbgl)	Geology	Lithology	Lithological Description	Field Notes	Well Design	Well Construction
0	ALL		ALLUVIUM: Gravel to pebble-sized clasts of GOV, BIF and SHL. Clay matrix with minor WH CLA.	Intial WL 6.60 mbtoc (12/4/09)		+0.7 - 5.3 m Steel 219 mm (8") collar cemented
15	CID		BCC: Small angular chips of GOV, GOL, HEM pisolites. Some BIF chips.	Airlift 5 L/s.		+0.5 - 14 m, Cl12, 50 mm PVC blank casing
20	WW Fm		WW: BIF and SHL. Finely laminated BIF. Small chips of chert. Some SHL present. Occasional Jasperlitic BIF.	Gravel 3 x 500 kg bags		14 - 50 m, Cl12, 50 mm PVC slotted casing, 1 mm aperture
40				Field chemistry: no chemistry due to mud drilling.		0- 50 m Gravel pack (graded 3.2-6.4 mm)
50						

Well Completion Details - PZ08YJSW026

HOLE DETAILS

PROJECT: Yandicoogina
LOCATION: Junction South West
DATE COMMENCED: 24-Oct-08
DATE COMPLETED: 25-Oct-08

DRILLING DETAILS

DRILLING COMPANY: Nudrill Pty Ltd
DRILLER: Andrew McInerney
DRILLING METHOD: Air/Hammer
HYDROGEOLOGIST(s): Emma McGiven

LOCATION

GRID NAME: MGA94 Zone 50
EASTING: 724728.41
NORTHING: 7480567.46
ELEVATION: 533.08 mRL (TOC)

Well Notes: Hole diameter 12 inch hammer 0-5.3 m, 7&7/8 inch hammer 5.3-50 m.

Depth (mbgl)	Geology	Lithology	Lithological Description	Field Notes	Well Design	Well Construction
0	ALL		ALLUVIUM: Alluvial material. BIF, dark grey. Red shale.			
5	ALL Fm		ALLUVIUM: BIF, dark grey. Red shale. Orange and white clay.			+0.7 - 5.3 m Steel 219 mm (8") collar cemented
10	WW Fm		WW: BIF, blue grey. Red and orange shale. Minor grey opaque chert. 14-16m increased orange shale ~40%. Fracture at 18m. 26-34m increased orange/light brown clay.			
15				Airlift of bore ~1 - 1.5 L/s.		+0.5 - 21 m, Cl12, 50 mm PVC blank casing
20						21 - 48 m, Cl12, 50 mm PVC slotted casing, 1 mm aperture
25				Intial WL 25.58 mbtoc (29/10/08)		
30				Field chemistry: pH = 8.03, EC = 1106 uS/cm, temp = 26.7 C.		
35	WW Fm		WW: Dark grey BIF, red streak, red BIF, silicious material. Minor orange/yellow shale. Rare chert			11- 48 m Gravel pack (graded 3.2-6.4 mm)
40				Gravel 4 x 500 kg bags		
45	WW Fm		WW: Red/grey BIF. Orange, opaque and clear chert ~10-20%. Orange shale ~20-30%,			48-50 m Natural packing
50						

Well Completion Details - WB08YJSE001

HOLE DETAILS
PROJECT: Yandicoogina
LOCATION: Junction South East
DATE COMMENCED: 23-Nov-08
DATE COMPLETED: 30-Nov-08

DRILLING DETAILS
DRILLING COMPANY: Nudrill Pty Ltd
DRILLER: Lee Martin
DRILLING METHOD: Air/Hammer
HYDROGEOLOGIST(s): Emma McGiven

LOCATION
GRID NAME: MGA94 Zone 50
EASTING: 731074.59
NORTHING: 7478278.34
ELEVATION: 508.84 mRL (TOC)

Well Notes: Hole diameter 24 inch air/roller 0-6 m, 17.5 inch air/hammer 6-98 m.

Depth (mbgl)	Geology	Lithology	Lithological Description	Field Notes	Well Design	Well Construction
0	ALL		ALLUVIUM: Light brown, hard, subangular BIF. Hydrated vitreous goethite and pisolites present.			+0.1 - 6 m Steel 508 mm (20") collar cemented
5	CID		GVU: Dark grey vitreous goethite matrix with clast supported hematite goethite peloids. Limonitic clay with minor soft white clay present.			+0.2 - 25 m, 324 mm (OD), 305 (ID) steel blank casing
10						
15						
20						
25	CID		GVL: Dark grey vitreous, limonitic goethite matrix with hematite goethite peloids. Hard, angular, limonitic clay throughout with minor soft white clay.	Intial WL 24.63 mbtoc (23/01/09)		25 - 73 m, 324 mm (OD), 305 (ID) steel slotted casing, 3 mm aperture.
30						
35				Gravel 33 x 500 kg bags		
40						
45				Airlift 18 L/s. Airlift conducted for 16 hrs as very silty		0 to 97 m graded gravel (3.2 to 6.4 mm)
50						
55	CID		LGC: Yellow limonite and goethite, moderately hard denatured CID. Limonitic clay present.			
60						
65						
70	CID		BCC: Yellow grey, hard, denatured CID, BIF, chert, pisolites and limonitic clay. Minor quartz present.			73 - 85 m, 324 mm (12") stainless steel screen casing
75						
80				Field chemistry: pH = 7.67, EC = 996 uS/cm, temp = 24.3 C.		85 - 91 m, 324 mm (OD), 305 (ID) steel slotted casing, 3 mm aperture.
85						
90	WW Fm		WW: Grey, fresh, hard, angular BIF, chert and quartz.			91 - 97 m, 324 mm (OD), 305 (ID) steel blank casing 97 - 98 m Natural packing
95						

Well Completion Details - WB08YJSE002

HOLE DETAILS

PROJECT: Yandicoogina
LOCATION: Junction South East
DATE COMMENCED: 6-Dec-08
DATE COMPLETED: 7-Dec-08

DRILLING DETAILS

DRILLING COMPANY: Nudrill Pty Ltd
DRILLER: Lee Martin
DRILLING METHOD: Mud/Rotary
HYDROGEOLOGIST(s): Simon Page

LOCATION

GRID NAME: MGA94 Zone 50
EASTING: 731867.37
NORTHING: 7478031.14
ELEVATION: 499.46 mRL (TOC)

Well Notes: Hole diameter 24 inch air/roller 0-1.5 m, 12.5 inch mud/rotary 1.5-37 m.

Depth (mbgl)	Geology	Lithology	Lithological Description	Field Notes	Well Design	Well Construction
0	ALL		ALLUVIUM: Red brown unconsolidated soil, angular to subangular bedded BIF, chert and minor pisolite material. Sand to fine pebble size.			+0.7 - 1.5 m Steel 317 mm (14") collar cemented
5	ALL		ALLUVIUM: Red brown clay, angular to subangular BIF, chert and pisolite material. Sand to fine pebble size.			+0.5 - 6 m, Cl12 200 mm PVC blank casing
10	ALL		ALLUVIUM: Red brown clay. Angular to subangular BIF and chert material. Sand to fine pebble size.	Intial WL 10.95 mbtoc (22/01/09)		
15	ALL		ALLUVIUM: Red brown clay, angular to subangular BIF, chert, quartz and pisolitic material. Sand to fine pebble size.	Field chemistry: pH = 8.49, EC = 1007 uS/cm, temp = 24.9 C.		0 to 37 m graded gravel (3.2 to 6.4 mm)
20						
25	ALL		ALLUVIUM: Green brown clay, angular to subangular BIF, dolerite (pitted and weathered green) and chert. Sand to fine pebble size.			
	ALL		ALLUVIUM: Green and brown sandy clay. Angular to subangular BIF and chert. Sand to fine pebble size. Weathered green and pitted dolerite.			6 - 37 m, Cl12 200 mm PVC slotted casing, 3 mm aperture
30	ALL		ALLUVIUM: Green/brown clay, angular to subangular BIF and chert. Weatherd dolerite. Sand to medium pebble size.	Airlift ~5 L/s. Airlift conducted with compressor and 20 mm tremie pipe.		
35	ALL		ALLUVIUM: Green brown clay. Angular to subangular BIF and chert. BIF not weathered, sand to fine pebble size.			

Well Completion Details - PZ08YJSE001

HOLE DETAILS

PROJECT: Yandicoogina
LOCATION: Junction South East
DATE COMMENCED: 21-Oct-08
DATE COMPLETED: 22-Oct-09

DRILLING DETAILS

DRILLING COMPANY: Nudrill Pty Ltd
DRILLER: Andrew McInerney
DRILLING METHOD: Air/Hammer
HYDROGEOLOGIST(s): Glenn Kirkpatrick

LOCATION

GRID NAME: MGA94 Zone 50
EASTING: 731085.55
NORTHING: 7478261.46
ELEVATION: 508.98 mRL (TOC)

Well Notes: Hole diameter 12 inch hammer 0-5.3m, 7&7/8 inch hammer 5.3-98m.

Depth (mbgl)	Geology	Lithology	Lithological Description	Field Notes	Well Design	Well Construction
0	ALL		ALLUVIUM: unconsolidated, light brown, hard, hydrated, subangular bedded BIF, vitreous goethite, limonite and pisolites			+0.7 - 5.3 m Steel 219 mm (8") collar cemented
5	CID		GVU: Brown, hard, angular CID. Hematite-goethite peloids in a vitreous goethite matrix, clast supported. Limonitic clay and minor white clay present throughout.			+0.5 - 20 m, Cl12, 50 mm PVC blank casing
10						
15						
20						
25				Intial WL 24.10 mbtoc (30/10/08)		
30	CID		GVL: Light grey to yellow brown, hard, angular, hematite-goethite peloids in a vitreous goethite, limonitic goethite matrix. Limonitic and white clay pods throughout, minor earthy clay present.			
35						
40				Gravel 11 x 500 kg bags		
45						
50						20 - 98 m, Cl12, 50 mm PVC slotted casing, 1 mm aperture
55						
60	CID		LGC: Yellow, hard, subangular, denatured CID. Soft limonitic clay present throughout.	Field chemistry: pH = 7.77, EC = 1043 uS/cm, temp = 25.5 C.		
65						
70	CID		BCC: Yellow/grey, hard CID and vitreous goethite. Moderately stiff limonitic clay. White clay, BIF, chert and pisolites also present.	Airlift 11 L/s.		
75						19 - 98 m Gravel pack (graded 3.2-6.4 mm)
80						
85						
90	WW Fm		WW: Grey,hard, angular, fresh bedded BIF, chert and some quartz.			
95						

Well Completion Details - PZ08YJSE005

HOLE DETAILS

PROJECT: Yandicoogina
LOCATION: Junction South East
DATE COMMENCED: 5-Dec-08
DATE COMPLETED: 6-Dec-08

DRILLING DETAILS

DRILLING COMPANY: Nudrill Pty Ltd
DRILLER: Shaun McGinley
DRILLING METHOD: Mud/Rotary
HYDROGEOLOGIST(s): Simon Page

LOCATION

GRID NAME: MGA94 Zone 50
EASTING: 731931.96
NORTHING: 7477992.82
ELEVATION: 499.69 mRL (TOC)

Well Notes: Hole diameter 10 inch air/hammer 0-4 m, 6 inch mud/rotary 4-39.1m.

Depth (mbgl)	Geology	Lithology	Lithological Description	Field Notes	Well Design	Well Construction
0	ALL		ALLUVIUM: Red brown unconsolidated soil, angular to subangular bedded BIF, chert and minor pisolite material. Sand to fine pebble size.			+0.7 - 4 m Steel 219 mm (8") collar cemented
5	ALL		ALLUVIUM: Brown green clay. Angular to subangular BIF, chert and minor pisolite material. Sand to fine pebble size.			
	ALL		ALLUVIUM: Red brown clay. Angular to subangular bedded BIF and chert material. Sand to medium pebble size.	Intial WL 10.63 mbtoc (22/01/09)		+0.5 - 9.1 m, Cl12, 50 mm PVC blank casing
10						
15				Field chemistry: pH = 8.5, EC = 1096 uS/cm, temp = 21.1 C.		
	ALL		ALLUVIUM: Grey brown clay, angular to subangular bedded BIF and chert. Minor pisolite material present. Sand to medium pebble size.			
20						
	ALL		ALLUVIUM: Green brown clay, angular to subangular BIF, dolerite (pitted and weathered green) and chert. Sand to medium pebble size.			9.1 - 39.1 m, Cl12, 50 mm PVC slotted casing, 1 mm aperture
25						
30	ALL		ALLUVIUM: Purple green and brown clay. Angular to subangular bedded BIF and chert. Sand to medium pebble size.	Airlift ~2 L/s. Airlift conducted with compressor and 20 mm tremie pipe.		0 to 39.1 m graded gravel (3.2 to 6.4 mm)
	ALL		ALLUVIUM: Purple/green and red in colour, angular to subangular bedded BIF and quartz. Sand to medium pebble size.			
35						

Well Completion Details - PZ08YJSE006

HOLE DETAILS

PROJECT: Yandicoogina
LOCATION: Junction South East
DATE COMMENCED: 3-Dec-08
DATE COMPLETED: 5-Dec-09

DRILLING DETAILS

DRILLING COMPANY: Nudrill Pty Ltd
DRILLER: Shaun McGinley
DRILLING METHOD: Mud/Rotary
HYDROGEOLOGIST(s): Glenn Kirkpatrick

LOCATION

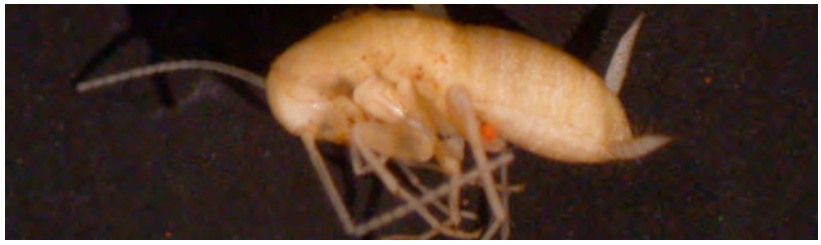
GRID NAME: MGA94 Zone 50
EASTING: 732128.48
NORTHING: 7477866.39
ELEVATION: 500.18 mRL (TOC)

Well Notes: Hole diameter 12.5 inch mud/rotary 0-4 m, 6 inch mud/rotary 4-48m.

Depth (mbgl)	Geology	Lithology	Lithological Description	Field Notes	Well Design	Well Construction
0	ALL		ALLUVIUM: Red brown unconsolidated soil and fill. Clasts of hard angular siliceous BIF, chert and minor pisolites.			+0.7 - 4 m Steel 219 mm (8") collar cemented
5	ALL		ALLUVIUM: Grey/white, hard siliceous BIF and minor chert. Angular to subangular grey still consolidated clay.			
10	ALL		ALLUVIUM: Red/brown soft clay with angular bedded BIF.	Intial WL 10.78 mbtoc (22/01/09)		
15	ALL		ALLUVIUM: Brown clay and BIF. BIF is siliceous, subangular with minor chert. Course sand to pebble size.	Field chemistry: pH = 8.48, EC = 1030 uS/cm, temp = 24.6 C.		+0.5 - 24 m, Cl12, 50 mm PVC blank casing
20	ALL		ALLUVIUM: Brown BIF and clay, pebble size, subrounded, siliceous, bedded with minor chert and quartz. Red soft clay and yellow medium stiff clay present.			
25	ALL		ALLUVIUM: Light brown, hard, subrounded to rounded BIF, chert and quartz. Red soft clay present with minor yellow clay throughout. Some pitted fracture surfaces.			
30	ALL		ALLUVIUM: Light brown, hard, subangular bedded BIF and chert + quartz. Yellow/red soft clay present throughout. Sand to pebble size range.	Airlift ~2 L/s. Airlift conducted with compressor and 20 mm tremie pipe.		24 - 48 m, Cl12, 50 mm PVC slotted casing, 1 mm aperture
35	ALL					0 - 48 m graded gravel (3.2 to 6.4 mm)
40	WW Fm		WW: Grey, fresh, hard, angular. silicious, fine grained BIF, quartz and chert. Minor soft grey clay and black shale.			
45						

Biota Environmental Sciences

Yandicoogina Stygofauna Assessment: 2010 Addendum



Prepared for Rio Tinto Iron Ore

February 2011

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Yandi Stygofauna 2010 Addendum

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1.0 Introduction

1.1 Project Background

The Yandicoogina (Yandi) iron ore mine, currently operated by Pilbara Iron (PI) on behalf of Rio Tinto Iron Ore (RTIO), is located approximately 90 km northwest of Newman in the Pilbara region of Western Australia (Figure 1.1). The original Yandi mine, Junction Central (JC) started construction in 1997 and the first shipment of ore occurred in 1999. An expansion to existing mining developments, Yandi Junction South-east (JSE), was proposed in 2005. This expansion area is situated near the confluence of three major creek systems in the area, Marillana, Yandicoogina and Weeli Wolli, and included a new open-cut pit. The Yandi mining areas are located within Channel Iron Deposits (CID) and are situated mostly below the water table.

The Ministerial Statement (695) approving the Yandi JSE expansion included a condition (Condition 695:M11) identifying the requirement for the preparation of a Subterranean Fauna Management Plan (SFMP). The subsequent SFMP was prepared by Biota Environmental Sciences (Biota), and identified the requirement for further field sampling of stygofauna at Yandi and associated taxonomic studies.

RTIO is currently seeking to sustain their mining operations at Yandi and are planning two new pit developments, located to the west and southwest of the existing operations (Figure 1.1):

- Yandicoogina Junction South West (JSW); and
- Oxbow.

An assessment of the subterranean fauna of the Yandicoogina project area (Biota 2010) detailed a summary of all stygobitic fauna collected during the previous five phases of sampling, as well as results of the single phase troglobitic fauna survey conducted in 2009. Potential risks to subterranean fauna populations as a result of dewatering and mining operations were identified, and methods aimed at mitigating these hazards proposed.

1.2 Scope of Additional Studies

The primary objectives of the additional studies completed in 2010 were to:

- ensure compliance with Ministerial Statement 695 (Condition 695:M11) and subsequent Subterranean Fauna Management Plan (Biota 2006);
- collect stygofauna and troglofauna data;
- collect data from areas outside the current and predicted impact zone; and
- collect further specimens of taxa identified as significant in the Ministerial Statement, such as *Gomphodella sp. 'yandi'* and *Recifella sp.1*.

1.3 Role of This Report

This report acts as an addition to previous phases of subterranean fauna sampling and should be read as an addendum to the Yandicoogina Subterranean Fauna Assessment Phases I – V (Biota 2010). This document should therefore be read in context with the wider subterranean fauna sampling programme.

The purpose of this report is to present the methods and results associated with Phases 6 and 7 of stygobitic fauna sampling and the second phase of troglobitic fauna sampling completed in the Yandi project area. Additionally, it provides updated species accumulation curve figures and associated analysis, which indicate the proportion of taxa recorded during sampling to-date.

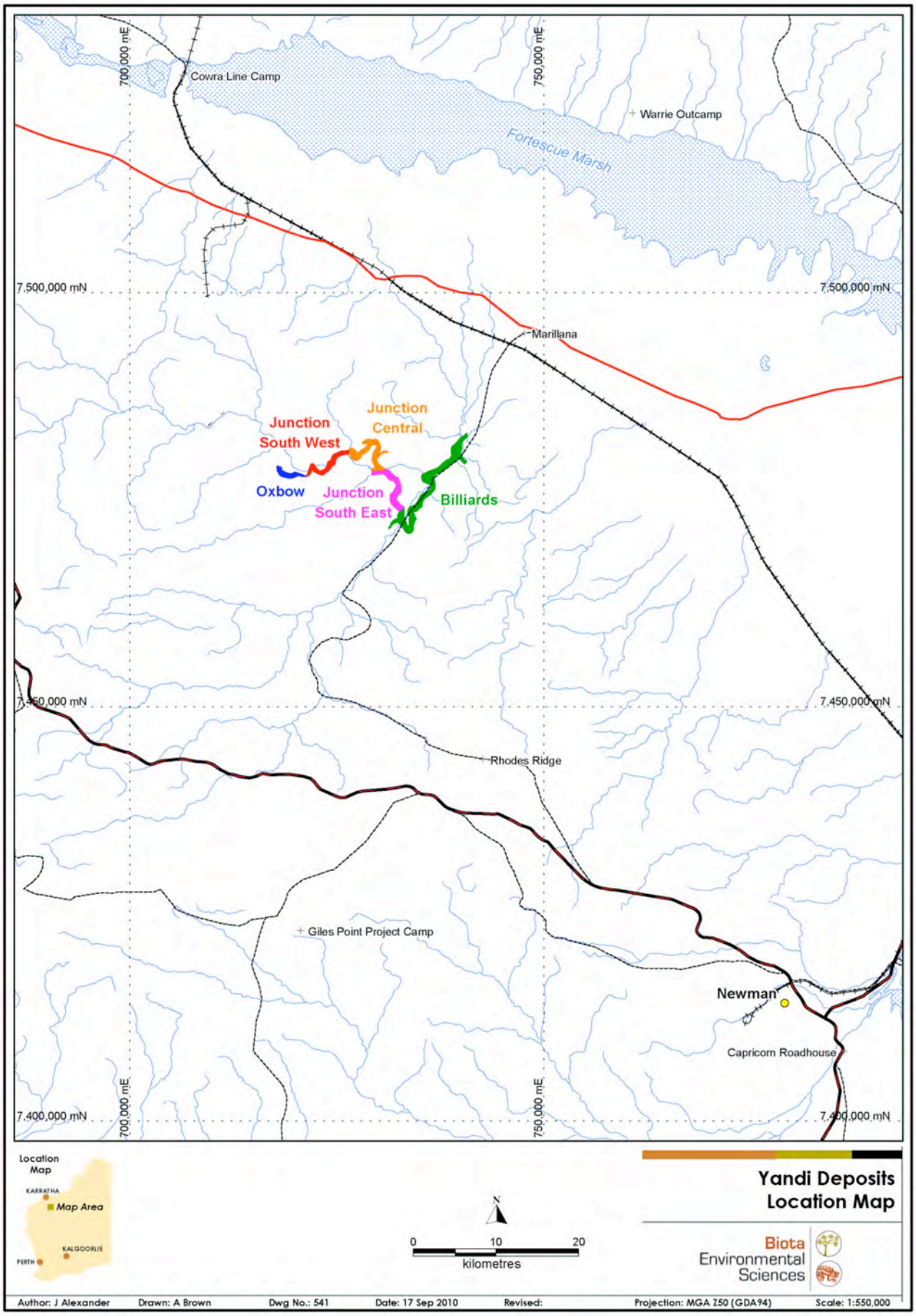

Figure 1.1: Location of the Yandicoogina study area in relation to Newman, the closest township.

2.0 Methodology

2.1 Survey Timing and Personnel

Biota completed two additional field surveys in 2010 comprising two phases of stygobitic fauna sampling and a single phase of troglobitic fauna sampling (Table 2.1).

Table 2.1: Field sampling dates, personnel and activities for 2010 surveys.

Survey Dates	Field Survey Personnel	Survey Activities
20th – 24th September 2010	Jason Alexander, Jack Tatler (of Biota)	Stygofauna survey (Phase 6) and placement of troglobitic fauna colonisation traps (Phase 2)
10th – 14th November 2010	Jason Alexander, Jessica Cairnes (of Biota)	Stygofauna survey (Phase 7) and recovery of troglobitic fauna colonisation traps (Phase 2)

The project was coordinated by Garth Humphreys and managed by Jason Alexander, both of Biota. Collected troglobitic fauna samples were sorted and identified taxonomically to order level in the Biota laboratory by Jack Tatler.

Specimens of interest were handed on to relevant taxonomic experts at Bennelongia Environmental Consultants and the Western Australian Museum (WAM) for identification to genus and species level, where possible.

2.2 Sampling Techniques

Subterranean fauna sampling within the RTIO Yandi project area followed a similar format to other sampling projects undertaken previously in the Pilbara bioregion.

2.2.1 Stygobitic Fauna Sampling Techniques

Methodology and approach for stygobitic fauna sampling were consistent with those outlined in the EPA Guidance Statement 54 (EPA 2003) and Draft Guidance Statement 54a (EPA 2007).

Groundwater sampling was undertaken using modified plankton haul nets. Each bore was dragged a minimum of three times unless fauna were detected, in which case five hauls were completed. On the final haul the net was gently agitated so as to stir the benthos layer and mobilise any fauna present for more effective specimen collecting. On the surface, the net was thoroughly flushed with fresh water, the sample placed in a labelled container stored in a shaded esky.

Sorting and identification of specimens to order level was completed in an on-site laboratory under a dissecting microscope (Olympus SZ40 and SZ61, magnification up to 40x). Stygofauna specimens were preserved in 100% ethanol (to allow both morphological and molecular analysis). Specimens were sent to relevant experts for further identification to the lowest possible taxonomic level (Section 2.1).

A more detailed account of the stygobitic fauna methodologies used can be found in the Yandi Subterranean Fauna Assessment phases I – V (Biota 2010).

2.2.1.1 Stygobitic Fauna Species Accumulation

Two species accumulation curves were plotted including data from all seven phases of sampling. These include:

- the first being the actual observed species accumulation over phases (S{obs}); and
- a permutated, smoothed curve (UGE) (Ugland et al. 2003) to aid prediction of the asymptotic value (Section 5.1.3, Figure 5.1).

Non-parametric estimators were used to predict total species richness (S_{max}) of the stygal community.

2.2.2 Troglobitic Fauna Sampling Techniques

Methodology and approach for troglobitic fauna sampling was consistent with those outlined in the EPA Guidance Statement 54 (EPA 2003) and Draft Guidance Statement 54a (EPA 2007).

Leaf litter, particularly that from Acacia spp., was gathered locally from the project area, soaked in water and sterilised in a microwave before being packed into the traps. Prepared traps, which were kept in sealed containers until immediately prior to placement in selected bores, were left in place for six to eight weeks to allow sufficient time for troglofauna colonisation. Once recovered, the traps were stored in labelled zip-lock bags to maintain humidity during the return to Perth for sorting.

Fauna specimens were recovered from the traps using specially designed Tullgren funnel units and identified to order or family level using dissecting microscopes (Olympus SZ40 and SZ61, magnification up to 40x. Samples were preserved in 100% ethanol to allow for both morphological and molecular analysis. Specimens of interest were submitted Western Australian Museum for finer scale identification where possible.

A more detailed account of the troglobitic fauna methodologies used can be found in the Subterranean Fauna Assessment phases I – V (Biota 2010).

2.3 Survey Sampling Effort

2.3.1 Stygofauna

Thirty-two sites were sampled in total for stygobitic fauna sampling in 2010, with 31 sites sampled in September and 28 sites sampled in November (Table 2.2, Figure 2.1). Twenty-seven of the sites were sampled consecutively during both phases. All sites successfully sampled had been sampled previously during Phases I - V.

Attempts to sample additional sites from historical drilling at RTIO Meander deposit, approximately 22 km west of Oxbow deposit were unsuccessful due to the age and location of the sites,.

Table 2.2: **Sampling effort and locations of stygofauna sites for 2010 sampling** (co-ordinates in zone 50, datum GDA94).

Area	Site Name	Easting (m E)	Northing (m N)	September	November	Comments
Billiards	99YJWB03	734850	7474599	√	√	
	99YJWB04	735931	7477480	√	√	
	WW4	734448	7474705	√	√	
	JSE36	735937	7475846	√	√	
	YM119	738345	7479063	√	√	
Junction Central	Marillana03a	728209	7479045	√	-	Mar03a. Unable to sample in November.
	Plant	728677	7479732	-	-	Dry
	WB/YJ99	725805	7480628	√	√	
	Fauna	726433	7483097	√	√	
	MAR06a	731182	7478693	√	√	
Junction South East	D08YJ050	732887	7473094	√	√	
	99YJWB02	732433	7472677	√	√	
	JSE39	733145	7472585	√		

Area	Site Name	Easting (m E)	Northing (m N)	September	November	Comments
	WW2	733200	7472664	√	√	
	WW3	733370	7473592	√	√	
	PZ08YJSE003	730892	7478388	√	√	
	JSE14	733707	7473602	√	√	
Junction South West	Marillana7	725592	7480218	√	√	Mar07
	Marillana02	725082	7479990	√	√	Mar02
	Marillana01	723792	7479113	√	√	Mar01
	MNEW1upstream	726009	7480355	√	-	Dry in November.
	PZ08YJSW002	721670	7478287		√	
	PZ08YJSW017	724263	7478750	√	√	
	PZ08YJSW020	724976	7479538	√	√	
	PZ08YJSW009	722534	7478167	√		
	PZ08YJSW003	721670	7478287	√	√	
	PZ08YJSW004	722689	7478744	√	√	
Oxbow	PZ08YOXB003	718308	7478847	√	√	
	PZ08YOXB004	718788	7477937	√	√	
	PZ08YOXB005	718514	7477670	√	√	
	PZ08YOXB006	719936	7478158	√	√	
	PZ08YOXB007	720681	7477777	√	√	
	MC4	730180	7478691	√	√	
Meander	YS-WB1	701989	7487034		-	Unable to locate
	YS-WB2	702139	7487034		-	Unable to locate
	YR11BP	698780	7484780		-	Unable to locate
	YR13P	705850	7482260		-	Unable to locate
- Visited but unable to sample			**Total**	**31**	**28**	

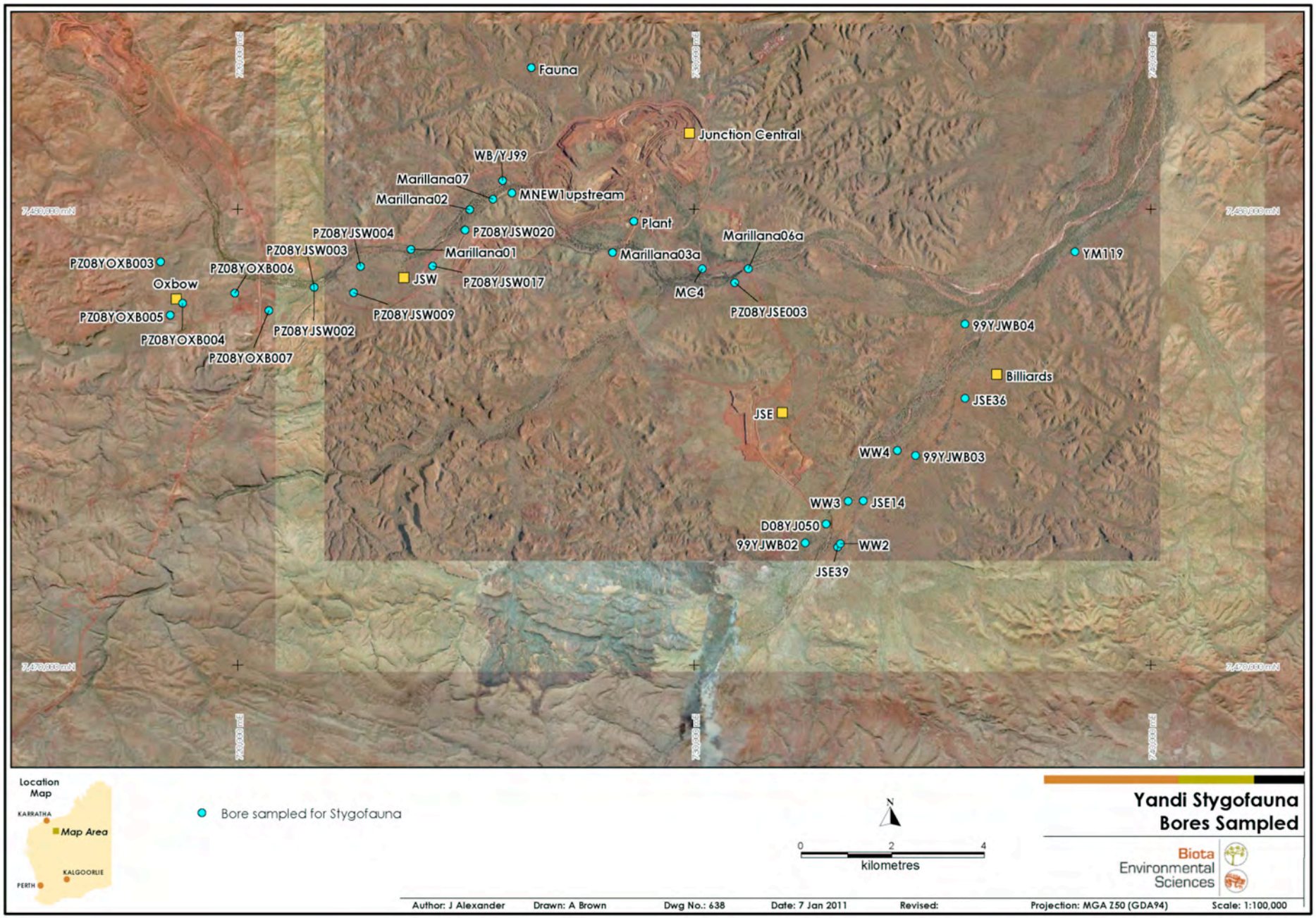

Figure 2.1: Location of sites sampled for stygofauna during 2010.

2.3.2 Troglofauna

A total of 46 sites were selected for troglobitic fauna sampling in 2010. Of these sites, all were successfully sampled, with the exception of MNEW1upstream (Table 2.3, Figure 2.2). These sites represent a mix of previously sampled and new troglobitic fauna sampling sites. Records of previously sampled sites can be seen in the Subterranean Fauna Assessment phases I – V (Biota 2010).

Table 2.3: **Sampling effort and locations of troglofauna sites for 2010 sampling** (co-ordinates in zone 50, datum GDA94).

Site Name	Easting (m E)	Nothing (m N)	Trap Number	Trap Depths	Comments
BFS475	733601	7471190	2	5, 10	
D03YJ1684	721823	7479143	2	5, 10	
D03YJ1711	721732	7478091	1	10	
D03YJ1806	720657	7478049	2	10, 15	
D04YJ1816	726208	7480912	1	5	
D04YJ1824	726030	7480805	2	10, 20	
D04YJ1894	724544	7480311	2	5, 10	
D04YJ2084	724938	7480341	2	5, 10	
D04YJ2121	724827	7479887	1	5	
D04YJ2190	724261	7479603	1	5	
D06YJ098	722987	7478472	1	10	
D06YJ102	723026	7478014	2	5, 10	
D06YJ170	723697	7478754	1	5	
D06YJ192	724293	7478866	1	5	
D06YJ222	736213	7475572	1	5	
D06YJ261	722529	7478862	1	5	
D06YJ274	724792	7479349	1	5	
D07YJ071	732782	7472212	2	5, 10	
D07YJ079	733421	7471573	2	5, 10	
D07YJ083	734904	7474334	1	1	
D07YJ114	733354	7472497	1	5	
D07YJ167	740135	7479284	2	5, 15	
D07YJ212	733209	7472068	1	10	
D07YJ218	732924	7471648	1	10	
D08YJ050	732887	7473094	2	10, 20	
D08YJ106	725286	7480560	2	10, 15	
D08YJ113	725583	7480699	2	10, 20	
D08YJ224	740846	7479990	2	10, 20	
D08YJ225	740778	7479923	2	5, 10	
D08YJ229	740844	7483102	2	10, 20	
D09YJ007	732288	7472987	2	10, 20	
D09YJ015	732288	7472704	2	10, 20	
MM526	743122	7479776	2	15, 30	
MNEW1upstream	726009	7480355	-	1.5	Trap had been removed, laying beside site on retrieval
RC06YJ005	734693	7472567	2	5, 15	
RC06YJ007	736956	7476527	1	5	
RD06YJ391	734981	7474822	1	4.5	
RD09YJ096	733602	7473376	1	5	
RD09YJ163	734232	7472179	2	5, 15	
RD09YJ280	733952	7471259	2	5, 10	
RD09YJ382	733041	7472590	1	5	
WW2	733200	7472664	2	4, 8	
WW3	733370	7473592	2	4	
WW4	734448	7474705	2	3.5	
Yandi un-named 01	734089	7472885	2	5, 10	Site name unclear
YW-P16	731523	7472123	2	5, 10	
- Visited but unable to sample		**Total**	**72**		

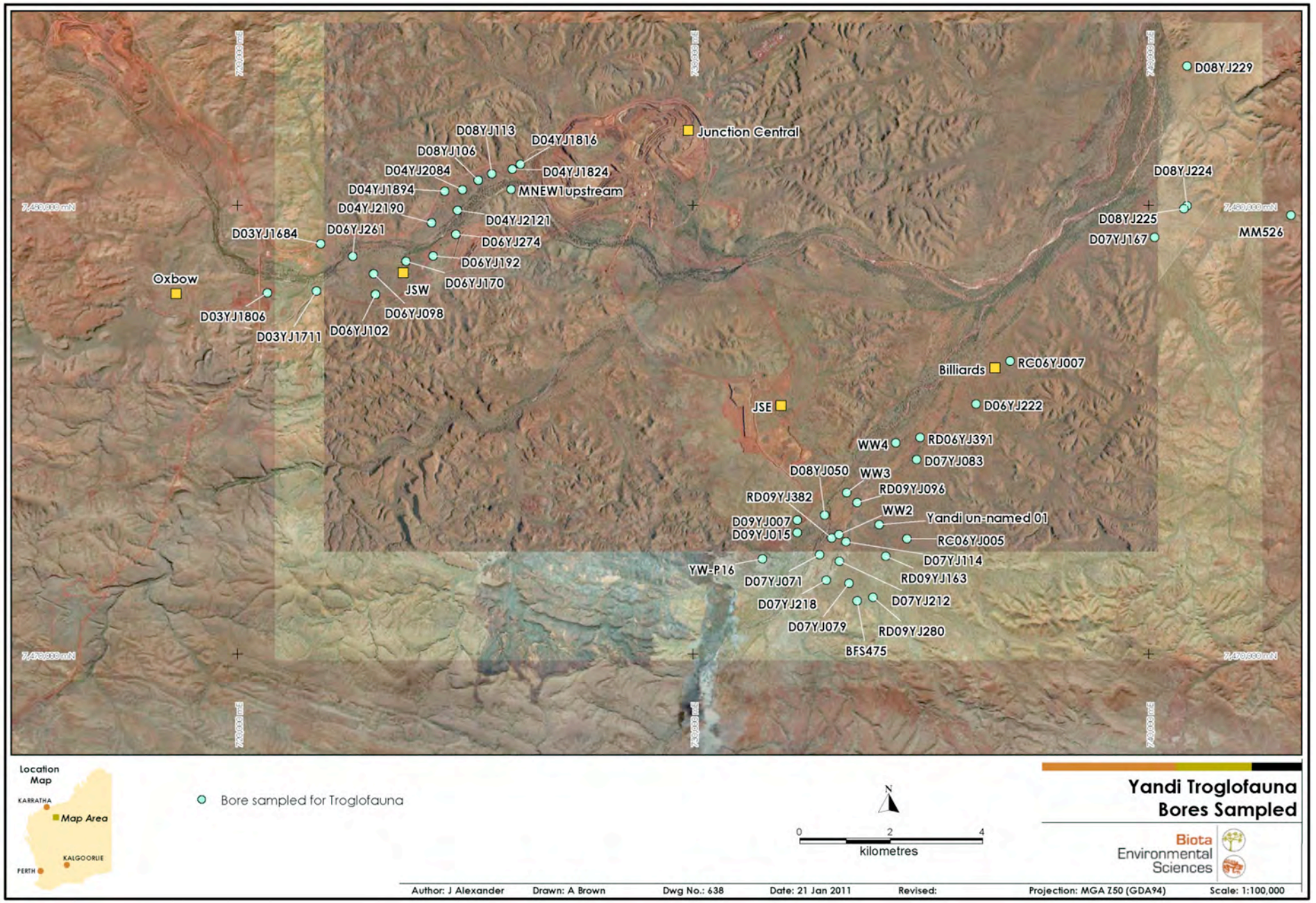

Figure 2.2: Location of sites sampled for troglofauna during 2010.

2.4 Survey Limitations

A common limitation of subterranean fauna surveys is the lack of taxonomic framework for some groups. This limits the level of identification possible for some taxa collected during this study.

Several specimens from the Yandi study site were juvenile or damaged and therefore lacked the characteristics necessary for identification to species level. Those specimens unable to be identified to species level were identified to the lowest possible taxonomic level or morphotype possible.

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3.0 Results

3.1 Stygobitic Fauna

A total of 1,471 stygofauna specimens were collected from the Yandi project area in 2010. This total includes 910 specimens from sampling in September and 562 specimens from November. Seven of the collected specimens belonging to the higher orders Coleoptera, Diptera, Gastropoda, Hemiptera and Polyxenida were not classed as stygal species and are therefore not discussed further in this report (Appendix 1).

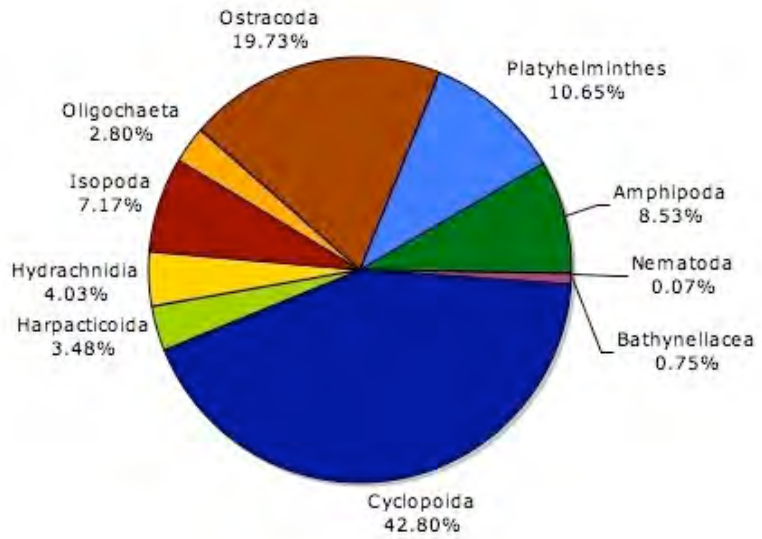

Figure 3.1: Proportional representation of stygobitic fauna collected from the Yandi project area in 2010.

The assemblage of stygobitic fauna represented seven classes and 10 orders (Table 3.1). The most frequently collected specimens were cyclopoid copepods, which accounted for 43 % of the total specimens collected (Figure 3.1). A single nematode specimen represented the smallest contributor of faunal composition with less than one percent of the total collected.

Table 3.1: Specimens collected and taxonomic summary of stygobitic fauna collected in 2010.

Taxonomy			Number Collected
Phylum	**Class**	**Order (common Name)**	
Annelida	Clitellata	Oligochaeta (Earthworms)	41
Chelicerata	Arachnida	Hydrachnidia (Water mites)	59
Crustacea	Malacostraca	Amphipoda (Amphipods)	125
		Bathynellacea (Bathynellids)	11
		Isopoda (Slaters)	104
	Copepoda	Cyclopoida (Cyclopoids)	627
		Harpacticoida (Harpacticoids)	51
	podocopida	Ostracoda (Ostracod)	289
Nematoda		(Nematodes)	1
Platyhelminthes	Turbellaria	(Flatworms)	156
		Total	**1,464**

A more detailed list of stygobitic taxa recorded is located in Section 4.1, which outlines species distributions in relation to the project area, further identifications and, where applicable, conservation significance.

3.2 Troglobitic Fauna

A total of 2,300 specimens were collected during troglofauna sampling in 2010 (Appendix 2). These specimens represented three phyla, four classes and 12 orders (Table 3.2). The greatest contributor to faunal composition was the order Acarina, or mites, which represented over 51 % of all specimens recorded (Figure 3.2).

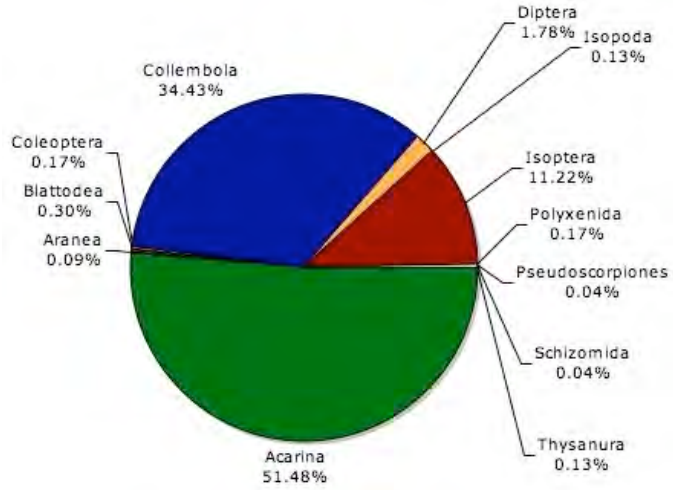

Figure 3.2: **Proportional representation of troglobitic fauna collected from the Yandi project area in 2010.**

Predominantly however the collected taxa displayed little evidence of troglomorphism (reduced pigmentation and eyes), and are likely to be edaphobitic (living in the soil layer) or epigean (surface) fauna. Four taxa displayed troglobitic characteristics including two arachnid orders (Pseudoscorpiones and Schizomida), a sole representative from the class Diplopoda, and some specimens of the insect order Blattodea (Table 3.2). For the purposes of this report, no further consideration will be given to those taxa considered not to be troglomorphic or unlikely to be short range endemic.

Table 3.2: **Overview of fauna collected from colonisation traps at Yandi in 2010** (specimens in bold indicate troglomorphic specimens).

Taxonomy			Number Collected	Number of Sample Sites
Phylum	**Class**	**Order (Common Name)**		
Chelicerata	Arachnida	Acarina (Mites)	1,184	28
		Aranea (Spiders)	2	2
		Pseudoscorpiones (Pseudoscorpions)	1	1
		Schizomida (Schizomids)	1	1
Crustacea	Malacostraca	Isopoda (Slaters)	3	2
Uniramia	Collembola	Collembola (Springtails)	792	28
	Diplopoda	**Polyxenida (Pincushion Millipedes)**	4	4
	Insecta	**Blattodea (Cockroaches)**	7	3
		Coleoptera (Beetles)	4	2
		Diptera (Flies)	41	4
		Isoptera (Termites)	258	9
		Thysanura (Silverfish)	3	2
		Total	**2,300**	

A detailed account of troglomorphic taxa is located in Section 4.2.

4.0 Annotated Account of Subterranean Fauna

4.1 Stygofauna

4.1.1 Order: Oligochaeta

A total of 41 oligochaete worms were collected during sampling in 2010. These specimens represented four distinct taxa from four families (Table 4.1). Most specimens from 2010 had been recorded during previous stygobitic fauna surveys (Biota 2010). However, the family Aeolosomatidae is previously unrecorded within the project area. This taxon was collected from two sites within the proposed impact area (Mar06a and Mar07). The most abundantly collected species was *Ainudrilus nr.* WA26, which was collected from a single site, Mar06a.

Table 4.1: Taxonomic identification and locations of Oligochaete specimens collected in 2010.

Taxonomy		Number Collected	Sites (Number of sites)	Comments
Family	**Taxa**			
Aeolosomatidae	*Aeolosoma* sp. 1 (PSS)	3	Mar06a, Mar07 (n= 2)	
Tubificidae	*Ainudrilus* nr. *WA26*	30	Mar06a (n= 1)	
Enchytaeidae	Enchytaeidae sp. 2	7	Fauna (n= 1)	
Phreodrilidae	Phreodrilidae with similar ventral chaetae	1	Mar07 (n= 1)	probably immature *Insulodrilus*

Oligochaete worms are generally not thought to display short-range endemism (Biota 2010) and many of the collected taxa have been located elsewhere in the Pilbara (Biota unpublished data, DEC Pilbara Stygofauna Survey unpublished data).

4.1.2 Order: Hydrachnidia

A total of 59 specimens belonging to the order Hydrachnidia were recorded. These specimens represented seven distinct taxa assigned to five families (Table 4.2). All specimens collected in 2010 had been recorded from the Yandi project area in the previous years.

Recifella sp. 1 was the most commonly recorded and widespread species with 30 specimens collected across four sites in 2010, Mar01, Mar07, MNEW1upstream and WW4. The Ministerial Statement 695 and subsequent Subterranean Fauna Management Plan (Biota 2006) identify this species as a taxon of significance and details the requirement to:

"*establish additional data on the distribution of existingstygofauna species and communities, particularly the ostracod Gomphidella sp. and the water mite Recifella sp., to demonstrate there is no threat to the species*".

Historically this species has only been collected adjacent to Marillana Creek only. The presence of *Recifella* sp.1 at site WW4 however not only demonstrates a range extension for the species, but also is indicative of the extensive connectivity between Marillana and Weeli Wolli Creek alluvial aquifers.

Table 4.2: Taxonomic identification and locations of Hydrachnidia specimens collected in 2010.

Taxonomy		Number Collected	Sites (Number of sites)	Comments
Family	**Taxa**			
Arrenuridae	*Arrenurus* sp nov yandi (sp 1)	8	Mar01 (n= 1)	-
	Arrenurus sp. 2	11	Mar07, MNEW1upstream (n= 2)	-
	Arrenurus sp. 3	4	WW3 (n= 1)	-
Halacaridae	Halacaridae sp.	1	Mar06a (n=1)	Desiccated, in poor condition.

Taxonomy		Number Collected	Sites (Number of sites)	Comments
Family	Taxa			
Limnesiidae	*Limnesia* sp. B1	3	Mar07, MNEW1upstream (n= 2)	-
Unionicolidae	*Recifella* sp. 1	30	Mar01, Mar07, MNEW1upstream, WW4 (n= 4)	-
Limnocharidae	*Stygolimnochares* sp B*1*	2	Mar07 (n= 1)	Body elongate

4.1.3 Order: Amphipoda

A total of 125 specimens belonging to the order Amphipoda were collected during two phases of sampling in 2010. All three species collected belonged to the family Paramelitidae (Table 4.3). Paramelitidae sp. 2 (PSS) was the most commonly recorded taxon, with 79 specimens recorded across 13 sites; 7 at Marillana Creek and 6 at Weeli Wolli. All species recorded have been collected during previous phases.

Table 4.3: Taxonomic identification and locations of Amphipoda specimens collected in 2010.

Taxonomy		Number Collected	Sites (Number of sites)	Comments
Family	Taxa			
Paramelitidae	*Chydaekata* sp.	33	JSE14, Mar01, Mar06a, Mar07, WW2, WW3, WW4 (n= 7)	-
	Maarka wolli' (ms name)	13	Mar06a, PZ08YJSW003, WW2, WW3, YM119 (n= 5)	-
	Paramelitidae sp. 2 (PSS)	79	D08YJ050, JSE14, JSE36, Mar01, Mar06a, Mar07, MC4, PZ08YJSW002, PZ08YJSW003, PZ08YJOXB004, WW2, WW3, WW4 (n= 13)	-

Most taxa identified have been recorded outside the project area with Paramelitidae sp.2 (PSS) and the genus *Chydaekata* sp. having a wide-ranging distribution throughout the Pilbara Bioregion (Biota unpublished data, Finston et al. 2007). The wider distribution of *Maarka* wolli (ms name) is less well documented, although it is unlikely to display short-range endemism based on known aquifer connectivity and the distribution of the other paramelitids in the study area.

4.1.4 Order: Bathynellacea

Fourteen specimens of the order Bathynellacea (Bathynelida) were collected during sampling in 2010. Eight of the specimens collected belonged to the genus *Atopobathynella*, which has been previously recorded from the project area. A single specimen of the previously unrecorded genus *Chilibathynella(*?) was collected from Weeli Wolli Creek. The five remaining specimens could not be identified beyond order level due to current limitations to the taxonomic framework for bathynellids (Table 4.4). This species was recorded from reference site WW4 and is unlikely to be impacted by the proposed development.

Table 4.4: Taxonomic identification and locations of Bathynellacea specimens collected in 2010.

Taxonomy		Number Collected	Sites (Number of sites)	Comments
Family	Taxa			
Indeterminate	Bathynella sp.	5	Mar07, MNEW1upstream	-
Parabathynellidae	*Atopobathynella sp. B4*	8	Mar01, Mar03a, MNEW1upstream (n= 3)	-
	Chilibathynella? sp. B6	1	WW4 (n= 1)	? denotes most likely to belong to this genus

Molecular and morphological species characterisation is ongoing in the Bathynellacea and it is unlikely that species level identification for those specimens collected at Yandi will be available in the near future. The family Parabathynellidae, and in particular the genus *Atopobathynella*, are widespread throughout Western Australia (Cho et al. 2006).

4.1.5 Order: Isopoda

A total of 104 specimens of isopod were collected from two surveys in 2010. All specimens collected belonged to the genus *Pygolabis* (Family; Tainisopidae) (Table 4.5). *Pygolabis weeliwolli* (Plate 4.1) was commonly collected from across both Weeli Wolli and Marillana Creek systems. All taxa have been recorded historically from sampling within the project area.

Plate 4.1: Isopoda specimen *Pygolabis weeliwolli* collected from site PZ08YJSW003.

Table 4.5: Taxonomic identification and locations of Isopoda specimens collected in 2010.

Taxonomy		Number Collected	Sites (Number of sites)	Comments
Family	**Taxa**			
Tainisopidae	*Pygolabis* sp. nov. 1	43	Mar02, Mar06a, Mar07 (n= 3)	-
	Pygolabis weeliwolli	61	99YJWB02, D08YJ050, JSE39, Mar01, Mar06a, PZ08YJSW003, PZ08YJSW004, WW2, WW3, WW4 (n= 10)	-

The genus *Pygolabis* is widespread throughout the Pilbara Bioregion with *P. weeliwolli* distributed outside the project area along Weeli Wolli Creek (Biota unpublished data). Specimens of *Pygolabis* sp. nov. 1, which is considered morphologically distinct from *P. weeliwolli*, are currently undergoing morphological characterisation by George Wilson at the Australian Museum. Given aquifer connectivity and Pygolabis genus characteristics it is unlikely that this undescribed species, *Pygolabis* sp. nov. 1, is confined to the Yandi Project area.

4.1.6 Class: Copepoda

The class Copepoda, and in particular the order Cyclopoida, are frequently collected stygobitic fauna and have been well collected and documented in the Pilbara. Of the 678 copepod specimens collected during 2010 sampling, 627 belong to the order Cyclopoida (Table 4.6). The harpacticoid copepod family Parastenocaridae has not previously been recorded within the project area and further specimens would be required for a species level identification.

Table 4.6: Taxonomic identification and locations of Cyclopoida specimens collected in 2010.

Taxonomy			Number Collected	Sites (Number of sites)	Comments
Order	**Family**	**Taxa**			
Cyclopoida	Cyclopidae	*Diacyclops humphreysi humphreysi*	425	99YJWB02, 99YJWB03, 99YJWB04, D08YJ050, JSE14, JSE39, Mar01, Mar02, Mar06a, Mar07, MNEW1upstream, PZ08YJSW002, PZ08YJSW003, PZ08YJSW004, PZ08YJSW020, PZ08YOXB006, WW2, WW3, WW4, YM119 (n= 20)	-
		Diacyclops sobeprolatus	140	99YJWB02, JSE14, Mar03a, Mar07, PZ08YJSW002, PZ08YJSW003, WW3 (n= 7)	-
		Mesocyclops darwini	1	MAR06a (n= 1)	-
		Metacyclops pilbaricus	50	PZ08YOXB006 (n= 1)	-
		Microcyclops varicans	10	Mar07, MNEW1upstream (n= 2)	-
Harpacticoida	Canthocamptidae	Canthocamptidae sp. B1	3	JSE14, WW4 (n= 2)	-
		Gordanitocrella trajani	48	99YJWB02, 99YJWB03, 99YJWB04, JSE14, PZ08YJSW002, WW2, WW4 (n= 7)	Previously 'Inermipes sp. B2'
	Parastenocarididae	*Parastenocaris* sp. B9	1	Mar06a (n= 1)	-

All taxa identifiable to species level have been described prior to sampling at Yandi and are known to occur outside of the project area. The remaining two taxa, Canthocamptidae sp. B1 and *Parastenocaris* sp B9, are unlikely to have a narrower distribution than that of the primary alluvial habitat associated with Weeli wolli and Marillana Creeks.

4.1.7 Order: Ostracoda

Sampling in 2010 recorded a total of 289 ostracod specimens (Table 4.7) representing less than 20 % of the total fauna recorded, in comparison with the Cyclopoida, which comprised nearly 43 % (Figure 3.1). This is somewhat unusual as in previous surveys the Ostracoda have been the largest contributor to faunal composition.

The specimens collected were from six distinct taxa representing two families, Candoninae and Limnocytheridae. The most abundant taxon recorded was *Meridiescandona facies*, which was found at 12 sites across Marillana and Weeli Wolli Creek systems. Of the specimens collected in 2010, all had been collected in previous phases within the project area (Biota 2010).

Table 4.7: Taxonomic identification and locations of Ostracoda specimens collected in 2010.

Taxonomy		Number Collected	Sites (Number of sites)	Comments
Family	**Taxa**			
Limnocytheridae	*Gomphodella hirsuta*	4	WW2, WW3 (n= 2)	-
	Gomphodella sp BOS200	4	Mar06a, WW2 (n= 2)	-

Taxonomy		Number Collected	Sites (Number of sites)	Comments
Family	**Taxa**			
	Gomphodella sp. "yandi"	11	Mar01 (n= 1)	-
Candoninae	*Meridiescandona facies*	187	99YJWB02, Mar01, Mar02, Mar03a, Mar06a, Mar07, MNEW1upstream, PZ08YJSW003, PZ08YJSW020, WW2, WW3, WW4 (n= 12)	-
	Meridiescandona lucerna	6	MNEW1upstream (n= 1)	CB2 seta present
	Notacandona boultoni	77	JSE14, Mar01, PZ08YJSW003, WW2, WW3, WW4, YM119 (n= 7)	-

As part of the Yandicoogina JSE Ministerial Statement (Condition 695; M11) and subsequent Stygofauna Management Plan (Biota 2010), additional data on the ostracod species *Gomphodella* sp. "yandi" has been collected and collated to improve knowledge of the species, including its distribution. All specimens will be submitted to the Western Australian Museum for species description.

4.1.8 Phylum: Nematoda

A single specimen belonging to the phylum Nematoda was collected during sampling in 2010. This specimen was unable to be identified beyond phylum level due to a lack of available expertise and the resultant limitations in the taxonomic framework. It is unlikely that this specimen, collected from site MNEW1upstream along Marillana Creek, will be identifiable to species level in the near future.

4.1.9 Phylum: Platyhelminthes

A total of 164 platyhelminth worms were collected from 4 sites across Marillana Creek (Table 4.8). While superficially very similar morphologically, further work is needed to identify these specimens to species level. Due to a lack of expertise in the area, it is unlikely that any species level resolutions will be forthcoming in the short term.

Table 4.8: Taxonomic identification and locations of Platyhelminth worm specimens collected in 2010.

Taxonomy		Number Collected	Sites (Number of sites)	Comments
Class	**Taxa**			
Turbellaria	Turbellaria sp.	164	Mar01, Mar02, Mar06a, Mar07 (n= 4)	-

4.2 Troglofauna

4.2.1 Order: Pseudoscorpiones

A single troglomorphic pseudoscorpion was recorded from site D08YJ2084. This order is a frequently collected troglobitic taxa in the Pilbara (Biota unpublished data), however the specimen collected from Yandi during the second phase of sampling is a nymph representative of the terrestrial genus *Indolpium* (M. Harvey pers. comm. WA Museum 2010) and is not considered troglobitic. Due to the juvenile nature of the specimen, identification to species level was not possible.

4.2.2 Order: Schizomida

Schizomids are fast moving, predatory arachnids that live predominantly in tropical climates (Harvey 1992). They superficially resemble spiders but have a tail-like structure at the end of the

abdomen (the flagellum) and long, sensory front legs (Harvey and Yen 1989). In the tropics schizomids can be found under rocks, in humid leaf litter and soil or in caves, however in the Pilbara Region all recorded specimens are troglobitic.

A single specimen of troglobitic schizomid belonging to the genus *Draculoides* (family Hubbardiidae) (M. Harvey pers. comm. WA Museum 2010), was collected from site DO8YJ2084 at Yandi in 2010. The specimen is a juvenile and therefore could not be identified to species level using morphologically traits. More detailed classification of this species may be facilitated using genetic analysis techniques.

4.2.3 Order: Polyxenida

Plate 4.2: Troglomorphic polyxenid millipede collected from site D09YJ007.

The taxonomy of the Australian polyxenid fauna is very poorly known with only four species described (Framenau 2009). Two epigean, or surface dwelling, species occur in Western Australia, *Unixemus attemsi* and *U. mjoebergi* (Duy-Jacquemin and Condé 1967; Koch 1985). The latter species appears periodically in irruptive populations throughout the northern parts of the state (Koch 1985).

Recent analysis of polyxenid genetic relationships has indicated that, while some lineages are currently only known to have limited distributions, most are widespread throughout the Pilbara Bioregion (Helix 2010). This study was undertaken to assess the population structure between locations and with respect to specimens from the wider Pilbara region.

Four specimens of pincushion millipedes were collected across four different sites within the Yandi project area, D09YJ007 (Plate 4.2), D09YJ015, D03YJ1684 and D04YJ1824. Historically, six polyxenid millipedes have been collected from the project area (Biota 2010). Given the recent studies into this group and the widespread distribution of most assessed taxa, it is unlikely that the specimens from Yandi display short-range endemism and for the purposes of this report are classed as non-troglobitic.

4.2.4 Order: Blattodea

Seven specimens belonging to the order Blattodea were collected from colonisation traps placed at Yandi. Of these specimens, four displayed troglomorphic characteristics (Plate 4.3). Those specimens lacking troglomorphic characters are not considered further in this report.

The remaining specimens exhibited traits consistent with troglobitic fauna and were identified as representatives of the family Nocticolidae. Due to a lack of expertise within Australia however, they could not be identified beyond this level. These specimens were collected from sites D08YJ2084 and D09YJ015.

Plate 4.3: Troglobitic Blattodea collected from site D08YJ2084.

Troglobitic cockroaches have been collected elsewhere from the north of Western Australia. However it is not possible to determine if the Yandi specimens are the same as those from elsewhere in the Pilbara, and therefore their distribution. Further identification may be possible and the taxa placed into regional context with historically collected specimens from the Pilbara, however molecular analysis would be required.

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5.0 Discussion

A more detailed account of habitat characterisation, potential impacts to subterranean fauna, drawdown analysis, recommendations and mine closure options is located in the Yandi Subterranean Fauna Assessment phases I – V (Biota 2010). As per Section 1.3, this report focuses predominantly on compiling and updating data from all completed phases of subterranean fauna sampling within the Yandi project area.

5.1 Stygobitic Fauna

5.1.1 Summary of 2010 Collections

Two phases of stygofauna sampling completed from September to November 2010 recorded a total of 35 taxa from 10 orders. These taxa were recorded from both the Marillana and Weeli Wolli Creek systems and across most deposits, although very few specimens were recorded from JSE. While most taxa recorded had been collected during previous sampling phases, four taxa representing four separate families have not previously been recorded at Yandi. These taxa included:

- ***Aeolosoma* sp1 (PSS) (Oligochaeta; Aeolosomatidae)** – three specimens from two sites within the Marillana Creek dewatering zone, sites Mar06a and Mar07;
- **Halicaridae sp. (Hydrachnidia; Halacaridae)** – a single desiccated specimen retrieved from site Mar06a within the Marillana creek dewatering zone. Further specimens are needed for this individual to be identified beyond genus level;
- ***Chilibathynella*? sp. B6 (Bathynellacea; Parabathynellidae)** – a single specimen from reference site WW4 adjacent to Weeli Wolli Creek; and
- ***Parastenocaris* sp. B9 (Harpacticoida; Parastenocaridae)** – one specimen from dewatering site Mar06a within Marillana Creek.

Given the extensive connectivity displayed between Marillana Creek and Weeli Wolli Creek (Biota 2010), it is unlikely that any the species listed above would be restricted to a single creek system. That these taxa were previously unrecorded is likely more an artefact of sampling bias and / or limitations inherent in subterranean fauna sampling. This highlights the value of repeat sampling effort in more fully documenting the fauna of any given area at least until species accumulation curves indicates that the majority of taxa have been collected.

Eleven specimens of the undescribed *Gomphodella* sp. "yandi" (Ostracoda) were collected from site Mar01. This taxa has historically only been collected from within Marillana Creek. Thirty specimens of the other taxon identified in the Yandi SFMP, *Recifella* sp. 1 were also collected from both creek systems.

5.1.2 Phase 1 – 7 Analysis Update

Seven phases of sampling have yielded a total of 52 species of stygobitic fauna, representing 21 families, across the Yandi project area to date. Updated distributions of stygal population composition relative to predicted drawdown until 2022 are shown in Figures 4.2 – 4.4.

Several taxa, identified as significant to compliance requirements in the Ministerial Statement 695 and subsequent SFMP, were previously thought to be restricted to the Marillana Creek system, including *Recifella* sp.1 (Hydrachnidia) and *Gomphodella* sp. A (ostracoda) (BOS200). However, *Recifella* sp.1 was recently collected from the Weeli Wolli creek system during 2010, a range extension that reflects the high level of connectivity as evidenced by the alluvial deposits of the two creek systems (Biota 2010).

Ten taxa, predominantly of the order Hydrachnidia (water mites), have to date been recorded only within the proposed dewatering contours at Yandi (Table 5.1). However, the connectivity of

the Marillana and Weeli Wolli Creek systems discussed above, in conjunction with the occurrence of other water mites *(*specifically *Axonopsella* sp. B1, and now *Recifella* sp.1) recorded from both drawdown and reference sites across both systems, render it unlikely that these species are restricted only to the predicted impact area. The distribution patterns of stygal water mites are less well documented in the Pilbara.

Table 5.1: Taxa only recorded from sites within predicted drawdown contours.

Taxa	Site	Comment
Copepoda		
Goniocyclops sp.	PZ08YOXB004	The family cyclopidae are known to be wide ranging. Unlikely to be restricted to the drawdown area
Hydrachnidia		
Arrenurus sp. 1	Mar01, Mar07, MNEW1upstream	-
Arrenurus sp. 2	Mar07, MNEW1upstream	-
Albia sp.	Mar07, MNEW1upstream	-
Limnesia sp. B1	MNEW1upstream	-
Stygiolimnochares sp B1	Mar06a, Mar07	-
Mideopsinae sp. (nr *penemidopsis*)	Mar06a	-
Ostracoda		
?*Candonopsis* n. sp.	MNEW1upstream	Unlikely to be restricted to the drawdown area
Pilbaracandona sp.	Discharge, Mar07, MNEW1upstream	Unlikely to be restricted to the drawdown area
Platyhelminthes		
Turbellaria sp.	D08YJ050, Discharge, Mar01, Mar02, Mar06a, Mar07, MC10, MNEW1upstream, PZ08YJSW003, W01YJ15D	Class Turbellaria known from elsewhere in the Pilbara. Taxonomic resolution unlikely in the near future.

For the remaining copepod and ostracod taxa, it is unlikely that these will be confined solely to project dewatering zones. Similarly to the Hydrachnarina, both groups contain species found both at reference sites and dewatering zones (for example *Diacyclops humphreysi humphreysi, Gomphodella* sp. yandi and *Gomphodella* sp. A (BOS200)), reflecting the connectivity between the creek systems. It is likely that species of the same genera and general body morphology display similar abilities to disperse and would be distributed at least throughout the local catchments.

Due to the lack of taxonomic framework for the phylum Platyhelminthes, it is not possible at this stage to determine species distributions. The class Turbellaria however has been recorded from elsewhere in the Pilbara including Bungaroo Valley (biota unpublished data) and from the DEC Pilbara Stygofauna Survey (Eberhard et al. 2008).

5.1.3 Stygobitic Fauna Species Accumulation Curve

A total of 52 species of stygobitic fauna have been collected from the Yandi project area to-date. This includes six new species of stygofauna collected during Phases 6 and 7 in 2010. In comparison, Phases 4 and 5 yielded 18 new species (Biota 2010). This is to be expected as, with increased sampling effort over time the species accumulation curve will approach its asymptote, reflecting the smaller number of new species to be recorded (Colwell and Coddington1994). It should be noted that statistical accuracy improves as the number of sampling phases increases. Damaged and juvenile specimens, which could not be confidently identified, were excluded from the species accumulation curve so as not to adversely affect final curve values and subsequent S_{max} values.

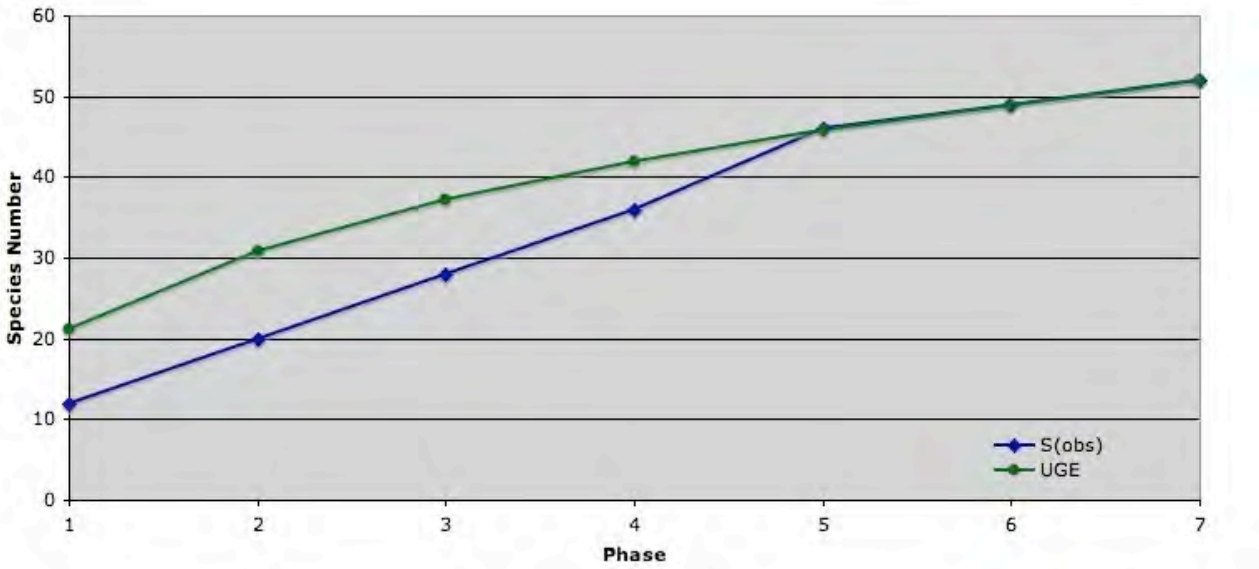

Figure 5.1: Sample-based (UGE) and randomised (S{obs}) species accumulation curves for all stygobitic fauna collected during seven phases within the Yandi project area.

The revised S_{max} values range from 59.8 to 70.0 species with a mean of 64.9 species (Table 5.2). These estimates appear consistent with the trajectory of the species accumulation curve (Figure 5.1).

Table 5.2: Observed and estimated stygobitic fauna species richness at the Yandi project area.

Observed Species Total	52

Richness Estimator	**Predicted S_{max}**
Jacknife 1	70.0
Bootstrap	59.8

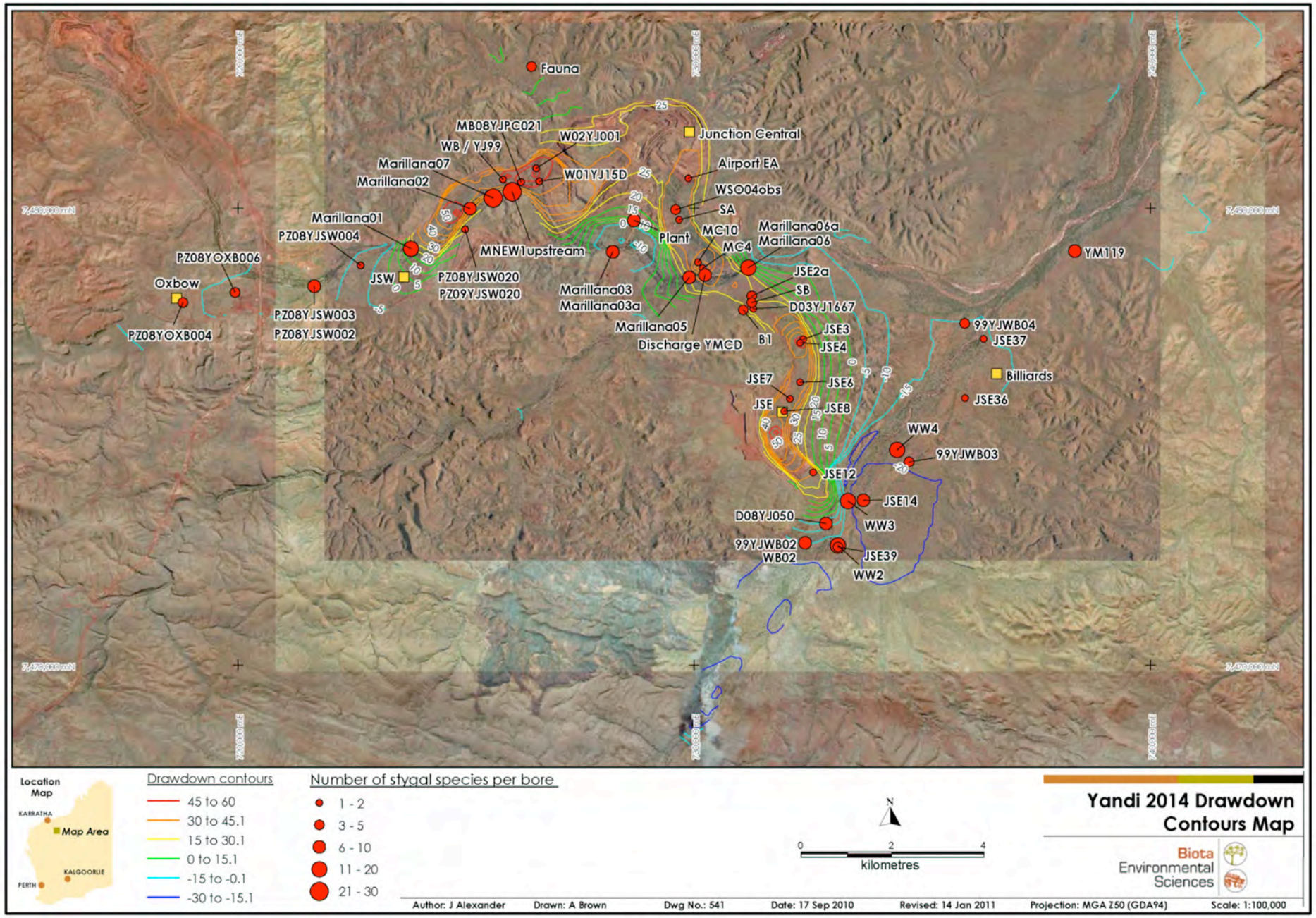

Figure 5.2: Phase 1 – 7 stygobitic fauna results in relation to predicted 2014 drawdown contours.

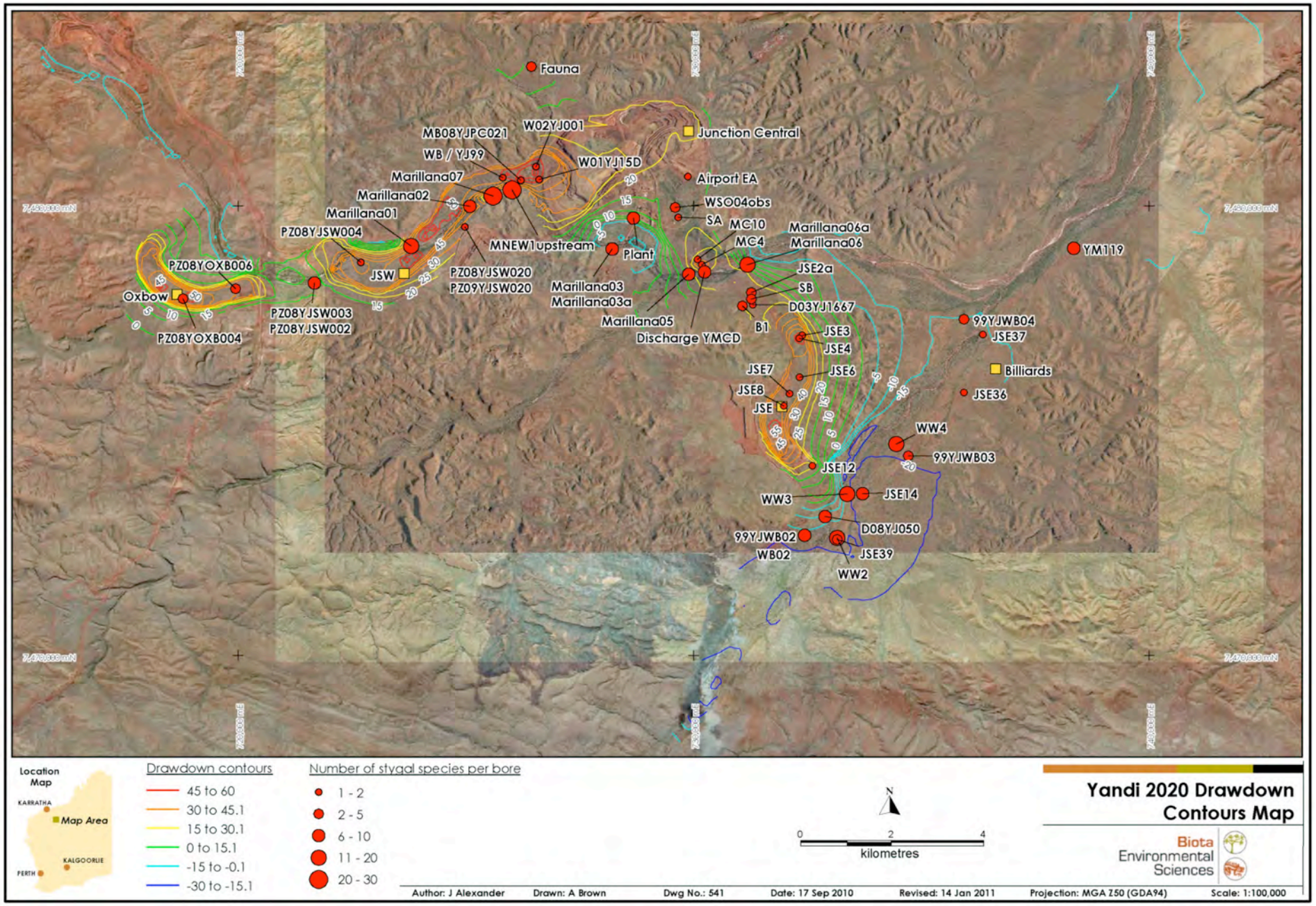

Figure 5.3: Phase 1 – 7 stygobitic fauna results in relation to predicted 2020 drawdown contours.

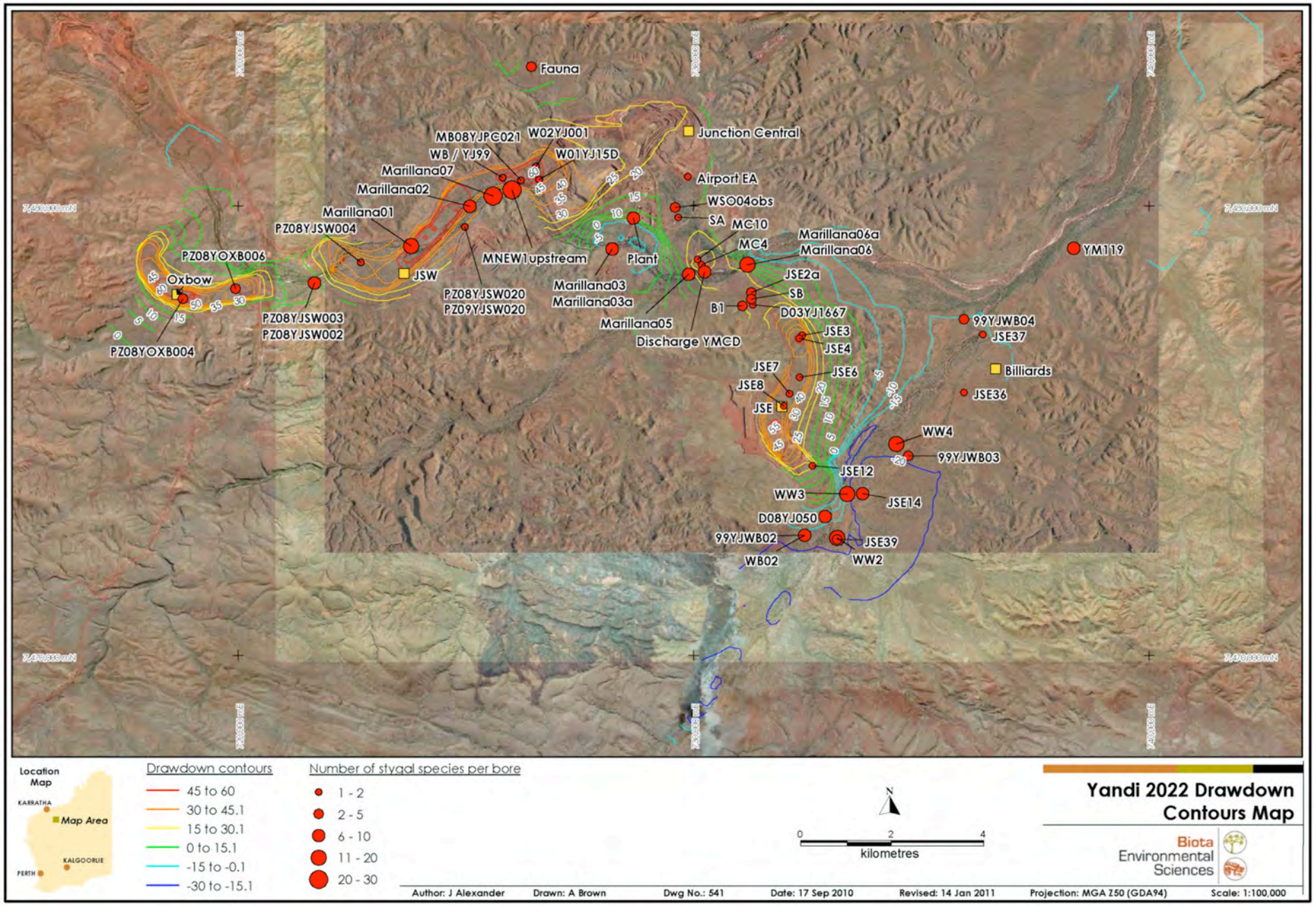

Figure 5.4: Phase 1 – 7 stygobitic fauna results in relation to predicted 2022 drawdown contours.

5.2 Troglobitic Fauna

A total of eight troglobitic specimens have been collected from the Yandi project area, two of which represent new species (Table 5.3). The remaining individuals were unable to be identified to species level due to either a lack of taxonomic expertise, or due to damaged or juvenile specimens. Further identification may be possible on juvenile specimens using genetic analysis techniques

Specimens were collected predominantly from three sites adjacent to the Billiards prospect as well as the JSW deposit (Figure 5.5).

Table 5.3: Updated summary of all troglobitic fauna collected from the Yandi project area (results include taxa collected as by-catch of stygofauna sampling as well as troglofauna sampling).

Date Collected	Taxa	Common Name	Number Collected	Site Collected	Comments
August 2008	*Draculoides* sp.	Schizomid	1	WW3	Partial specimen, Female
April 2009	*Myrmopopaea* sp. nov	Spider	1	WW2	New species
October 2009	*Lagynochthonius* sp. nov	Pseudoscorpion	1	MNEW1upstream	New species
November 2010	*Draculoides* sp.	Schizomid	1	DO8YJ2084	Juvenile
	Nocticolidae sp.	Cockroach	4	D08YJ2084, D09YJ015	-
		Total	**8**		

Further information on troglobitic fauna and habitat viability, refer to Yandi Subterranean Fauna Assessment phases I - 5 (Biota 2010).

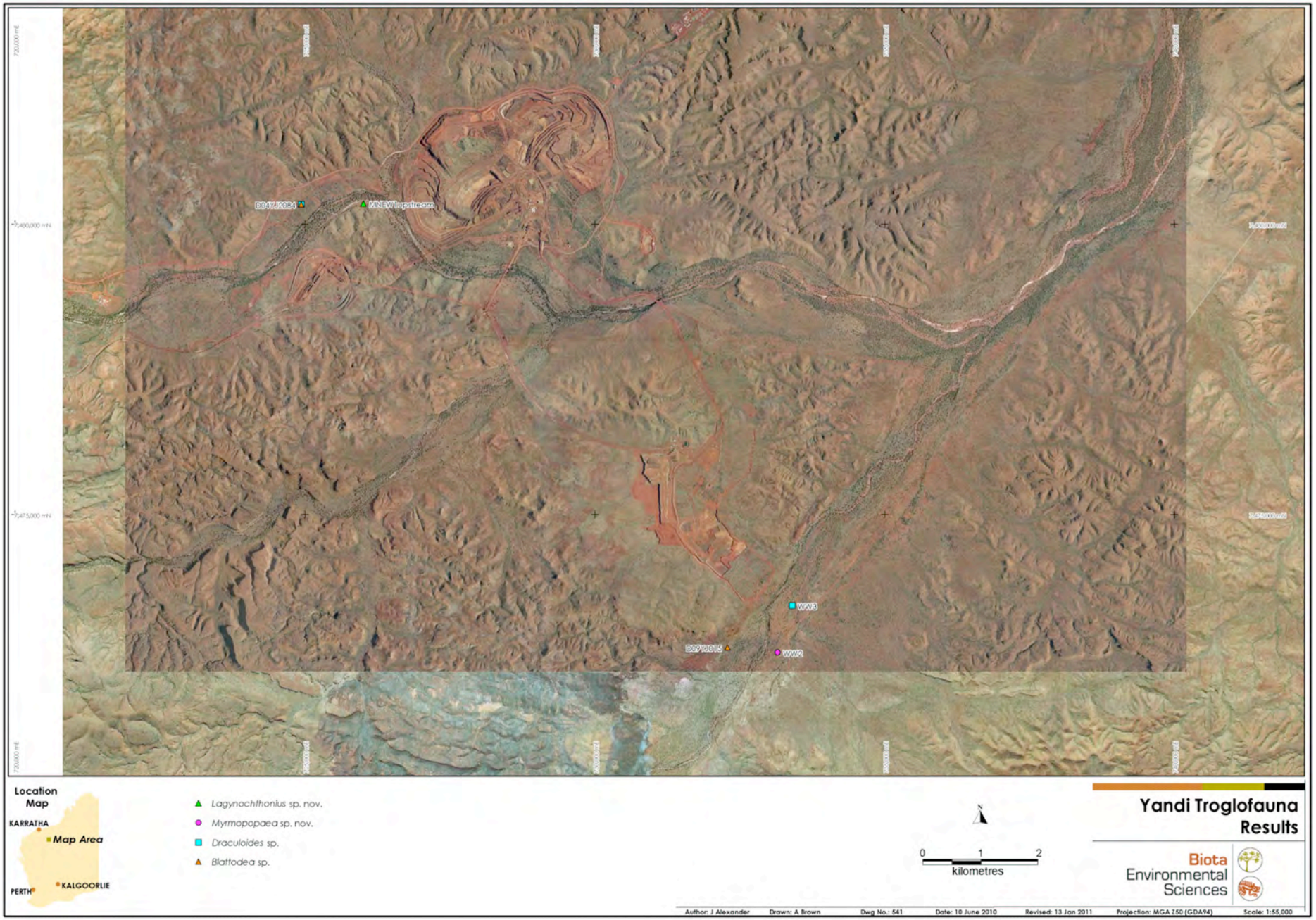

Figure 5.5: Location of all troglobitic fauna collected within the Yandi project area to-date.

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Appendix 1

Raw 2010 Collection Data; Stygofauna

Phase	Site Name	Easting (m E)	Northing (m N)	Field Identification	Final Identification	Number	Comments
6	99YJWB02	732433	7472677	Cyclopoida	*Diacyclops humphreysi humphreysi*	8	
6	99YJWB02	732433	7472677	Harpacticoida	*Gordanitocrella trajani (ex inermipes sp. B2)*	2	
6	99YJWB02	732433	7472677	Pauropoda	*Polyxenida sp*	1	Remains terr moult
6	99YJWB04	735931	7477480	Harpacticoida	*Gordanitocrella trajani (ex inermipes sp. B2)*	17	
6	99YJWB04	735931	7477480	Cyclopoida	*Diacyclops humphreysi humphreysi*	2	
6	D08YJ050	732887	7473094	Amphipoda	*Paramelitidae sp. 2 (PSS)*	1	
6	D08YJ050	732887	7473094	Cyclopoida	*Diacyclops humphreysi humphreysi*	1	
6	FAUNA	726433	7483097	Oligochaeta	*Enchytraeidae pilbara sp. 2*	5	
6	JSE14	733707	7473602	Amphipoda	*Paramelitidae sp. 2 (PSS)*	7	
6	JSE14	733707	7473602	Amphipoda	*Chydaekata sp.*	3	
6	JSE14	733707	7473602	Ostracoda	*Notacandona boultoni*	13	
6	JSE14	733707	7473602	Harpacticoida	*Gordanitocrella trajani (ex inermipes sp. B2)*	3	
6	JSE14	733707	7473602	Harpacticoida	*Canthocamptidae sp B1*	1	male
6	JSE14	733707	7473602	Cyclopoida	*Diacyclops humphreysi humphreysi*	29	
6	JSE39	733145	7472585	Isopoda	*Pygolabis weeli wolli*	4	
6	JSE39	733145	7472585	Cyclopoida	*Diacyclops humphreysi humphreysi*	1	
6	Marillana01	723792	7479113	Amphipoda	*Chydaekata sp.*	2	
6	Marillana01	723792	7479113	Isopoda	*Pygolabis weeli wolli*	8	
6	Marillana01	723792	7479113	Isopoda	*Atopobathynella sp. B4*	1	
6	Marillana01	723792	7479113	Hydracarina	*Arrenurus sp nov yandi (sp 1)*	4	
6	Marillana01	723792	7479113	Platyhelminthes sp. 1	*Turbellaria sp.*	50	2 males 2 females
6	Marillana01	723792	7479113	Platyhelminthes ?? sp. 2	*Turbellaria sp.*	3	
6	Marillana01	723792	7479113	Ostracoda	*Meridiescandona facies*	3	1 in sample, CB2 seta absent
6	Marillana01	723792	7479113	Copepoda	*Diacyclops humphreysi humphreysi*	12	
6	Marillana02	725082	7479990	Cyclopoida	*Diacyclops humphreysi humphreysi*	27	
6	Marillana02	725082	7479990	Ostracoda	*Meridiescandona facies*	50	
6	Marillana02	725082	7479990	Isopoda	*Pygolabis nsp. 1*	1	
6	Marillana02	725082	7479990	Hemiptera	*Fulgoroidea*	1	nymph with developing eyes
6	Marillana02	725082	7479990	Platyhelminthes sp. 1	*Turbellaria sp.*	1	
6	Marillana02	725082	7479990	Larvae?	*Coccoidea*	1	
6	Marillana03a	728209	7479045	Cyclopoida	*Diacyclops nr sobeprolatus*	35	
6	Marillana03a	728209	7479045	Bathynellacea	*Atopobathynella sp. B4*	1	
6	Marillana03a	728209	7479045	Ostracoda	*Meridiescandona facies*	1	
6	Marillana06a	731182	7478693	Platyhelminthes sp. 1	*Turbellaria sp.*	20	
6	Marillana06a	731182	7478693	Amphipoda	*Maarka wolli' ms name*	2	
6	Marillana06a	731182	7478693	Amphipoda	*Chydaekata sp.*	5	
6	Marillana06a	731182	7478693	Amphipoda	*Paramelitidae sp. 2 (PSS)*	10	
6	Marillana06a	731182	7478693	Copepoda	*Diacyclops humphreysi humphreysi*	5	
6	Marillana06a	731182	7478693	Copepoda	*Mesocyclops darwini*	1	

Phase	Site Name	Easting (m E)	Northing (m N)	Field Identification	Final Identification	Number	Comments
6	Marillana06a	731182	7478693	Ostracoda	*Gomphodella sp BOS200*	2	small, featureless
6	Marillana06a	731182	7478693	Isopoda	*Pygolabis weeli wolli*	1	
6	Marillana06a	731182	7478693	Harpacticoida	*Parastenocaris s.p B9*	1	male
6	Marillana06a	731182	7478693	Oligochaeta	*Aeolosoma sp. 1 (PSS)*	1	
6	Marillana07	725592	7480218	Platyhelminthes sp. 1	*Turbellaria sp.*	50	
6	Marillana07	725592	7480218	Amphipoda	*Paramelitidae sp. 2 (PSS)*	6	
6	Marillana07	725592	7480218	Amphipoda	*Chydaekata sp.*	1	
6	Marillana07	725592	7480218	Isopoda	*Pygolabis nsp. 1*	27	
6	Marillana07	725592	7480218	Cyclopoida	*Diacyclops humphreysi humphreysi*	5	
6	Marillana07	725592	7480218	Cyclopoida	*Diacyclops nr sobeprolatus*	5	
6	Marillana07	725592	7480218	Cyclopoida	*Microcyclops varicans*	5	
6	Marillana07	725592	7480218	Hydracarina sp1	*Limnesia sp. B1*	1	
6	Marillana07	725592	7480218	Hydracarina sp1	*Arrenurus sp. 2*	6	
6	Marillana07	725592	7480218	Hydracarina sp1	*Recifella sp. 1*	14	
6	Marillana07	725592	7480218	Oligochaeta	*Aeolosoma sp. 1 (PSS)*	2	
6	Marillana07	725592	7480218	Ostracoda	*Meridiescandona facies*	12	
6	Marillana07	725592	7480218	Oligochaeta?	*Phreodrilidae with similar ventral chaetae*	1	(probably immature Insulodrilus)
6	Marillana07	725592	7480218	Hydracarina sp2	*Stygolimnochares sp B1*	1	Elongate body
6	Marillana07	725592	7480218	Bathynellacea	*Bathynella sp.*	4	
6	MC4	730180	7478691	Amphipoda	*Paramelitidae sp. 2 (PSS)*	1	
6	MNEW1upstream	726009	7480355	Diptera Larvae	*Paramerina sp.A (parva?) (SAP)*	5	chironomid larvae
6	MNEW1upstream	726009	7480355	Cyclopoida	*Microcyclops varicans*	4	
6	MNEW1upstream	726009	7480355	Cyclopoida	*Diacyclops humphreysi humphreysi*	50	
6	MNEW1upstream	726009	7480355	Hydracarina	*Arrenurus sp. 2*	5	1 male 3 females 1 juv
6	MNEW1upstream	726009	7480355	Hydracarina	*Recifella sp. 1*	1	male
6	MNEW1upstream	726009	7480355	Hydracarina	*Limnesia sp. B1*	2	
6	MNEW1upstream	726009	7480355	Ostracoda	*Meridiescandona lucerna*	6	6 animals, CB2 seta present
6	MNEW1upstream	726009	7480355	Ostracoda	*Meridiescandona facies*	4	4 animals, CB2 seta absent
6	MNEW1upstream	726009	7480355	Bathynellacea	*Atopobathynella sp. B4*	2	juv
6	MNEW1upstream	726009	7480355	Bathynellacea	*Bathynella sp.*	1	
6	MNEW1upstream	726009	7480355	Annellida??	*Nematoda sp.*	1	
6	PZ08YJSW003	730892	7478388	Ostracoda	*Meridiescandona facies*	9	
6	PZ08YJSW003	730892	7478388	Isopoda	*Pygolabis weeli wolli*	12	
6	PZ08YJSW003	730892	7478388	Amphipoda	*Paramelitidae sp. 2 (PSS)*	12	
6	PZ08YJSW003	730892	7478388	Amphipoda	*Maarka wolli' ms name*	1	
6	PZ08YJSW003	730892	7478388	Copepoda	*Diacyclops humphreysi humphreysi*	12	
6	PZ08YJSW003	730892	7478388	Copepoda	*Diacyclops nr sobeprolatus*	4	
6	PZ08YJSW003	730892	7478388	Hemiptera larvae ??	*Meenoplidae sp.*	1	nymph with developing eyes
6	PZ08YJSW004	722689	7478744	Copepoda	*Diacyclops humphreysi humphreysi*	6	
6	PZ08YJSW004	722689	7478744	Isopoda	*Pygolabis weeli wolli*	1	

Phase	Site Name	Easting (m E)	Northing (m N)	Field Identification	Final Identification	Number	Comments
6	PZ08YJSW020	724976	7479538	Ostracoda	*Meridiescandona facies*	2	
6	PZ08YJSW020	724976	7479538	Cyclopoida	*Diacyclops humphreysi humphreysi*	4	
6	PZ08YOXB004	718788	7477937	Amphipoda	*Paramelitidae sp. 2 (PSS)*	11	
6	PZ08YOXB006	719936	7478158	Cyclopoida	*Metacyclops pilbaricus*	50	
6	PZ08YOXB006	719936	7478158	Cyclopoida	*Diacyclops humphreysi humphreysi*	5	
6	WW2	733200	7472664	Isopoda	*Pygolabis weeli wolli*	6	
6	WW2	733200	7472664	Amphipoda	*Maarka wolli' ms name*	1	
6	WW2	733200	7472664	Amphipoda	*Chydaekata sp.*	1	
6	WW2	733200	7472664	Amphipoda	*Paramelitidae sp. 2 (PSS)*	1	
6	WW2	733200	7472664	Ostracoda	*Gomphodella sp BOS200*	2	2 animals
6	WW2	733200	7472664	Ostracoda	*Notacandona boultoni*	2	2 animals
6	WW2	733200	7472664	Ostracoda	*Meridiescandona facies*	2	2 animals
6	WW2	733200	7472664	Ostracoda	*Gomphodella hirsuta*	2	2 animals
6	WW2	733200	7472664	Cyclopoida	*Diacyclops humphreysi humphreysi*	29	
6	WW2	733200	7472664	Harpacticoida	*Gordanitocrella trajani (ex inermipes sp. B2)*	5	
6	WW3	733370	7473592	Ostracoda	*Gomphodella hirsuta*	1	1 plus 1 valve
6	WW3	733370	7473592	Amphipoda	*Maarka wolli' ms name*	1	
6	WW3	733370	7473592	Amphipoda	*Chydaekata sp.*	11	
6	WW3	733370	7473592	Amphipoda	*Paramelitidae sp. 2 (PSS)*	2	
6	WW3	733370	7473592	Copepoda	*Diacyclops humphreysi humphreysi*	10	
6	WW3	733370	7473592	Copepoda	*Diacyclops nr sobeprolatus*	10	
6	WW3	733370	7473592	Isopoda	*Pygolabis weeli wolli*	9	
6	WW4	734448	7474705	Isopoda	*Pygolabis weeli wolli*	1	
6	WW4	734448	7474705	Cyclopoida	*Diacyclops humphreysi humphreysi*	21	
6	WW4	734448	7474705	Harpacticoida	*Canthocamptidae sp B1*	1	male
6	WW4	734448	7474705	Ostracoda	*Meridiescandona facies*	6	
6	YM119	738345	7479063	Amphipoda	*Maarka wolli' ms name*	4	very juv
6	YM119	738345	7479063	Cyclopoida	*Diacyclops humphreysi humphreysi*	1	
6	YM119	738345	7479063	Ostracoda	*Notacandona boultoni*	35	35 animals
7	99YJWB02	732433	7472677	Isopoda	*Pygolabis weeli wolli*	1	male
7	99YJWB02	732433	7472677	Cyclopoida	*Diacyclops nr sobeprolatus*	1	
7	99YJWB02	732433	7472677	Ostracoda	*Meridiescandona facies*	1	1 juv
7	99YJWB02	732433	7472677	Gastropod shell	*Hydrobiidae? sp.*	1	shell only dead when collected
7	99YJWB03	734850	7474599	Cyclopoida	*Diacyclops humphreysi humphreysi*	39	
7	99YJWB03	734850	7474599	Harpacticoida	*Gordanitocrella trajani (ex inermipes sp. B2)*	1	
7	99YJWB04	735931	7477480	Cyclopoida	*Diacyclops humphreysi humphreysi*	2	
7	99YJWB04	735931	7477480	Harpacticoida	*Gordanitocrella trajani (ex inermipes sp. B2)*	6	
7	D08YJ050	732887	7473094	Isopoda	*Pygolabis weeli wolli*	1	female
7	Fauna	726433	7483097	Oligochaeta	*Enchytraeidae pilbara sp. 2*	2	
7	JSE14	733707	7473602	Ostracoda	*Notacandona boultoni*	4	

Phase	Site Name	Easting (m E)	Northing (m N)	Field Identification	Final Identification	Number	Comments
7	JSE14	733707	7473602	Cyclopoida	*Diacyclops nr sobeprolatus*	45	plus 1 harpacticoid
7	JSE14	733707	7473602	Cyclopoida	*Canthocamptidae sp B1*	1	female has cephalic window on cehalothorax
7	JSE14	733707	7473602	Harpacticoida	*Gordanitocrella trajani (ex inermipes sp. B2)*	6	
7	JSE14	733707	7473602	Amphipoda	*Paramelitidae sp. 2 (PSS)*	1	
7	JSE36	735937	7475846	Amphipoda	*Paramelitidae sp. 2 (PSS)*	1	Dead
7	Marillana02	725082	7479990	Ostracoda	*Meridiescandona facies*	50	
7	Marillana02	725082	7479990	Cyclopoida	*Diacyclops humphreysi humphreysi*	30	
7	Marillana06a	731182	7478693	Cyclopoida	*Diacyclops humphreysi humphreysi*	5	
7	Marillana06a	731182	7478693	Amphipoda	*Paramelitidae sp. 2 (PSS)*	6	
7	Marillana06a	731182	7478693	Isopoda	*Pygolabis nsp. 1*	5	
7	Marillana06a	731182	7478693	Platyhelminthes	*Turbellaria sp.*	18	
7	Marillana06a	731182	7478693	Oligochaeta (?)	*Ainudrilus nr. WA26*	30	
7	Marillana06a	731182	7478693	Ostracoda	*Meridiescandona facies*	8	
7	Marillana06a	731182	7478693	Hydracarina	*Halicaridae*	1	Desiccated. On slide in poor condition
7	Marillana07	725592	7480218	Platyhelminthes	*Turbellaria sp.*	20	
7	Marillana07	725592	7480218	Larvae	*Scirtidae sp.*	1	(Not stygal)
7	Marillana07	725592	7480218	Isopoda	*Pygolabis nsp. 1*	10	
7	Marillana07	725592	7480218	Ostracoda	*Meridiescandona facies*	5	
7	Marillana07	725592	7480218	Hydracarina 1	*Recifella sp. 1*	9	
7	Marillana07	725592	7480218	Cyclopoida	*Diacyclops nr sobeprolatus*	11	
7	Marillana07	725592	7480218	Cyclopoida	*Microcyclops varicans*	1	
7	Marillana07	725592	7480218	Amphipoda	*Chydaekata sp.*	1	
7	Marillana07	725592	7480218	Hydracarina 2	*Stygolimnochares sp B1*	1	
7	Marillana01	723792	7479113	Ostracoda	*Gomphodella yandi*	11	11 animals
7	Marillana01	723792	7479113	Ostracoda	*Notacandona boultoni*	1	1 animal
7	Marillana01	723792	7479113	Ostracoda	*Meridiescandona facies*	21	21 animals
7	Marillana01	723792	7479113	Hydracarina	*Recifella sp. 1*	5	
7	Marillana01	723792	7479113	Hydracarina	*Arrenurus sp nov yandi (sp 1)*	4	1 male 3 females
7	Marillana01	723792	7479113	Cyclopoida	*Diacyclops humphreysi humphreysi*	1	juv
7	Marillana01	723792	7479113	Platyhelminthes	*Turbellaria sp.*	2	
7	Marillana01	723792	7479113	Amphipoda	*Paramelitidae sp. 2 (PSS)*	3	plus 1 cyclopoid
7	Marillana01	723792	7479113	Amphipoda	*Chydaekata sp.*	1	
7	Marillana01	723792	7479113	Bathynellaceae	*Atopobathynella sp. B4*	1	
7	PZ08YJSW002	730892	7478388	Amphipoda	*Paramelitidae sp. 2 (PSS)*	8	8 dead/partial
7	PZ08YJSW002	730892	7478388	Cyclopoida	*Diacyclops humphreysi humphreysi*	10	
7	PZ08YJSW002	730892	7478388	Cyclopoida	*Diacyclops nr sobeprolatus*	10	
7	PZ08YJSW002	730892	7478388	Harpacticoida	*Gordanitocrella trajani (ex inermipes sp. B2)*	5	
7	PZ08YJSW003	730892	7478388	Amphipoda	*Paramelitidae sp. 2 (PSS)*	3	

Phase	Site Name	Easting (m E)	Northing (m N)	Field Identification	Final Identification	Number	Comments
7	PZ08YJSW003	730892	7478388	Isopoda	*Pygolabis weeli wolli*	10	
7	PZ08YJSW003	730892	7478388	Ostracoda	*Notacandona boultoni*	6	6 animals
7	PZ08YJSW003	730892	7478388	Ostracoda	*Meridiescandona facies*	4	4 animals
7	PZ08YJSW003	730892	7478388	Cyclopoida	*Diacyclops nr sobeprolatus*	4	
7	PZ08YJSW004	722689	7478744	Cyclopoida	*Diacyclops humphreysi humphreysi*	9	
7	WW2	733200	7472664	Isopoda	*Pygolabis weeli wolli*	4	
7	WW2	733200	7472664	Cyclopoida	*Diacyclops humphreysi humphreysi*	26	
7	WW2	733200	7472664	Ostracoda	*Notacandona boultoni*	4	4 animals
7	WW2	733200	7472664	Ostracoda	*Meridiescandona facies*	1	1 animal, 2 valves
7	WW2	733200	7472664	Amphipoda	*Paramelitidae sp. 2 (PSS)*	2	
7	WW3	733370	7473592	Hydracarina	*Arrenurus sp. 3*	4	2 male 2 females
7	WW3	733370	7473592	Ostracoda	*Gomphodella hirsuta*	1	1 animal
7	WW3	733370	7473592	Ostracoda	*Notacandona boultoni*	1	1 animal
7	WW3	733370	7473592	Ostracoda	*Meridiescandona facies*	1	1 animal
7	WW3	733370	7473592	Amphipoda	*Paramelitidae sp. 2 (PSS)*	2	
7	WW3	733370	7473592	Amphipoda	*Chydaekata sp.*	7	
7	WW3	733370	7473592	Cyclopoida	*Diacyclops humphreysi humphreysi*	15	
7	WW3	733370	7473592	Cyclopoida	*Diacyclops nr sobeprolatus*	15	
7	WW3	733370	7473592	Isopoda	*Pygolabis weeli wolli*	1	One partial specimen
7	WW4	734448	7474705	Amphipoda	*Paramelitidae sp. 2 (PSS)*	1	
7	WW4	734448	7474705	Amphipoda	*Chydakata sp.*	1	gravid female
7	WW4	734448	7474705	Harpacticoida	*Gordanitocrella trajani (ex inermipes sp. B2)*	3	
7	WW4	734448	7474705	Ostracoda	*Notacandona boultoni*	1	1 animal
7	WW4	734448	7474705	Ostracoda	*Meridiescandona facies*	7	7 animals
7	WW4	734448	7474705	Hydracarina	*Recifella sp. 1*	1	male
7	WW4	734448	7474705	Cyclopoida	*Diacyclops humphreysi humphreysi*	10	
7	WW4	734448	7474705	Bathynellaceae	*Chilibathynella? sp. B6*	1	female
7	WW4	734448	7474705	Isopoda	*Pygolabis weeli wolli*	1	
7	YM119	738345	7479063	Amphipoda	*Maarka wolli' ms name*	4	Dead
7	YM119	738345	7479063	Ostracoda	*Notacandona boultoni*	1	Dead

Appendix 2

Raw 2010 Collection Data; Troglofauna

Site Name	Batch Number	Easting (m E)	Northing (m N)	Field Identification	Taxa	Collected	Comment
BFS475	BFS475P2T1-1	733601	7471190	Isoptera		17	
BFS475	BFS475P2T2-1	733601	7471190	Isoptera		14	
D03YJ1684	D03YJ1684P2T1-1	721823	7479143	Acarina		50	
D03YJ1684	D03YJ1684P2T1-2	721823	7479143	Collembola		16	
D03YJ1684	D03YJ1684P2T1-3	721823	7479143	Isopoda		1	
D03YJ1684	D03YJ1684P2T1-4	721823	7479143	Polyxenida		1	
D03YJ1684	D03YJ1684P2T2-1	721823	7479143	Acarina		20	
D03YJ1684	D03YJ1684P2T2-2	721823	7479143	Isopoda		1	
D03YJ1684	D03YJ1684P2T2-3	721823	7479143	Isoptera		5	
D03YJ1711	D03YJ1711P2T1-1	721732	7478091	Collembola		50	
D03YJ1806	D03YJ1806P2T1-1	720657	7478049	Collembola		50	
D03YJ1806	D03YJ1806P2T1-2	720657	7478049	Isoptera		2	
D03YJ1806	D03YJ1806P2T2-1	720657	7478049	Acarina		2	
D03YJ1806	D03YJ1806P2T2-2	720657	7478049	Collembola		50	
D04YJ1816	D04YJ1816P2T1-1	726208	7480912	Acarina		20	
D04YJ1816	D04YJ1816P2T1-2	726208	7480912	Collembola		9	
D04YJ1824	D04YJ1824P2T1-1	726030	7480805	Acarina		50	
D04YJ1824	D04YJ1824P2T1-2	726030	7480805	Collembola		7	
D04YJ1824	D04YJ1824P2T2-1	726030	7480805	Acarina		50	
D04YJ1824	D04YJ1824P2T2-2	726030	7480805	Polyxenida		1	
D04YJ1824	D04YJ1824P2T2-3	726030	7480805	Thysanura		1	
D04YJ1894	D04YJ1894P2T2-1	724544	7480311	Collembola		8	
D04YJ1894	D04YJ1894P2T1-1	724544	7480311	Acarina		20	
D04YJ1894	D04YJ1894P2T1-2	724544	7480311	Collembola		3	
D04YJ2084	D04YJ2084P2T1-1	724938	7480341	Acarina		20	
D04YJ2084	D04YJ2084P2T1-2	724938	7480341	Blattodea		2	
D04YJ2084	D04YJ2084P2T1-3	724938	7480341	Blattodea	Nocticolidae sp.	1	Troglobitic
D04YJ2084	D04YJ2084P2T1-4	724938	7480341	Coleoptera larvae		1	
D04YJ2084	D04YJ2084P2T1-5	724938	7480341	Collembola		20	
D04YJ2084	D04YJ2084P2T1-6	724938	7480341	Pseudoscorpiones	*Indolpium* sp.	1	Not Troglobitic
D04YJ2084	D04YJ2084P2T1-7	724938	7480341	Schizomida	*Draculoides* sp.	1	Troglobitic - Juvenile
D04YJ2084	D08YJ2084P2T2-1	724938	7480341	Acarina		50	
D04YJ2084	D08YJ2084P2T2-2	724938	7480341	Collembola		20	
D04YJ2121	D04YJ2121P2T1-1	724827	7479887	Acarina		14	
D04YJ2121	D04YJ2121P2T1-2	724827	7479887	Collembola		10	
D04YJ2190	D04YJ2190P2T1-1	724261	7479603	Acarina		50	
D04YJ2190	D04YJ2190P2T1-2	724261	7479603	Collembola		15	
D06YJ098	D06YJ098P2T1-1	722987	7478472	Collembola		6	
D06YJ102	D06YJ102P2T1-1	723026	7478014	Acarina		8	
D06YJ102	D06YJ102P2T2-1	723026	7478014	Acarina		9	

Site Name	Batch Number	Easting (m E)	Northing (m N)	Field Identification	Taxa	Collected	Comment
D06YJ102	D06YJ102P2T2-2	723026	7478014	Collembola		12	
D06YJ170	D06YJ170P2T1-1	723697	7478754	Collembola		20	
D06YJ192	D06YJ192P2T1-1	724293	7478866	Acarina		17	
D06YJ192	D06YJ192P2T1-2	724293	7478866	Collembola		3	
D06YJ261	D06YJ261P2T2-1	722529	7478862	Acarina		13	
D06YJ261	D06YJ261P2T2-2	722529	7478862	Collembola		20	
D06YJ274	D06YJ274P2T2-1	724792	7479349	Acarina		50	
D07YJ071	D07YJ071P2T1-1	732782	7472212	Araneae		1	
D07YJ071	D07YJ071P2T1-2	732782	7472212	Isoptera		10	
D07YJ071	D07YJ071P2T2-1	732782	7472212	Collembola		50	
D07YJ114	D07YJ114P2T1-1	733354	7472497	Acarina		3	
D07YJ167	D07YJ167P2T1-1	740135	7479284	Acarina		30	
D07YJ167	D07YJ167P2T1-2	740135	7479284	Blattodea		1	
D07YJ167	D07YJ167P1T2-1	740135	7479284	Acarina		20	
D07YJ167	D07YJ167P1T2-2	740135	7479284	Collembola		20	
D07YJ212	D07YJ212P2T2-1	733209	7472068	Acarina		20	
D07YJ218	D07YJ218P2T1-1	732924	7471648	Acarina		20	
D07YJ218	D07YJ218P2T1-2	732924	7471648	Collembola		4	
D08YJ050	D08YJ050P2T1-1	732887	7473094	Acarina		50	
D08YJ050	D08YJ050P2T1-2	732887	7473094	Collembola		16	
D08YJ050	D08YJ050P2T2-1	732887	7473094	Acarina		20	
D08YJ106	D08YJ106P2T1-1	725286	7480560	Acarina		20	
D08YJ106	D08YJ106P2T1-2	725286	7480560	Collembola		50	
D08YJ106	D08YJ106P2T2-1	725286	7480560	Acarina		50	
D08YJ106	D08YJ106P2T2-2	725286	7480560	Collembola		20	
D08YJ106	D08YJ106P2T2-3	725286	7480560	Diptera		1	
D08YJ113	D08YJ113P2T1-1	725583	7480699	Acarina		50	
D08YJ113	D08YJ113P2T1-2	725583	7480699	Coleoptera		1	
D08YJ113	D08YJ113P2T1-3	725583	7480699	Coleoptera larvae		2	
D08YJ113	D08YJ113P2T1-4	725583	7480699	Collembola		20	
D08YJ113	D08YJ113P2T1-5	725583	7480699	Diptera larvae		5	
D08YJ113	D08YJ113P2T2-1	725583	7480699	Acarina		50	
D08YJ113	D08YJ113P2T2-2	725583	7480699	Diptera		1	
D08YJ113	D08YJ113P2T2-3	725583	7480699	Diptera larvae		9	
D08YJ113	D08YJ113P2T2-4	725583	7480699	Isopoda		1	
D08YJ224	D08YJ224P2T1-1	740846	7479990	Acarina		20	
D08YJ224	D08YJ224P2T1-2	740846	7479990	Collembola		20	
D08YJ224	D08YJ224P2T2-1	740846	7479990	Acarina		50	
D08YJ225	D08YJ225P2T1-1	740778	7479923	Acarina		50	
D08YJ225	D08YJ225P2T1-2	740778	7479923	Collembola		18	

Site Name	Batch Number	Easting (m E)	Northing (m N)	Field Identification	Taxa	Collected	Comment
D08YJ225	D08YJ225P2T1-3	740778	7479923	Diptera larvae		4	
D08YJ225	D08YJ225P2T2-1	740778	7479923	Acarina		28	
D08YJ225	D08YJ225P2T2-2	740778	7479923	Collembola		50	
D08YJ225	D08YJ225P2T2-3	740778	7479923	Diptera larvae		20	
D08YJ229	D08YJ229P2T1-1	740844	7483102	Acarina		20	
D08YJ229	D08YJ229P2T2-1	740844	7483102	Acarina		20	
D08YJ229	D08YJ229P2T2-2	740844	7483102	Collembola		13	
D09YJ007	D09YJ007P2T1-1	732288	7472987	Acarina		12	
D09YJ007	D09YJ007P2T1-2	732288	7472987	Collembola		20	
D09YJ007	D09YJ007P2T1-3	732288	7472987	Diptera larvae		1	
D09YJ007	D09YJ007P2T1-4	732288	7472987	Polyxenida		1	
D09YJ007	D09YJ007P2T2-1	732288	7472987	Collembola		50	
D09YJ015	D09YJ015P2T1-1	732288	7472704	Acarina		50	
D09YJ015	D09YJ015P2T1-2	732288	7472704	Collembola		50	
D09YJ015	D09YJ015P2T2-1	732288	7472704	Acarina		50	
D09YJ015	D09YJ015P2T2-2	732288	7472704	Blattodea	Nocticolidae sp.	3	Troglobitic
D09YJ015	D09YJ015P2T2-3	732288	7472704	Collembola		50	
D09YJ015	D09YJ015P2T2-4	732288	7472704	Polyxenida		1	
MM526	MM526P2T1-1	743122	7479776	Acarina		50	
MM526	MM526P2T2-1	743122	7479776	Acarina		20	
RC06YJ005	RC06YJ005P2T2-1	734693	7472567	Thysanura		2	
RC06YJ007	RC06YJ007P2T1-1	736956	7476527	Acarina		20	
RC06YJ007	RC06YJ007P2T1-2	736956	7476527	Isoptera		20	
RD09YJ096	RD09YJ096P2T1-1	733602	7473376	Isoptera		20	
RD09YJ280	RD09YJ280P2T1-1	733952	7471259	Isoptera		20	
RD09YJ280	RD09YJ280P2T2-1	733952	7471259	Isoptera		20	
RD09YJ382	RD09YJ382P2T1-1	733041	7472590	Araneae		1	
RD09YJ382	RD09YJ382P2T1-2	733041	7472590	Isoptera		30	
WW2	WW2P2T2-1	733200	7472664	Collembola		33	
WW3	WW3P2T1-1	733370	7473592	Collembola		13	
WW4	WW4P2T1-1	734448	7474705	Collembola		6	
UNNAMED01	UNNAMED01P2T1-1	734089	7472885	Isoptera		50	
UNNAMED01	UNNAMED01P2T2-1	734089	7472885	Acarina		8	
UNNAMED01	UNNAMED01P2T2-2	734089	7472885	Isoptera		50	
YW-P16	YW-P16P2T1-1	731523	7472123	Acarina		10	