Rockwater
PROPRIETARY LIMITED

AUSTRALIAN PREMIUM IRON JV

HARDEY PROJECT

SUBTERRANEAN FAUNA SAMPLING PROGRAMME

JULY 2011

REPORT FOR
API MANAGEMENT PTY LTD

(Report 371-1/11/1-1)

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1 INTRODUCTION

1.1 GENERAL

API Management Pty Ltd (API) is managing the Australian Premium Iron Joint Venture on behalf of equal joint venture partners Aquila Resources Ltd and AMCI Holdings Australia Pty Ltd. API holds a number of iron ore tenements in the western Pilbara area of Western Australia and is assessing the feasibility of the Hardey Proposal (the proposal). The Hardey project (the project) is located approximately 50 km west-northwest of the township of Paraburdoo (Figure 1). Access is via the Nanutarra-Munjina Road from Paraburdoo.

The project deposit is bedded hematite iron that extends 90 m or more below the local groundwater level. Mining will be undertaken via the open pit method and dewatering operations will be required, to allow mining of the deeper parts of the deposit. Mining operations may present a range of potential environmental impacts to subterranean fauna, if they are found to occur in the project area.

Consideration of subterranean fauna is required during the Environmental Impact Assessment (EIA) of the project as there is generally considered to be a high likelihood of subterranean fauna being present in the Pilbara of Western Australia. The Pilbara is an important region for subterranean biodiversity and relevant guidelines for assessment of subterranean fauna (EPA 2003, 2007) suggest that, for projects in the Pilbara of WA, it should be assumed that all sites will support significant assemblages of stygofauna and troglofauna unless there is evidence to the contrary.

Subterranean fauna were first considered for the project in a preliminary fauna review by Biota (2009a). Following a review of that study, Rockwater was commissioned to undertake an assessment of subterranean fauna for the project. A pilot study, incorporating a desktop study and a brief stygofauna and troglofauna sampling programme, was undertaken in January 2010. Following the detection of stygofauna during the pilot study, the sampling programme was extended to increase its sampling intensity. The Subterranean Fauna Sampling Programme (SFSP) represents a comprehensive survey that incorporates relevant guidelines for assessment of subterranean fauna (EPA 2003, 2007).

The objectives of the subterranean fauna investigation were to:

1. confirm whether subterranean fauna are a relevant environmental factor for the project;
2. identify and sample sites within the project area that are most likely to provide suitable habitat for subterranean fauna;
3. identify any conservation-significant species within aquifers or formations likely to be impacted by the implementation of the proposal;

4. assess the significance and conservation status of the stygofauna and troglofauna communities identified in the project area; and
5. identify potential impacts of the proposal on the troglofauna and stygofauna conservation values.

2 TERMINOLOGY AND DEFINITIONS

2.1 SUBTERRANEAN FAUNA

Subterranean fauna include both troglofauna (terrestrial) and stygofauna (aquatic). Troglofauna are highly specialised subterranean fauna, which occur between the superficial soil layer and the water table, particularly in vuggy or karstic materials (including calcretes). Subterranean fauna are significant in terms of Australian faunal biodiversity (EPA 2007).

The presence and extent of troglofauna populations in Western Australia are poorly documented. However, they have been recorded at Cape Range, Barrow Island, in the Kimberley, in pisolitic mesa formations in the Pilbara, and in the cave systems of Yanchep, Margaret River and the Nullarbor.

Troglofauna are classified into three ecological-evolutionary categories.

1. Animals that have the ability to spend part of their life cycles in subterranean habitats '*trogloxenes*'.
2. Animals that have the capacity to spend their entire life cycle in either underground or epigean habitats, '*troglophiles*'.
3. Animals that have adapted and are restricted exclusively to subterranean environments, '*troglobites*'.

Troglobites are distinguished from trogloxenes and troglophiles by completing their entire life-cycles restricted to subterranean habitats. A species is generally considered troglobitic if it displays troglomorphic character traits including loss or reduction of eyes and wings, dark pigmentation, elongated appendages, a slender body form and enhancement of non-optic sensory structures (Eberhard 2007).

Troglobites generally occur between the superficial soil layer and the water table. Suitable habitats are those that allow some form of air access, have adequate sized voids, pits or cavities, and those areas that maintain a moist constantly humid sub-surface environment (Lawrance 2009).

Stygofauna are groundwater-dependent interstitial fauna, largely consisting of crustaceans but also including worms, snails, insects, several other invertebrate groups and blind fish. Stygofauna occur in a range of geological environments, including, but not restricted to, karstic carbonate rocks, fractured-rock aquifers and porous unconsolidated sediments,

e.g. alluvium (Eberhard 2007). Stygofauna have been found in most regions of Western Australia, with hotspots in the Pilbara and also recordings from the Goldfields, Kimberly, Murchison and the Yilgarn area (Biota 2007). Like troglofauna, stygofauna may be similarly classified into three ecological-evolutionary categories, i.e. '*stygoxenes*', '*stygophiles*' and '*stygobites*'.

Other terms used within this report include:

- Epigean: occurring on or just below the ground surface.
- Edaphobites/Edaphobitic: soil dwelling fauna. These may display similar morphological characteristics to troglofauna; however, their primary habitat is within surface soils.
- Impact area: the area of mining influence/disturbance. For stygofauna the impact area includes the mine pit and all areas affected by drawdown of groundwater levels; however, for troglofauna, the (direct) impact area is limited to the mine pit.
- Sample site: an individual site selected for sampling, i.e. an exploration hole or bore.
- Impact site: a sample site within the impact zone.
- Reference site: a regional sample site outside the defined impact zone.

3 PHYSICAL SETTING

The geology of the project area has been mapped by interpretation of Quickbird satellite imagery (Nick Lockett and Associates 2009). The geological setting, as outlined by Rockwater (2010a, b), is summarised below:

API plans to mine two iron ore deposits within sedimentary rocks of the Hamersley Group: a bedded hematitic iron deposit in the Brockman Iron Formation, and limonite and goethite in the Marra Mamba Iron Formation, which is lower in the sequence of strata. Shale and other sedimentary strata of the Mt McRae Shale and Mt Silvia Formation, and dolomite of the Wittenoom Formation, separate the two iron deposits. The footwall of the Marra Mamba Iron Formation consists of metavolcanic and metasedimentary rocks of Archaean age.

The project area lies at the eastern end of the Hardey Syncline, an asymmetrical feature striking roughly east–west with steeply-dipping sediments to the north of the synclinal axis and gently-dipping sediments to the south.

3.1 STRATIGRAPHY

The stratigraphic sequence at the project is given in Table 1.

Table 1: Stratigraphic Column of the Southwest Hamersley Province–Hardey Project

Age	Group		Formation	Member	Description
Phanerozoic			Quaternary sediments	undifferentiated	Alluvium and colluvium
			Cainozoic sediments	undifferentiated	Calcrete, laterite and duricrust deposits
Proterozoic	Mount Bruce Supergroup	Hamersley Group	Brockman Iron Formation	*Yandicoogina Shale Member	Interbedded shale and chert
				Joffre Member	BIF with minor shale
				Mt Whaleback Shale Member	Interbedded chert and shale with two BIF bands at the base
				Dales Gorge Member	Sequence of BIF and shale
Archaean			Mt McRae Shale		Interbedded shale and chert
			Mt Silvia Formation		Dolomitic shale and BIF
			Wittenoom Formation	undifferentiated	Dolomite and chert
			Marra Mamba Iron Formation	Mt Newman Member	BIF minor chert
				Macleod Member	Shale, chert BIF
				Nammuldi Member	Goethite, limonite and chert
		Fortescue Group	Jeerinah Formation	undifferentiated	Metabasalt metasediments

*Absent at the Hardey project

3.2 GROUNDWATER OCCURRENCE

The Brockman Iron, Wittenoom, and Marra Mamba Iron Formations present at Hardey have produced moderate to large supplies of fresh to brackish groundwater in other parts of the Pilbara. Groundwater targets have been identified in these formations at the project in faulted and fractured brittle host rocks, mineralised rocks and along geological contacts.

A groundwater investigation and hydraulic testing programme was undertaken within the project area by Rockwater (2010a, 2010b, 2010c). Data collected from these tests and recent drilling indicate that low to moderate groundwater supplies are obtainable from the Wittenoom and Mt Silvia aquifers, and moderate to high yields are possible from the Brockman Iron, Jeerinah and Marra Mamba aquifers.

The overall hydrogeological setting of the Brockman aquifer is an elongate zone of moderate to high permeability mineralised iron ore, which is interbedded with low permeability shale

beds. It is possible that the Brockman aquifer is connected to Wittenoom dolomite aquifers, to saturated BIF/chert beds within the McRae Shale and Mt Silvia Formation, and to the base of the Marra Mamba Iron Formation, below the proposed pits of the project.

The water table lies between 363 and 375 m AHD and slopes downwards to the northwest, suggesting that recharge is via infiltration from the Hardey River and direct infiltration of rainfall. Several perched aquifers may be present above the regional water table due to the presence of less-permeable clay/shale layers. The most prominent perched aquifer that has been recognised to date occurs beneath a ridgeline in the eastern part of the Brockman Deposit (ex. holes HARC 153, 154, 155, 157, 159, 168, and 177) where water levels are between 377 and 378 m AHD, about 7 to 8 m above the regional water table. There is a relatively abrupt change in water levels near the centre of the Brockman Deposit with water levels at about 364 m to the west and 370 m to the east. This change in water level is interpreted to be the result of a low permeability feature (fault or dyke) that strikes NE-SW and impedes groundwater flow towards the northwest (Fig. 2).

3.3 CLIMATE

The region experiences a subtropical-dry-type climate (Gentilli 1972) with very low rainfall, high daytime temperature in summer and low minimum temperatures in winter. The nearest Bureau of Meteorology climate stations to the project area are Paraburdoo (station no. 007178) and Tom Price (station no. 005072). The average annual rainfall for the two centres is 283.8 mm and 405.7 mm respectively, with recordings received predominantly between December and June, and being associated with tropical rainfall systems from the north. Long-term climatic data (Tables 2 and 3) indicate that Tom Price is wetter and cooler than Paraburdoo; probably because it is in a high-relief area (725 m AHD) having enhanced orographic effects. Paraburdoo is situated at the foot of Radio Hill on the southern bank of Seven Mile Creek at an elevation of 390 m AHD. The climate at the project is more likely to be similar to that at Paraburdoo because of the similar topographic setting.

Table 2: Average Monthly Rainfall (Tom Price Station 007178 1974–2011) and Temperature (1997 - 2011).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Temperature(°C)	35.9	34.2	31.6	27.6	23.5	23.0	25.5	29.1	33.6	35.6	37.8	31.3	
Rainfall (mm)	82.3	95.5	60.4	30.9	20.4	25.3	16.8	10.8	2.4	4.4	10.9	40.7	**404.8**

Source Bureau of Meteorology, 2011

Table 3: Average Monthly Rainfall (Paraburdoo Station 005072 1974–2011), and Temperature (1996 - 2011).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Temperature(°C)	41.1	38.5	36.6	33.4	29.1	25.2	24.8	27.2	31.2	35.7	38.3	40.2	
Rainfall (mm)	47.7	78.5	45.6	27.1	16.9	22.5	14.9	12.2	3.7	3.7	8.3	29.2	**313.3**

Source Bureau of Meteorology, 2011

4 DESKTOP STUDY

A desktop study was conducted as part of the pilot study, comprising a literature review of other previous subterranean fauna studies in the region, available hydrogeological reports and maps and data supplied by API.

4.1 PREVIOUS STUDIES

A preliminary fauna review for the project by Biota (2009a) assessed geological data and results from previous subterranean fauna sampling in the region, and concluded that stygal communities were likely to be present in association with major drainages (the Hardey River) and creek alluvial systems within and adjacent to the project. No core-habitat for troglofauna was identified in the project area; however, it was noted that there have been occasional records of troglofauna from habitats associated with BIF geology elsewhere in the Pilbara.

The Pilbara region supports a diverse range of stygofauna communities, with the most comprehensive study conducted during a regional survey between 2002 and 2005. In this study about 350 species were documented, with up to 54 species at individual bores (Eberhard *et al*. 2008).

Stygofauna have recently been found to be widely associated with alluvial and calcrete aquifers through much of the Pilbara (Eberhard *et al*. 2005). There are no calcrete or alluvial aquifers within the project area and minor drainages through the project area comprise shallow alluvial deposits over bedrock. These shallow alluvial systems feed into the Hardey River, approximately 1.3−3.9 km south of the project.

A stygofauna assessment undertaken for seven ore bodies comprising API's West Pilbara Iron Ore Project (Biota 2009b) recorded 37 stygal taxa representing eight orders and 16 families. Nineteen of 20 species collected from the impact area were shown to occur more widely and the risk of impacts to the remaining species beyond localised population level impacts was considered to be low.

A subterranean fauna assessment for the West Turner Syncline Section 10 orebody (Biota 2008a), located approximately 46 km northeast of the project, yielded no troglobitic or stygobitic fauna and concluded that there was a low likelihood of subterranean fauna occurring in the habitats associated with the Brockman Iron Formation. Results of downhole camera surveys and inspection of drill core for this assessment, used to characterise subterranean habitats, showed that core-habitat for subterranean fauna was not present and the likelihood of troglofauna/stygofauna occurrence was low (Biota 2008a).

4.2 POTENTIAL STYGOFAUNA HABITAT AT HARDEY

Photographs of diamond drill core from five mineral exploration holes were reviewed as part of the desktop survey. Plates 1 to 7 show representative sections of the diamond drill core relevant to the interpretation of potential stygofauna habitat. Although no core-habitat for stygofauna was identified in the project area, sections of the Brockman Iron Formation that are fractured and/or vuggy below the water table may provide suitable habitat for stygofauna. The interpretation of diamond core photos from the project areais summarised in Table 4. Four of the diamond holes interpreted contained sections of saturated Brockman Iron Formation that were considered suitably broken or vuggy to provide potential stygofauna habitat. Results of the interpretation of drill cores were used to select sites during stygofauna sampling for the project.

Table 4: Review of Diamond Drill Cores from the Project Area and Interpretation for Potential Stygofauna Habitat.

Drill Hole[1]	Formation	Unit[2]	Stratigraphy[3]	Plates	Suitability for Stygofauna
HADD006 SWL = 78.0 m	Brockman	DGM	78.0 – 146.2 m: Hematite with minor bands of goethite and shale 146.2 – 154.6 m EOH: BIF	Plate 1	Possibly prospective 146.2 – 152.2 (BIF)
HADD007 SWL = 46.6 m	Brockman	DGM	46.6 – 106.6 m: Goethite-hematite with bands of shale and minor bands of clay, fractured throughout, small vugs (58.0 – 59.0 m). 106.6 – 107.2 m: mineralised iron formation 107.2 – 115.7 m EOH: BIF, fractured	Plates 2 & 3	**Prospective** 58.0 – 59.0 m 106.7 – 115.7 m
HADD008 SWL = 116.7 m	Brockman	WS overlying DGM	116.7 – 123.6 m: shale 123.6 – 130.2 m: BIF, highly fractured 130.2 – 133.4 m: mineralised iron formation, highly fractured 133.4 – 144.5 m EOH: BIF, highly fractured	Plate 4	**Prospective** 125.0 – 128.0 m
HADD010 SWL ~ 44 m	Brockman	DGM	44.0 – 170.2 m EOH: Goethite and hematite with large sections of shale	Plates 5 & 6	**Prospective** 65.5 – 66.0 m 73.75 – 74.3 m 79.3 – 83.5 m 97.3 – 104.1 m 106.3 – 146.58 m
HADD011 SWL ~ 42 m	Brockman	DGM	42.0 – 50.7 m: Goethite and hematite with large sections of shale. Vuggy 27.0 – 30.5 m 50.7 – 86.2 m: shale and clay 86.2 – 112.2 m: BIF, silicified, fractured throughout 112.2 – 124.4 m EOH: shale	Plate 7	**Prospective** 86.2 – 112.2 m

[1]Where SWL data were unavailable, levels were estimated using neighbouring holes and RL data, and modelled groundwater contours.
[2]WS – Whaleback Shale
DGM –Dales Gorge Member
[3]BIF – Banded Iron Formation
EOH – End of Hole
All holes drilled at a dip of -60°

Plate 1: Silica-rich BIF (146.35 – 150.1 m) in HADD006, in the Brockman Formation.

Plates 2 & 3: Sections from goethite-hematite (56.77 – 59.89 m) and BIF section (110.2 – 113.48 m) areas in HADD007, in the Brockman Formation.

Plate 4: Representative BIF (125.0 – 128.6 m) from HADD008 in the Brockman Formation.

Plates 5 & 6: Potential stygofauna habitat in the goethite (81.2 – 85.85 m) and hematite-rich (137.15 – 140.3 m) sections of hole HADD010.

Plate 7: HADD011, silica-rich BIF (108.0 – 111.15 m)

4.3 POTENTIAL TROGLOFAUNA HABITAT AT HARDEY

Diamond drill core photographs from eleven mineral exploration holes were reviewed as part of the desktop survey. The core, together with geological sections and lithological logs, provided evidence of potentially suitable troglofauna habitat between the superficial weathered zone and the water table in several holes (Table 5). Plates 8 to 31 show representative sections of relevant diamond drill core that were reviewed for the interpretation of potential troglofauna habitat.

Table 5: Review of Diamond Drill Cores from the Project Area and Interpretation for Potential Troglofauna Habitat.

Drill Hole[1]	Formation	Unit[2]	Stratigraphy[3]	Plates	Suitability for Troglofauna
HADD001 Dry	Brockman	WS overlying DGM	0 – 3.4 m : lateritic duricrust, pale 5.8 – 70.45 m (EOH): Goethite-hematite with bands of shale; highly fractured with vuggy areas 19.7 – 28.0 m. Cavity noted 22.6 – 23.2 m	Plates 8 & 9	**Prospective** 19.7 – 28.0 m
HADD002 Dry	Brockman	WS overlying DGM	3.1 – 7.5 m : lateritic duricrust 7.5 – 88.0 m (EOH): Goethite-hematite with bands of shale; highly fractured, particularly 13.7 – 22.7 m. Vuggy areas 8.0 – 13.2 m.	Plate 10 & 11	**Prospective** 8.0 – 22.7 m
HADD003 Dry	Brockman	DGM	0 – 2.0 m : lateritic duricrust 2.0 – 17.5 m: Goethite-hematite 17.5 – 36.7 m: Hematite with minor bands of shale. Vuggy 18.2 – 26.0 m 36.7 – 37.3 m: Goethite 37.3 – 139.7 (EOH): Goethite-hematite, silicified with large areas of shale. Highly fractured throughout, particularly 75.2 – 79.7 m and 93.2 – 115.4 m.	Plates 12 & 13	**Prospective** 18.2 – 26.0 m 57.2 – 59.0 m
HADD004 Dry	Marra Mamba	-	0 – 2.6 m: soil 2.6 – 6.4 m: clay with silcrete (5.2 – 5.65 m) 6.4 – 24.2 m: Goethite-hematite with clay (13.1 – 13.7 m). Cavity noted 16.7 – 17.2 m 24.2 – 31.1 m: shale, fractured 31.1 – 31.7 m: clay 31.7 – 40.3 m: Goethite-hematite, fractured 40.3 – 43.05 m: clay 43.05 – 47.0 m (EOH): BIF, fractured	Plate 14	**Prospective** 16.7 – 17.2 m Possibly prospective 6.4 – 47.0 m (except clay areas)
HADD005 Dry	Marra Mamba	-	0 – 21.2 m: Goethite-Hematite, fractured, small vugs (1.5 – 15.2 m). Cavity noted 11.4 – 12.2 m 21.2 – 25.8 m: BIF, fractured, small vugs (23.0 – 24.0 m) 25.8 – 28.1 m: shale 28.1 – 30.2 m: BIF, fractured 30.2 – 50.1 m (EOH): shale, very broken	Plates 15, 16 & 17	**Prospective** 1.5 – 15.2 m and 23.0 – 24.0 m
HADD006 SWL = 78.0 m	Brockman	DGM	0 – 1.7 m: saprolite 7.1 – 12.8 m: Hematite 12.8 – 20.2 m: Goethite-hematite 20.2 – 25.0 m: shale 25.0 – 26.6 m: Goethite 26.6 – 34.8 m: Goethite-hematite, comparably tight, limited fractures 34.8 – 57.2 m: Hematite, fractures 57.2 – 61.1 m: shale 61.1 – 68.5 m: Goethite 68.5 – 70.5 m: shale 70.5 – 78.0 m: Hematite with minor bands of goethite and shale	Plate 18	Possibly prospective 18.7 – 20.0 m

Drill Hole[1]	Formation	Unit[2]	Stratigraphy[3]	Plates	Suitability for Troglofauna
HADD007 SWL = 46.6 m	Brockman	DGM	3.0 – 11.3 m: shale 11.3 – 14.2 m: Goethite, fractured 14.2 – 46.6 m: Goethite-hematite with bands of shale and minor bands of clay (40.6 – 42.5 m), fractured throughout, small vugs (23.0 – 24.3 m)	Plate 19	**Prospective** 23.0 – 24.3 m 26.0 – 28.6 m
HADD008 SWL = 116.7 m	Brockman	WS overlying DGM	0 – 11.8 m: pisolitic duricrust, small vugs (2.6 – 3.7 m) 11.8 – 17.1 m: shale, fractured, small vugs (10.1 – 11.8 m) 17.1 – 27.2 m: Goethite, small vugs (18.0 – 19.0 m, 21.1 – 27.0 m) 27.2 – 31.6 m: shale, fractured, broken 31.6 – 80.6 m: Goethite and hematite with layers of shale, highly fractured, shale sections granular and broken 80.6 – 85.0m: clay, large vugs (80.2 – 80.4 m) 85.0 – 106.0 m: diorite, tight, broken 106.0 – 114.4 m: BIF, fractures throughout 114.4 – 116.7 m: shale	Plates 20 – 23	**Prospective** 2.6 – 3.7 m 6.0 – 11.8 m 18.0 – 19.0 m 21.1 – 27.0 m 80.2 – 80.4 m 106.0 – 113.5 m
HADD009 Dry	Brockman	DGM	1.4 – 11.0 m: mottled duricrust, small vugs (1.4 – 4.5 m, 6.0 – 8.0 m, 8.8 m) 11.0 – 15.4 m: clay 15.4 – 38.2 m: Goethite and hematite, broken, vuggy (15.4 – 21.0 m) 38.2 – 50.1 m: shale, broken, tight 50.1 – 91.4 m EOH: BIF, silicified with small sections of shale and mineralised iron formation	Plates 24 – 27	**Prospective** 1.4 – 4.5 m 6.0 – 8.0 m, 8.8 m 15.4 – 21.0 m 57.0 – 59.1 m 77.8 – 79.8 m
HADD010 SWL ~ 44 m	Brockman	DGM	7.2 – 44.0 m EOH: Goethite and hematite with large sections of shale	Plates 28 – 29	**Prospective** 14.9 – 15.4 m 22.3 – 26.8 m
HADD011 SWL ~ 42 m	Brockman	DGM	6.0 – 17.7 m: shale 17.7 – 42.0 m: Goethite and hematite with large sections of shale. Vuggy 27.0 – 30.5 m,	Plates 30 – 31	**Prospective** 27.0 – 30.5 m 34.5 – 39.6 m

[1]Where SWL data were unavailable, levels were estimated using neighbouring holes and RL data, and modelled groundwater contours.
[2]WS – Whaleback Shale
DGM –Dales Gorge Member
[3]BIF – Banded Iron Formation
EOH – End of Hole
All holes drilled at a dip of -60°

As for stygofauna (see Section 4.2), vuggy goethitic sections of the orebody appear to provide the most prospective habitat for troglofauna in the project area. Broken and weathered regolith may also provide prospective habitat. Core-sections from the eleven diamond holes indicated the presence of prospective troglofauna habitat, i.e. suitable vug development and/or fracturing above the water table within the BIF orebody (Table 5). The most prospective strata ranged from 1.5 m bgl (HADD005, Plate 15) to 113.5 m bgl (HADD008, Plates 20−23).

Plates 8 & 9: fractured and vuggy zones of Goethite-hematite (17.7 – 21.5 m and 21.5 – 26.6 m) in HADD001, in the Brockman Formation.

Plates 10 & 11: fractured and vuggy zones of Goethite-hematite in the Brockman Formation (6.2 – 10.0 m and 10.0 – 13.5 m) in hole HADD002.

Plates 12 & 13: representative core photographs of Hematite-rich zone (19.6 – 23.8 m) and silica rich Goethite-hematite (55.9 – 58.8 m) in hole HADD003, located in the Brockman Formation.

Plate 14: core photograph of a section of Goethite-hematite-rich zone in the Marra Mamba Formation (16.7 – 17.2 m) in hole HADD004. A cavity was noted from 16.7 to 17.2 m.

Plate 15: Goethite-Hematite (0 – 3.2 m) in hole HADD005, located in the Marra Mamba Formation.

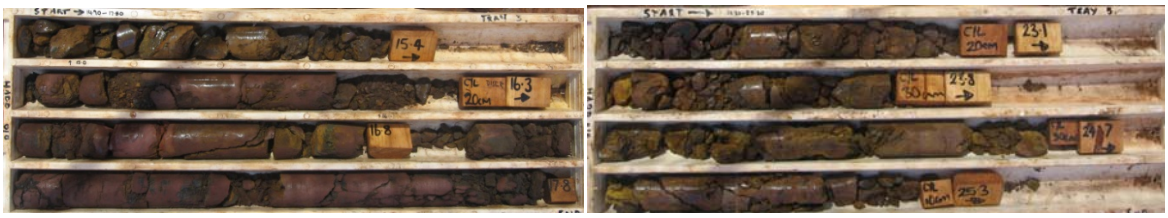
Plates 16 & 17: representative core photographs of Goethite-hematite-rich zone (7.2 –10.5 m) and BIF with shale layers (22.0 – 26.5 m) in the Brockman Formation, from hole HADD005.

Plate 18: Potential habitat in Goethite-hematite (18.7 – 20.0 m) in hole HADD006, located within the Brockman Formation.

Plate 19: Prospective troglofauna habitat of goethite-hematite (22.3 – 24.85 m) in hole HADD007, located in the Brockman Formation.

Plates 20 – 23: Prospective troglofauna habitat in the pisolitic duricrust (8.1 – 11.6 m) and Goethite (17.75 – 20.93 m) and in Goethite-hematite sections (77.66 – 81.77 m) and BIF (111.8 – 1151.28m) from HADD008, located in the Brockman Formation.

Plates 24 – 27: Prospective troglofauna habitat from HADD009. Plates 17 and 18 show sections with large vugs within the upper levels of the profile (mottled duricrust, 1.4 – 5.1 m and 5.1 – 8.91 m) while Plates 19 and 20 show prospective habitat in the goethite-hematite sections (16.3 – 20.02 m) and silica-rich BIF.



Plates 28 & 29: Fractured goethite-hematite sections (14.9 – 17.8 m and 20.3 – 25.3 m) of HADD010, in the Brockman Formation.

Plates 30 & 31: Fractured goethite-hematite sections (27.17 – 31.5 m and 34.5 – 40.1 m) of HADD011, in the Brockman Formation.

4.4 DATABASE SEARCH RESULTS

A search of the WA Museum's Arachnology Database was conducted for troglofauna records within approximately 50−85 km of the project area. The MGA94 search coordinates used were as follows:

- southwest corner: (Zone 50) 442 482 mE, 7415 716 mN; and
- northeast corner: (Zone 50) 597 965 mE, 7510 256 mN.

The search revealed a number of mites from boreholes on Rocklea and Wyloo pastoral stations (Table 6); however, mites are not generally a target group of troglofauna or stygofauna surveys as part of environmental assessment studies.

The area search also found a record of a palpigrade collected in a stygofauna trap. This specimen may represent a short-range endemic and is currently on loan to a specialist for further taxonomic assessment (*pers. comm.* Volker Framenau, WA Museum).

Table 6: Results of WA Museum Arachnology Database Search.

Order	Family	Taxa	Area	Site	Bore
Acari	Acari indet	-	Seven Mile Creek	PSS179	PSPRSLK48
	Arrenuridae	*Arrenurus Janine*	Janine Hardey River	PSS173	NWSLK220A
	Arrenuridae	*Arrenurus Janine*	Janine Paraburdoo Town Bore Field	PSS050	PTO-6
	Arrenuridae	*Arrenurus*	Paraburdoo Town Bore Field	PSS050	PTO-6
	Bdellidae	-	Paraburdoo Town Bore Field	PSS050	PTO-6
	Halacaridae sp.	-	Paraburdoo Town Bore Field	PSS050	PTO-6
	Halacaridae sp. 1	-	Paraburdoo Town Bore Field	PSS050	PTO-6
	Halacaridae sp. 1	-	Wyloo Station	PSS171	NWSLK136
	Mideopsidae	*Tiramideopsis lictus*	Rocklea	PSS045	PSPRSLK36
	Mideopsidae	*Tillia E*	Hardey River	PSS173	NWSLK220A
	Unionicolidae	*Recifella*	Paraburdoo Town Bore Field	PSS050	PTO-6
Palpigradi	Eukoeneniidae	-	c. 20.9 km W. of Tom Price	West Turner Syncline (section 10)	stygofauna trap

The Department of Environment and Conservation's (DEC) Biodiversity Survey of the Pilbara Region of Western Australia, 2002 – 2007 (in prep) included several stygofauna sites near the project area. A search of the DEC's Pilbara stygofauna study (PSS) database for

records near the project was undertaken by Stuart Halse of Bennelongia Environmental Consultants at Rockwater's request. The following GDA94 geographic coordinates were used for the database search:

- bottom right: 22˚65' lat, 117˚12′ long; and
- top left: 22˚50' lat, 117˚24′ long.

The search identified stygofauna from three sites; the nearest being approximately 8 km east-northeast of the project, on the Hardey River.

4.5 IDENTIFICATION OF POTENTIAL IMPACT MECHANISMS FOR SUBTERRANEAN FAUNA

The proposal to mine may impact subterranean fauna (where present) and subterranean fauna habitat that exists in the project area. Consideration of aspects of the project that may potentially impact subterranean fauna was undertaken as part of the desktop review. Potential impacts have been divided into direct and indirect. Direct impacts include aspects of the proposal that are likely to result in destruction of habitat and removal of local populations. These are more likely to lead to extinction of any restricted species that may be present in the project area. Indirect impacts include threatening processes that are more likely to lead to reduction in population sizes and secondary impacts to subterranean fauna habitat. The ecological significance of many of the potential indirect impacts is not well understood.

The principal impact of the project on troglofauna is direct loss of habitat through construction of the open pit. The proposed mine pits represent a disturbance area of approximately 134 ha. For stygofauna, impacts to potential habitat include the mine pit, but also extend to aquifers that may be subject to drawdown through dewatering or groundwater extraction during the life of the project.

Modelling of the aquifer system of the project was undertaken by Rockwater (2011) to assess the dewatering requirements for the project and to estimate the amount of excess water that would be produced based on an estimated annual mine water use of one gigalitre per annum (GL/a). The approximate area that will need to be dewatered based on the current life of mine plan is shown in Figure 2. Based on current modelling, water levels will be drawn down by 11 to 90 m within the project area (Rockwater 2010c, 2011).

Other aspects of the mining proposal that may potentially affect subterranean fauna include the following.

1. Clearing of remnant vegetation, which may lead to additional sediments entering the voids/cavities thereby reducing habitat availability.
2. Removal of vegetation (clearing), which may also reduce the input of organic material to subterranean systems.
3. Changes to surface hydrology in the vicinity of the mine, which may alter local recharge/discharge points.
4. Spills/leaks from mining operations, which may lead to surface or groundwater pollution.
5. Vibrations from blasts and other mining activities.
6. Reduction in the humidity of subterranean fauna habitat caused by dewatering drawdown of groundwater levels as the deeper parts of the orebody are mined.

These other potential impacts to subterranean fauna and the habitats they occupy are poorly understood; however, they are unlikely to be significant and could largely be controlled through environmental management actions.

5 SAMPLING METHODOLOGY

5.1 OVERVIEW

The subterranean fauna sampling approach and methodology for the Hardey study was prepared in accordance with the principles outlined in relevant EPA guidance statements (EPA 2003, EPA 2007). The investigation considers the requirements of the EPA for assessment of subterranean fauna for the project. It involves collecting sample sets, that are representative of aquifers and strata that may be suitable for subterranean fauna, from an appropriate spread of sampling sites across the project area and regionally.

Subterranean fauna sampling for the project was approved by the DEC and undertaken within the conditions of Regulation 17 Permit (No. SF 7247). A total of seven sampling rounds were completed, involving six rounds of troglofauna sampling and five rounds of stygofauna sampling.

5.2 STYGOFAUNA SAMPLING

Eighty five (85) stygofauna samples were taken between January and November 2010, from 39 impact sites and 19 reference sites (Table 7). Sixty five (65) samples were collected from sites in the project area. All project area sites were assumed to be impact sites for the purposes of EIA, as all sites will be subject to drawdown as deeper parts of the iron deposits are

dewatered ahead of mining. Locations of sites sampled for stygofauna are shown in Figures 2 and 3.

The sampling programme was commenced as a pilot study; however, following detection of stygofauna in the initial samples, a second round of sampling was undertaken. Sampling for stygofauna was commenced in January 2010 (Round 1). Eight samples were taken from two cased bores and six RC mineral exploration holes. The eight sites were selected for sampling based on depth and aperture of their screened sections (only bores HAWB001 and HAWB002 were cased), local geological characteristics and spread across the site.

Table 7: Stygofauna Sampling Effort (Number of Samples) over Four Sampling Rounds for the Project.

	Round 1 January 2010		**Round 2** March 2010			**Round 3** July 2010	**Round 4** September 2010	**Round 5** November 2010	**Round 6** May 2011	**Round 7** June 2011	
Site Type	**Net**	**Pump[1]**	**Net**	**Air-lift[2]**	**Pump[3]**	**Net**	**Net**	**Net**	**Net**	**Net**	**Total Samples[4]**
Impact	7	1	13	6	-	15	13	12	-	-	65
Reference	-	-	14	-	7	-	-	-	-	-	19

[1] Pump sample taken using submersible pump.
[2] Airlift samples taken by filtering a volume of water pumped during hydraulic testing (see Appendix IV)
[3] Pump samples taken from regional bores equipped with either a windmill or submersible pump (solar mill or gen-set powered).
[4] Total number of samples calculated based on combined methods for sampling at each site (i.e. net only sample or a net and pump sample during a single visit being considered a single sample).

The scope of stygofauna sampling was extended for Round 2 (March 2010) to include 19 regional sites, including pastoral bores/wells and disused Main Roads production bores. Bores in the project area were also sampled in March 2010. A total of 44 samples were taken between January and March 2010, with 25 from the project area and 19 from regional sites.

Further sampling was conducted in July, September and November 2010 to bring the sampling intensity in line with the EPA guidelines (EPA 2007). An additional 15 project area sites were sampled in July (Round 3), including 7 new sites. Nine cased monitoring bores were sampled in September (Round 4) and again in November (Round 5). The monitoring bores (labelled HAMB 1 – 8, Figure 2) were all at least 3 months old at the time of sampling (as required by the EPA) and were cased with 90 mm OD class 12 uPVC with 3 mm aperture slots below the water level. A total of 40 samples were taken during Rounds 3, 4 and 5.

Each bore was sampled as summarised below:

- prior to biological sampling, measurements of water level and basic water quality parameters (including salinity, conductivity, pH, dissolved oxygen and temperature);
- recordings of total depth, collar heights, diameters and other bore details, where available;
- collection of biological samples using stygofauna sampling nets; and
- preservation of biological samples in 100 % ethanol.

Water quality was measured using a Hydrolab minisonde multiparameter probe, either 'down-hole' using a 100 m cable or in a sample of one to two litres bailed from the bore. The probe was lowered down the bore casing to one metre below the water level or placed into the water sample and was held until water quality readings stabilised before readings were recorded.

Sampling nets with a diameter of approximately two thirds of the bore/hole diameter and filter mesh sizes 50 µm and 150 µm were used to sample all bores. Each net consists of a steel collar that supports a filter mesh, tapering to a hollow brass weight. A clear polycarbonate vial with the bottom removed and replaced with 50 µm filter mesh was screwed into the brass weight to collect samples filtered by the sampling nets. Nets were suspended by a carabineer and three trace wires attached to the steel collar.

Bores were sampled for stygofauna using customised haul nets by lowering sampling nets into bores using a reel of fishing braid until they reached the bottom of the bore where they were agitated to disturb sediment and any animals that may be present. Each biological sample was taken using three net-hauls of the 50 µm stygofauna sampling net and three net-hauls of the 150 µm sampling net, which were combined and preserved.

Several pumped samples were taken from regional bores equipped with either a submersible pump or windmill. In the project area, pumped samples were taken from six bores during a concurrently run hydraulic testing programme. Here, water was pumped or 'air-lifted' from the bores using compressed air and collected in buckets before being filtered through a 50 µm net. A pumped sample was also taken from bore HAWB002 in the project area during the Round 1 sampling, a time when it was equipped for use by drillers.

Samples were stored in 120 mL polycarbonate vials and preserved using 100% (absolute) ethanol. To avoid contamination between sites, the sampling nets were thoroughly washed with a decontaminant solution and then rinsed with distilled water between sample sites. All samples were forwarded to specialist stygofauna biologists at the end of each sampling round for sorting and identification.

5.3 TROGLOFAUNA SAMPLING

Two pits covering an area of approximately 134 ha were assessed within the project area; the larger Brockman Iron deposit and the smaller Marra Mamba deposit to the south. Provisional pit outlines provided by API were mapped to determine the status of sites sampled; those within this area were defined as impact sites for the purposes of an EIA (Figure 4).

A combination of trapping and net-scraping methods was used to sample troglofauna. Scrape samples were taken in all rounds except round 2, and traps were set in rounds 1, 3 and 6.
A total of 47 trap samples and 51 scrape samples were taken from 55 impact sites in the project area over three sampling rounds (Table 8). An additional 115 scrape samples and 52

trap samples were taken from reference sites during the survey. The locations of reference sites are provided in Figure 5.

Table 8: Troglofauna Sampling Effort (Number of Samples) over Three Sampling Rounds at the Project.

	R1 (Pilot) Jan-10		R3 Jul-10		R4 Sept-10	R5 Nov-10	R6 May-11		R7 Jun-11	
Site Type	**Scrape**	**Trap**	**Scrape**	**Trap**	**Scrape**	**Scrape**	**Scrape**	**Trap**	**Scrape**	**Total Samples**
Impact	9	12	32	35	10	-	-	-	-	54.5
Reference	7	7	13	11	-	26	36	34	33	115

Scrape or Scrape + trap = 1 sample; trap only = 0.5 Sample

Scrape and net samples from each site were processed separately, although they were considered to represent one sample. Samples collected using troglofauna traps only (i.e. no scrape sample taken at the time of trap installation) were assigned a value of 0.5 for the calculation of sampling efficiency (Section 6.2).

Lithological logs for all open RC holes in the project area were compiled and taken into the field for reference. When drill cuttings were inspected in the field at each site, the logs were used to confirm approximate depths of mineralised, vuggy sections of BIF. Geological sections, lithological data and photos of diamond drill core had been reviewed previously, during the desktop study. Traps were installed to intercept potential troglofauna habitat in mineralised BIF, or where drill core/cuttings indicated that the host rock was fractured or vuggy.

Troglofauna sampling was undertaken as follows:

- A scrape sample was taken from each uncased hole, using reinforced stygofauna sampling nets with 150 µm filter mesh, and preserved in 100% ethanol prior to the installation of the baited trap. Single scrapes were taken from angled holes while four scrapes were taken from vertical holes.
- A baited trap(s) was installed at pre-determined depth(s) to match prospective troglofauna habitat.
- A cap or plug was placed over each hole to minimise the amount of terrestrial fauna entering the traps, and to maintain a humid environment.
- Traps were retrieved after 6-8 weeks and immediately placed into sealed bags for transport to the laboratory.

The troglofauna traps are constructed of 120-180 mm long sections of 65 mm diameter PVC pipe. Each trap has a series of 10-20 mm holes drilled into the side and a vented PVC cap to allow fauna to colonise the baited trap.
Traps were baited with a mixture of leaf litter sourced from nearby native vegetation. The litter is soaked in water and irradiated in a microwave oven on maximum power setting for

5-10 minutes (to kill any surface invertebrates and assist in breakdown) prior to use. Once the leaf litter is added to the traps they are installed into the hole.

On retrieval, the trap contents were immediately transferred to a labelled zip-lock bag and placed in an esky for transport to the laboratory. Samples were submitted to the laboratory for sorting and identification at the end of each sampling round (scrape- and trap-sampling). Sorting and identification was undertaken by specialist subterranean biologists, Bennelongia Environmental Consultants.

6 SAMPLING RESULTS

6.1 STYGOFAUNA

The locations of sites sampled during the stygofauna sampling programme are shown in Figures 2 and 3. Site details are provided in Appendices III-VII.

A total of 1,428 stygofaunal animals representing 40 potential taxa were collected from 19 of 39 project area sites (Fig. 6) and 19 reference sites (Fig. 7) during the survey.

Sampling within the project area yielded 369 stygal animals of six higher order groups including Amphipoda, Copepoda, Oligochaeta, Ostracoda, Isopoda, and Bathynellacea (Table 9). The community was dominated by crustacean orders, in particular Copepods (Fig. 8), which accounted for over 76% of all taxa recorded.

Table 9: Overview of Higher Order Taxa Collected within the Project Area

Taxon			Total Individuals	Number of Sample Sites
Phylum	**Class**	**Order**		
Annelida	Oligochaeta	Haplotaxida	48	3
Crustacea	Malacostraca	Amphipoda	18	3
		Isopoda	3	3
		Bathynellacea	7	2
	Copepoda	Cyclopoida	219	5
		Harpacticoida	60	2
	Ostracoda	Podocopida	14	2
			369	

Regional sites yielded a considerably higher number and diversity of animals than sites in the project area (Table 10, Appendix III). Approximately 74% of all stygal animals collected were from regional sites. Crustacean orders accounted for 94% of all taxa recorded, with cyclopoid and harpacticoid copepods (49%), amphipods (23%) and ostracods (17%) being the most abundant groups (Fig. 8). This composition is typical of Pilbara stygofauna assemblages (Eberhard *et al*. 2005).

Table 10: Overview of Higher Order Taxa Collected from All Sites.

Taxon			Total Individuals	Number of Sample Sites
Phylum	**Class**	**Order**		
Annelida	Oligochaeta	Haplotaxida	75	7
	Polychaeta	-	4	2
Crustacea	Malacostraca	Amphipoda	326	16
		Isopoda	67	8
		Bathynellacea	7	2
	Copepoda	Cyclopoida	511	15
		Harpacticoida	186	14
	Ostracoda	Podocopida	252	16
			1,428	

Results of the sorting and identification of specimens from project area sites are shown in Table 11. The stygofauna community of the project area comprised a possible 18 species, with all but six species also collected from reference sites. Due to the high number of specimens collected at reference sites in alluvial aquifers during regional sampling rounds, only reference collections of taxa also recorded in the project area are shown in Table 11. Complete regional sampling results are provided in Appendix X.

A number of collections were only able to be identified to higher taxonomic levels (Table 11); however, three of these are not considered to represent additional species. It is more likely that *Chilibathynella* sp., Enchytraeidae sp. and *Parastenocaris* sp. fit within taxa identified by the SFSP given the pattern of distribution of other species in these groups. Two other species, *Pygolabis* sp. and *Phreodrilus* sp., were represented only by incomplete specimens (damaged and/or female/juvenile), which prevented further taxonomic identification.

Within the project area, 157 of 369 specimens (43%) representing 13 potential species came from a single bore (HAWB002). Bore HAWB002 is a production bore that has been used for camp and drilling water supplies during exploration. It is constructed within fractured rocks of the Jeerinah Formation. The bore was equipped with a submersible pump during Round 1 and it was possible to obtain both pump and net samples (the pump was removed for sampling purposes). Approximately 3.8 bore volumes (1,125 L) were pumped from the bore before it was netted in Round 1, with only the pumped sample yielding stygofauna (*Chilibathynella* sp. and *Parastenocaris* sp.). The bore was sampled more intensively than others in Round 2 as it was the only site that returned stygofauna during the initial sampling round. For Round 2, the bore was netted both immediately before and the day after a short pumping test, when three bore-volumes (~960L) were extracted (air-lifted) and a pumped sample was collected (i.e. three samples were taken from HAWB002 in Round 2). All of the Round 2 samples from HAWB002 yielded stygofauna (8 taxa in total), with additional species recorded from each successive sample.

Table 11: Taxonomic Summary of Stygofauna Collected at the Project.

Order	Family	Taxon	n[1]	Impact	Reference[2]
				(Number of animals in parenthesis)	
AMPHIPODA					
Amphipoda	Melitidae	Melitidae sp. 1 (PSS)	2	HAWB002 (1) HAMB003 (1)	SLK 220-1 NW (2), SLK 220-2 NW (2)
Amphipoda	Melitidae	*Nedsia* nr *hurlberti* (DEC)	1	HAMB003 (1)	RHR-1 (see Biota 2009b)
Amphipoda	Paramelitidae	*'Maarka'* nr sp. *wolli* (ms)	1	HAMB003 (1)	*M.* sp. *wolli* ms. - Weeli Wolli Ck, Hope Downs 4, Texas Deposit (See Outback 2009)
Amphipoda	Paramelitidae	Paramelitidae sp. 2 (PSS).	14	HAMB001 (2) HAMB003 (11) HAWB002 (1)	Cheela Springs (4) Moonmar Well (65) See Pilbara Stygofauna Survey
COPEPODA					
Cyclopoida	Cyclopoidae	*Diacyclops humphreysi humphreysi*	55	HARC104 (1), HARC110 (3), HARC145 (1), HAWB002 (50)	Breakaway Well (40), Kazput Well (50), Moonmar Well (10), SLK 207.8 NW (30) SLK 220-1 NW (100), SLK 220-2 NW (5)
Cyclopoida	Cyclopoidae	*Diacyclops sobreprolatus*	150	HAMB003 (150)	Melon Hole (1)
Cyclopoida	Cyclopoidae	*Metacyclops pilbaricus*	13	HAMB001 (12) HARC108 (1)	KB3-6, RHN-2 (see Biota 2009b)
Cyclopoida	Cyclopidae	*Microcyclops varicans*	1	HARC262 (1)	Gobbo Well (5), Madang Well (10), Moonmar Well (20) SLK 220-2 NW (20)
Harpacticoida	Ameiridae	*Abnitocrella halsei*	1	HAWB003 (1)	SLK 220-1 NW (5)
Harpacticoida	Parastenocarididae	*Parastenocaris jane*	42	HARC097 (5), HAWB002 (37)	Mangang Well (1)
Harpacticoida	Parastenocarididae	*Parastenocaris sp.*	4	HAMB003 (2) HAWB002 (2)	Melon Hole (1) Sandy Creek Well (1)
Harpacticoida	Miraciidae	*Schizopera roberiverensis*	13	HAMB003 (12) HAWB002 (1)	Breakaway Well (10), Gobbo Well (1), Kazput Well (1), Madang Well (32), Moonmar Well (5), SLK 200-2 NW (10)
ISOPODA					
Isopoda	Tainisopidae	*Pygolabis sp.*	3	HARC203 (1), HARC262 (1), HAWB002 (1)	-
OLIGOCHAETA					
Haplotaxida	Enchytraeidae	Enchytraeidae sp.	1	HARC110 (1)	-
Haplotaxida	Enchytraeidae	*Enchytraeus pilbara sp. 1*	40	HARC218 (3) HARC220 (1), HAWB002 (36)	Breakaway Well (1), Kazput Well (2), Rocklea Camp Bore (1)
Haplotaxida	Phreodrilidae	*Phreodrilus sp.*	4	HAWB002 (4)	-
OSTRACODA					
Podocopida	Cyprididae	*Candonocypris? fitzroyi*	10	HAWB002 (10)	Madang Well (1), Old Mill (1), Sandy Creek Well (30)
Podocopida	Limnocytheridae	*Gomphodella hirsuta*	2	HAWB002 (2)	API West (1), Kazput Well (1), Rocklea 1 (1), SLK 220-1 NW (1), SLK 220-2 NW (10)
Podocopida	Limnocytheridae	*Gomphodella sp. BOS 186 (cf. yandi)*	2	HARC262 (2)	Cheela Springs (5)
SYNCARIDA					
Bathynellacea	Parabathynellidae	*Chilibathynella sp.*	4	HAWB002 (4)	-
Bathynellacea	Parabathynellidae	*Chilibathynella sp. B3*	3	HAWB002 (3)	CW1 (see Biota 2009b)
		TOTAL	**369**		

[1] Number collected in project area sites only.

[2] Only reference collections of taxa recorded in the project area are listed (see Appendix I for full listing of species from reference sites).

HAWB003, also screened in the Jeerinah Formation, yielded high numbers of stygofauna (179 or 48% of the total 369 animals; representing 8 species). These results support the finding from HAWB002 and confirm the suitability of the Jeerinah Formation as a favourable habitat for stygofauna in the region. Aquifers of the Brockman Iron, Marra Mamba Iron, Mt McRae Shale and Mt Silvia Formations also returned stygofauna records in the project area (Tables 11 and 12).

Table 12: List of Sites and Aquifers that Yielded Stygofauna at Hardey Deposit

Bore/Hole Name	Stratigraphy of screened/saturated section
HARC145	Mineralised Dales Gorge Member of Brockman Formation
HARC146	Mineralised Dales Gorge Member of Brockman Formation
HARC171	Mineralised Dales Gorge Member of Brockman Formation
HARC203	Mineralised Dales Gorge Member of Brockman Formation
HARC204	Mineralised Dales Gorge Member of Brockman Formation
HARC205	Mineralised Dales Gorge Member of Brockman Formation
HARC216	Mineralised Dales Gorge Member of Brockman Formation
HARC220	Unmineralised Dales Gorge Member of Brockman Formation
HARC262	Unmineralised Dales Gorge Member of Brockman Formation
HARC110	Unmineralised DGM of Brockman FM overlying Mt McRae Shale
HAMB003	Jeerinah Formation
HAWB002	Jeerinah Formation
HAMB001	Mineralised Marra Mamba Formation
HARC097	Unmineralised Marra Mamba Formation
HARC104	Unmineralised Marra Mamba Formation
HARC229	Paraburdoo Member of Wittenoom Formation
HARC108	Mt McRae Shale

Regional sampling results have demonstrated that the majority of species recorded in the project area also occur beyond the impact zone (Figure 7). Twelve of the species were recorded from reference sites ranging from 20 km northeast (Madang Well) to 52 km east-southeast (Rocklea 1) and 45 km west of the deposit (Cheela Springs).

The physico-chemical groundwater data collected at each site are presented together with the details of sampled bores in Appendix III, IV, V and VII (Rounds 1, 2, 3 and 5). The groundwater salinities of bores within the project area were generally in the range 510 to 1,345 mg/L TDS (total dissolved solids); the exception being HARC097, which recorded a salinity of 3,740 mg/L TDS in Round 1. Field pH values were slightly acidic to neutral, ranging from 6.25 to 7.70.

6.2 TROGLOFAUNA

The locations of sites sampled for troglofauna are shown in Figures 4 and 5. Site details and trap depth settings for each round are outlined in Appendices II, III, V, VI and VII.

Seventy two (72) sites were sampled for troglofauna within the project area between January 2010 and June 2011, using a combination of net-scraping and trapping. Results of troglofauna sampling at Hardey are presented in Figures 9 and 10.

Eighty five (85) troglofaunal animals were collected during the survey, representing twelve orders (Table 13). The fauna were dominated by pauropods (*Pauropodidae* sp. B19) recovered from two sites, HARC005 (39 animals) and HARC248 (9 animals). Several other groups were represented in lower numbers including centipedes (Schendylidae and Cryptopidae), bristletails (Japygidae), isopods (Troglarmadillo) and the insect groups Nocticolidae (cockroaches), Carabidae (beetles), Meenoplidae (bugs) and Nicoletiidae (silverfish).

Troglofauna sampling within the two proposed pits yielded a total of 15 animals, representing six species (Table 13). In addition, a troglomorphic centipede (2 animals) was collected as by-catch from an impact site during stygofauna sampling. Reference sites yielded nine species including two that were collected as stygofauna by-catch.

Two centipedes were collected from impact sites. A small fragment of a centipede (Family Schendylidae) was collected from the northwestern edge of the Brockman Deposit (Fig. 9). The order Geophilomorpha are generally all blind; however, subterranean species can be distinguished by a lack of pigmentation. The poor condition of this specimen limited its identification to family level. A juvenile centipede (Cryptopidae) was recorded from impact site HARC132. Comparison of the specimen with material collected from a reference site confirmed it to be the same taxon, *Cryptops* sp.; however, the mature specimen was missing telopodites and could not be identified further.

Fragments of bristletails (Japygidae) were collected from two sites on the western margin of the Brockman Deposit. Both collections were missing rear segments and cerci and, therefore, only able to be identified to family level.

Palpigrades were collected from two sites in the Marra Mamba Deposit with an additional collection from a reference site in Brockman Formation to the west of the project area (Fig. 10). All animals were identified as the same species, Palpigrada sp. B5.

Site HARC137, at the centre of the Brockman Pit, yielded several specimens of the isopod *Troglarmadillo* sp. B24. Four animals were recorded from trap samples, in addition to the four recovered from an earlier stygofauna sample at the site.

Troglomorphic specimens from four insect orders were recovered from nine sites; however, none of these taxa were restricted to the impact zone. A nocticolid cockroach (*Nocticola* sp. B13) was collected from a trap sample at reference site HARC108. Juvenile nocticolid

specimens with reduced eyes were also recovered from stygofauna samples at this site (Table 13); however, they are considered unlikely to represent additional species.

Table 13: Results of Troglofauna Sampling.

Order	Family	Taxon	n	Project Area Site	Reference Site
ARACHNIDA					
Araneae	Gnaphosidae	nr. *Encoptarthria* sp.	0	-	RKR189 (1)
Palpigradida	-	Palpigradida sp. B5	2	HARC091 (1), HARC119 (1)	RKR198 (1)
CHILOPODA					
Geophilomorpha	Schendylidae	Schendylidae sp.	1	HARC205 (1)	-
Scolopendromorpha	Cryptopidae	*Cryptops* sp.	2	HARC132# (2)	RKR187 (1)
DIPLOPODA					
Polyxenida	Polyxenidae	Polyxenida sp. S1	0	-	RKR177 (1)
ENTOGNATHA					
Diplura	Japygidae	Japygidae sp.	2	HARC146 (1), HARC233 (1)	-
INSECTA					
Blattodea	Nocticolidae	*Nocticola* sp. B13	0	-	HARC108 (1)
Blattodea	Nocticolidae	*Nocticola* sp.	0	-	HARC108# (1), RKR156 (2), RKR164 (2)
Coleoptera	Carabidae	Carabidae sp.	0	-	SLK 207.8 NW# (1)
Hemiptera	Meenoplidae	Meenoplidae sp. B4	1	HARC204 (1)	RKR187(8), RKR189 (1)
Thysanura	Nicoletiidae	Hemitrinemura sp. B5	0	-	RKR103 (1)
ISOPODA					
Isopoda	Armadillidae	*Troglarmadillo* sp.B24	8	HARC137# (8)	-
PAUROPODA					
Pauropodina	Pauropodidae	Pauropodidae sp. B19	9	HARC248 (9)	HARC005 (39)
		TOTAL	**25**		

Recorded as stygofauna by-catch

A troglomorphic carabid beetle (fragment) was recovered from a stygofauna sample at reference site SLK207.8NW on the Hardey River to the south of the project area. Other insect groups, including bugs (Meenoplidae sp. B4) and silverfish (*Hemitrinemura* sp. B5), were collected in low numbers.

The majority of species were collected in very low abundance. Of six potentially troglobitic species recorded in troglofauna samples, two were collected as singletons (i.e. taxa represented by collections from a single location/sample) and another two as doubletons (Table 13). Singleton and doubleton records provide little information about species distributions.

The overall capture rate (combined impact and reference samples) for troglofauna sampling was 0.44 animals per sample (Table 14). Troglofauna capture rates are normally in the range of 0.20 - 0.25 animals per sample in the Pilbara (Subterranean Ecology 2007), with values of up to 1.43 (Bennelongia, 2010b) recorded by previous studies. Reference samples yielded higher numbers of troglomorphic specimens than impact samples, although high numbers of pauropods (39 animals) from one reference sample accounted for over half of all troglofauna collected by scrape and trap sampling.

Table 14 : Summary Statistics for Troglofauna Sampling.

	Impact	Reference	Total/Combined
No. of samples (adjusted) [1]	54.5	115	169.5
Total specimens	19	58	74
No. of troglofauna specimens per sample (capture rate)	0.35	0.50	0.44
No. of troglofauna species	5	8	10
No. of troglofauna species per sample	0.09	0.07	0.06

[1] As outlined in Section 5.3

Troglofauna sampling using the scraping method returned a greater number of animals (0.42 animals per sample) than from traps (0.05 animals per trap; Table 15). Scrape samples yielded higher numbers than trap samples in two of the three rounds where both were undertaken. Capture rates ranged from 0-3 animals per scrape compared with 0-0.07 animals per trap across all sampling rounds (Table 15). Troglofaunal specimens collected as stygofauna by-catch are not included in the summary statistics or sampling efficiency calculations (Tables 14 and 15 respectively).

Table 15: Comparison of Scraping and Trapping Capture Rates.

	Round 1		Round 3		Round 4	Round 5	Round 6		Round 7
Site Type	Scrape	Trap	Scrape	Trap	Scrape	Scrape	Scrape	Trap	Scrape
Impact	0 (9)	0.17 (24)	0.47 (32)	0 (46)	0 (10)	-	-	-	-
Reference	0 (7)	0.07 (14)	3.00 (13)	0 (6)	-	0 (26)	0.42 (36)	0.04 (55)	0.03 (33)

(number of scrapes/traps shown in parenthesis)
Note: Capture rate is per scrape/trap

Stratigraphic interpretations for the top 30 m of each hole that returned a positive troglofauna result in the project area are shown in Table 16. The data suggest that the Brockman Iron Formation provides the most favourable troglofauna habitat, with eight of the eleven sites logged as being within this formation. Stratigraphic interpretations for these sites indicate that the same formations extend to greater depths and so there is unlikely to be different or unique habitat at depths beyond the upper zone (i.e. deeper than 30 m).

Table 16: Stratigraphy within the Upper 30 m at Sites Yielding Troglofauna in the Project Area

Hole ID	Geology and Formation
HARC005	Mineralised Dales Gorge Member of Brockman Formation
HARC091	Mineralised Dales Gorge Member of Brockman Formation
HARC108	Mt McRae Shale
HARC119	Hard Cap overlying unmineralised Marra Mamba FM
HARC132	Mineralised Dales Gorge Member of Brockman Formation
HARC137	Alluvial material overlying unmineralised Brockman FM
HARC146	Mineralised Dales Gorge Member of Brockman Formation
HARC204	Mineralised Dales Gorge Member of Brockman Formation
HARC205	Mineralised Dales Gorge Member of Brockman Formation
HARC233	Hard Cap overlying unmineralised Brockman Formation
HARC248	Alluvial material overlying Bee Gorge Member of Wittenoom Formation

Regional geological mapping shows that four additional collections from reference sites to the east of the project occur in Brockman Iron Formation; however, detailed geological information for these reference sites was not available to interpret specific lithologies.

7 DISCUSSION

7.1 STYGOFAUNA

Sampling of stygofauna for the SFSP recorded 40 potential stygofauna species, with 18 of these identified from sites in the project area (impact sites). For the purposes of stygofauna impact assessment, all bores sampled in the project area may potentially be impacted by drawdown of groundwater levels associated with pumping for dewatering of the orebody and/or the project water supply.

Many of the species recorded have been collected by previous stygofauna surveys in the Pilbara (e.g. Bennelongia 2007a, b, Biota 2008b, 2009b and Pilbara Biodiversity Study *in prep*) and are known to have widespread distributions. Regional sampling, commissioned by API, has demonstrated that 12 of 18 species recorded within the predicted groundwater drawdown area also occur outside it. Three of the remaining six species (*Nedsia* nr *hurlberti*, *Metacyclops pilbaricus* and *Chilibathynella* sp. B3) have been recorded by previous studies (Table 6) and two others (*Pygolabis* sp. and *Phreodrilus* sp.) were represented by incomplete collections (damaged and/or female/juvenile specimens only), which prevented further taxonomic identification.

Pygolabis is a large and widespread genus. The taxon recorded at the project area is likely to be *Pygolabis eberhardi,* a widespread species recorded during regional sampling at three sites along the Hardey River and two pastoral wells.

Phreodrilids are known from both groundwater and surface water in the Pilbara. Of seven Phreodrilidae known from the Pilbara region of Western Australia, three are known from groundwater only and two are known from both groundwater and surface water (Pinder 2008). The wide distribution of some phreodrilid species in the Pilbara and the high number of immature specimens that remain undescribed from previous studies suggest that the group is likely to be far more common than current records indicate.

The remaining species, a paramelitid amphipod of the genus '*Maarka',* was only recorded from bore HAMB003 in the project area. The genus '*Maarka'* contains two species; one collected previously from Ethel Gorge and the other from Weeli Wolli Creek, in the central Hamersley Range (Pilbara Biodiversity Study *in prep*.). A record of '*Maarka'* nr sp. *wolli* ms at the project area represents either a significant range extension or a potential new species; however, the latter is considered more likely (*pers. comm.* J McRae, Bennelongia, 14 July 2011). Further taxonomic separation of these taxa would require DNA analysis, given the morphological similarities.

'Maarka' nr sp. *wolli* ms has also been collected from three sites (two reference, one impact) within the Hope Downs 4 study area (Outback Ecology Services 2009) in addition to the Weeli Wolli Creek collection, indicating a range of at least 45 km for the species. At Hope Downs, it was collected from bores screened within the alluvial aquifers and Tertiary calcretes in the broader Marillana Creek area. The project is approximately 250 km west-northwest of Hope Downs.

Like the majority of animals collected in the project area, '*Maarka'* nr sp. *wolli* ms was recorded from bores located adjacent to a tributary of the Hardey River and screened within aquifers of the Jeerinah Formation, which forms part of the extensive Fortescue Group. Lithological logs from these bores show large sections of fractured, broken chert and dolerite overlain at the surface by a thin (2 m or less) calcrete layer. The Jeerinah Formation can be traced throughout the Hardey Syncline, in narrow bands dipping to the west. All species collected from bores screened within this aquifer, with the exception of *'Maarka'* nr sp. *wolli* ms, were also found in reference sites over a range of up to 78 km.

A singleton record of '*Maarka'* nr sp. *wolli* ms at the project provides little information regarding its distribution. Like most other Amphipoda recorded by the SFSP, '*Maarka'* nr sp. *wolli* ms is expected to be present in low abundance within the project area stygofauna community and also within the alluvial aquifers of the Hardey River catchment.

Patterns of distribution for the three other amphipod species recorded at the project indicate that none is restricted to a single aquifer or to the project area itself. During regional sampling for the project, Melitidae sp. 1 (PSS) and Paramelitidae sp. 2 (PSS) were recorded at sites along the Hardey River, a pastoral well 35 km to the southeast of the deposit and from the Duck Creek Dolomite at Cheela Springs (approximately 45 km to the west). Both species

have also been recorded by previous studies (e.g. Outback Ecology 2009, Pilbara Biodiversity Study *in prep*.). The third species, *Nedsia* nr *hurlberti,* was recorded at a reference site (Red Hill) sampled for API's West Pilbara Iron Ore Project Stage 1 (WPIOP Stage 1), approximately 180 km northwest of the project.

The only syncarid recorded at the project was also found from a bore screened in the Jeerinah aquifer. *Chilibathynella* sp. B3 has previously been recorded at Catho Well, approximately 130 km northwest of the project area (Biota 2009b), and so it is not restricted to the project area.

Results of regional sampling from this study suggest that alluvial aquifers in the region are considerably more diverse than the fractured rock aquifers sampled within the project area. The higher frequency and diversity of stygofauna at reference sites may be explained by the wider range of geology/aquifers sampled, which included bores screened in unconsolidated sedimentary aquifers (alluvium and colluvium) along the Hardey and Beasley rivers and further west in springs of the Duck Creek Dolomite (Cheela Springs).

Groundwater investigations at the project (Rockwater 2010b, 2010c) indicate that recharge of aquifers in the project area is via infiltration of seepage from the Hardey River and direct infiltration of rainfall. Connectivity of aquifers in the project area with regional aquifers through recharge provides a conduit for the wider distribution of stygofauna recorded at the project.

The SFSP survey has shown that none of the stygofauna species recorded is likely to be restricted to the project area. Therefore, from an impact assessment perspective, development of the project is unlikely to affect the stygofauna conservation values identified by the survey.

7.2 TROGLOFAUNA

Twelve potential troglomorphic taxa were recorded by the SFSP at the project, of which seven were also found to occur at impact sites.

Four species recorded in the project area, Palpigrada sp. B5, *Cryptops* sp., Meenoplidae sp. B4 and Pauropodidae sp. B19, were also recorded from reference sites or have previously been recorded in the Pilbara. Two others, Japygidae sp. and Schendylidae sp., were represented by immature or incomplete specimens that displayed troglomorphic characteristics and possibly represent troglobitic species but cannot be identified further.

The two Japygidae collections from impact sites at the project were fragments only and could not be fully identified. A japygid dipluran, *Indjapyx* sp. A, was identified from 15 sites across six study areas for the WPIOP Stage 1 (Biota 2010). The nearest of the areas (Catho Well) is 130 km northwest of the project.

The isopod *Troglarmadillo* sp. B24 is currently known only from the project area. This species was represented by eight specimens collected from a single hole (two samples) in the centre of the Brockman Deposit. Troglomorphic forms of this genus have previously been recorded in the Pilbara (e.g. Bennelongia 2007b, Subterranean Ecology 2010). The taxon, *Troglarmadillo* sp. B3, was collected near Newman (Bennelongia, 2008c) and shown to occur over a range of approximately 150 km; however, other species have demonstrated more restricted distribution ranges. Given the geographical separation of the project in respect to other collections and the documented distributions of many troglobitic isopods, it is likely that *Troglarmadillo* sp. B24 represents a new species. This taxon is likely to occur at low abundance throughout the BIF habitat of the Hardey Syncline, as the pattern of occurrence of other troglobitic species recorded by the survey was mostly one of low abundance, but wider-ranging than the project itself. Furthermore, there is evidence of suitable troglofauna habitat in areas surrounding the proposed mine pits.

Palpigrades are tiny arachnids which generally occur in soil, leaf litter, caves and semi-aquatic interstitial environments. Troglobitic palpigrades have been collected in many surveys in the Pilbara (Bennelongia 2008a, b, 2009a, 2010a, b, SMEC 2009, Subterranean Ecology 2010). There is very little information on the ecology and distribution of palpigrades in Western Australia and it is unclear (without extensive taxonomic work) if the project specimens fit within any of the previously described groups; however, it is likely they represent a new species. The project is unlikely to have an impact on the conservation status of this species as additional collections were made at reference sites beyond the proposed pits.

The Brockman Iron Formation appears to provide the most favourable habitat for troglofauna, with the Marra Mamba Iron Formation yielding considerably less troglofauna. Unlike the pisolite/CID habitats studied in other parts of the Pilbara (e.g. Biota 2010), the BIF geology at the project is not considered to be core troglofauna habitat. There are limited previous troglofauna surveys undertaken within the Marra Mamba Iron Formation; however, the present study confirms that fractured BIF in this unit contains suitable habitat for troglofauna. A survey of the Marra Mamba Iron Formation north of Newman (SMEC 2009) yielded no troglobitic fauna.

The regional troglofauna results confirm that there is suitable habitat for troglofauna to the west of the project, where similar geological formations extend within the Hardey Syncline. Regional sites have returned a higher abundance and diversity of troglofauna than impact sites at the project area and it is unlikely that the troglofauna community of the broader Hardey Syncline is fully documented. However, sufficient data have been collected in line with relevant guidelines (EPA 2007) to outline the general taxonomic structure and diversity of the project area troglofauna community.

Regional geological mapping shows that the geological units that yielded troglofauna at the project are abundant in other parts of the Hardey Syncline (see Section 6.2). The overlap in species between the project sites and reference sites (four species in common) suggests that the habitats are similar and the troglobitic fauna present at the project area will be distributed more widely where suitable BIF habitat exists in other parts of the syncline. Troglofauna species distribution can be related to the distribution of geological formations (with reference to geological time-scales) in which they occur (Biota 2006). In relation to the two primary habitats at the project (Brockman Formation and Marra Mamba Iron Formation), the risk of small-scale species distributions is unlikely given the regional extent of these formations. The Brockman and Marra Mamba Deposits at the project form the start of a sequence of connected hills that extend west and northwest within the Hardey Syncline. Results of the present study confirm that continuous habitat exists within the Brockman Formation and other formations in adjacent parts of the syncline to the west of the project.

8 CONCLUSIONS

A comprehensive sampling programme in line with relevant guidelines was undertaken to characterise subterranean fauna in the project area. The survey results suggest that development of the project is unlikely to affect the biodiversity of troglofauna or stygofauna recorded.

A total of 18 potential stygofauna species were identified at the project from six Orders including Amphipoda, Copepoda, Oligochaeta, Ostracoda, Isopoda and Bathynellacea. The only stygofauna species not confirmed to occur beyond the project area, '*Maarka'* nr sp. *wolli* ms, is likely to represent a new species. Based on the distribution of other amphipods found by this survey and the regional extent of the aquifers that represent their habitat, the likelihood of this species being restricted to the project area is considered to be low.

Troglofauna sampling indicates that the project area troglofauna community is moderately diverse and typical of BIF habitats encountered by other studies in the Pilbara region. Thirteen species were recorded, including spiders, centipedes, millipedes, bristletails, cockroaches, beetles, silverfish, bugs, isopods and pauropods. Results of the survey confirm that at least four of seven taxa identified within the impact area also occur at reference sites beyond the planned proposed mine pits. The deposits at the project form part of an interconnected series of BIF hills that span the Hardey Syncline. The presence of similar species and geological units at reference sites in adjacent parts of the Hardey Syncline suggests that there is continuity of troglofauna habitat beyond the project area.

Implementation of the mining proposal will result in direct loss of subterranean fauna habitat associated with the two mine pits. In addition, dewatering of the Brockman Deposit to maintain dry mining conditions will result in a reduction of groundwater levels around the

project area that will further reduce the available stygofauna habitat. Results of the SFSP and subsequent impact assessment suggest that the impact to subterranean fauna values of the project area from implementation of the mining proposal is likely to be low.

Dated: 29 July 2011 **Rockwater Pty Ltd**

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Environmental Scientist

Nick Evelegh
Principal Environmental Scientist

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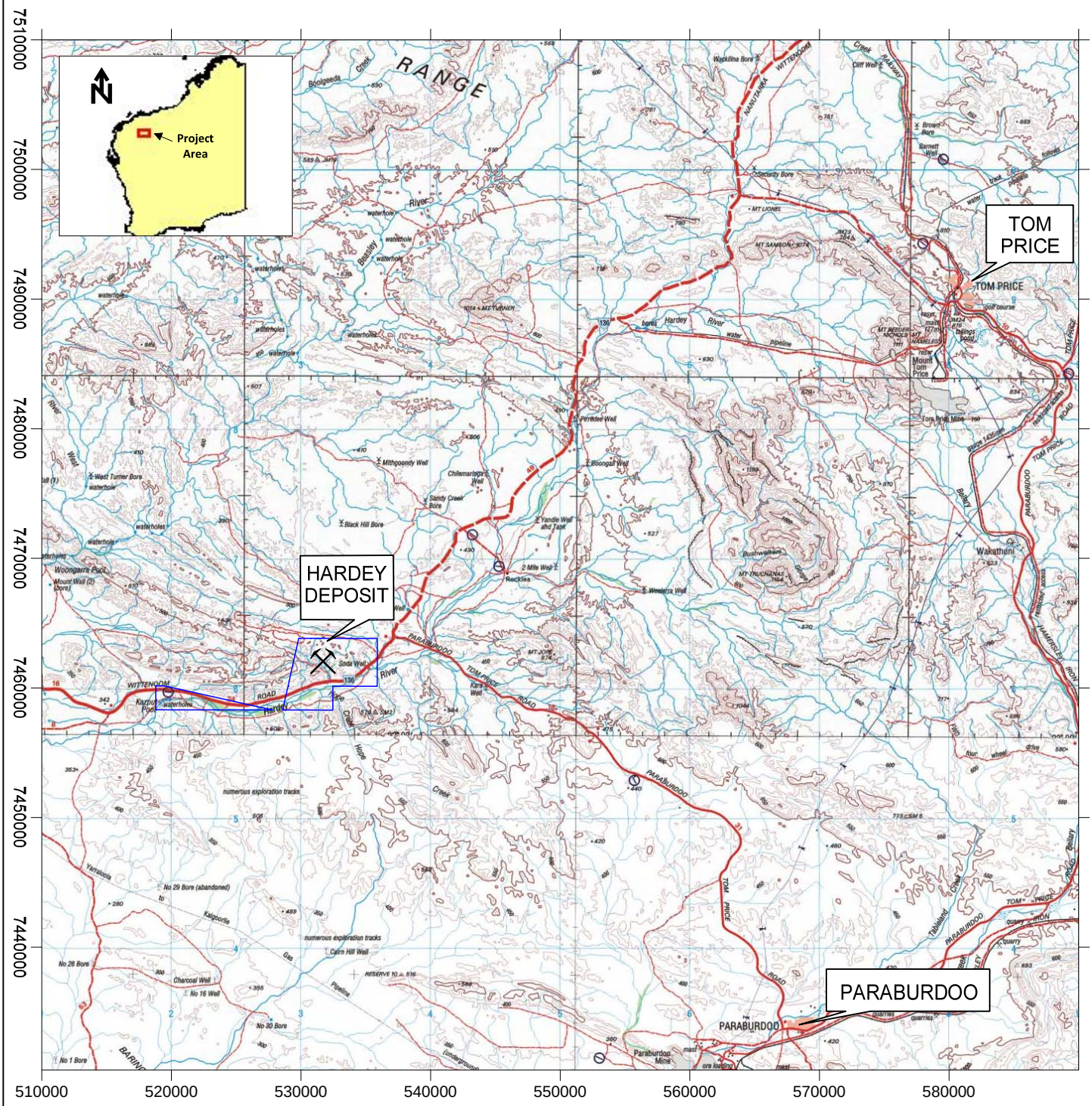
FIGURES

Figure 1



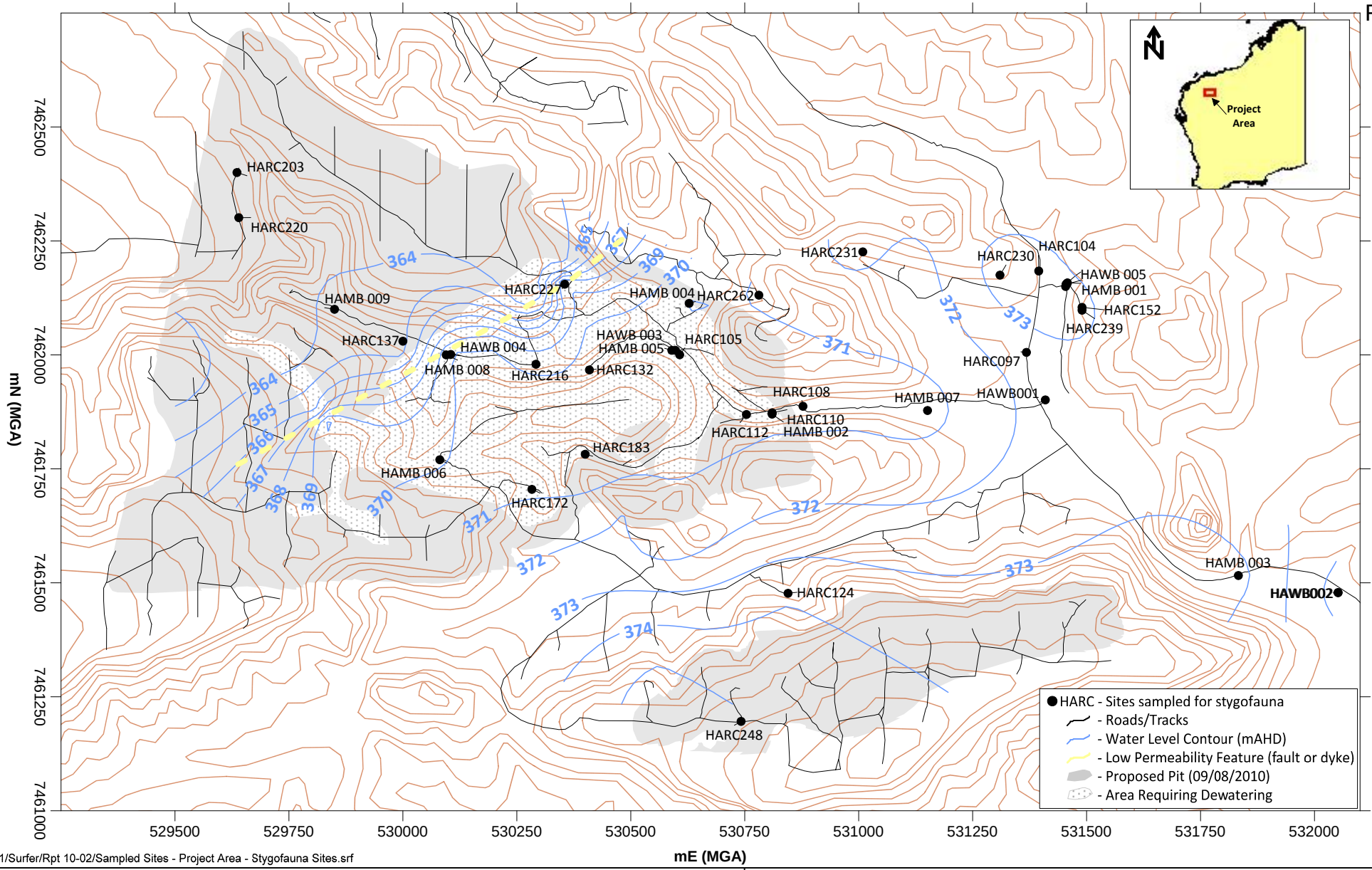
361-1/Surfer/Rpt 11-01/Fig 1 - Location Plan.srf

CLIENT:	API Management
PROJECT:	Hardey Deposit Subterranean Fauna Sampling
DATE:	July 2011
Dwg. No:	371-1/11/1-1

HARDEY DEPOSIT
LOCALITY MAP

Rockwater

Figure 2



371-1/Surfer/Rpt 10-02/Sampled Sites - Project Area - Stygofauna Sites.srf

CLIENT:	API Management Pty Ltd
PROJECT:	Hardey Deposit Subterranean Fauna Sampling
DATE:	July 2011
Dwg. No:	371-1/11/1-2

HARDEY DEPOSIT
STYGOFAUNA SAMPLING LOCATIONS

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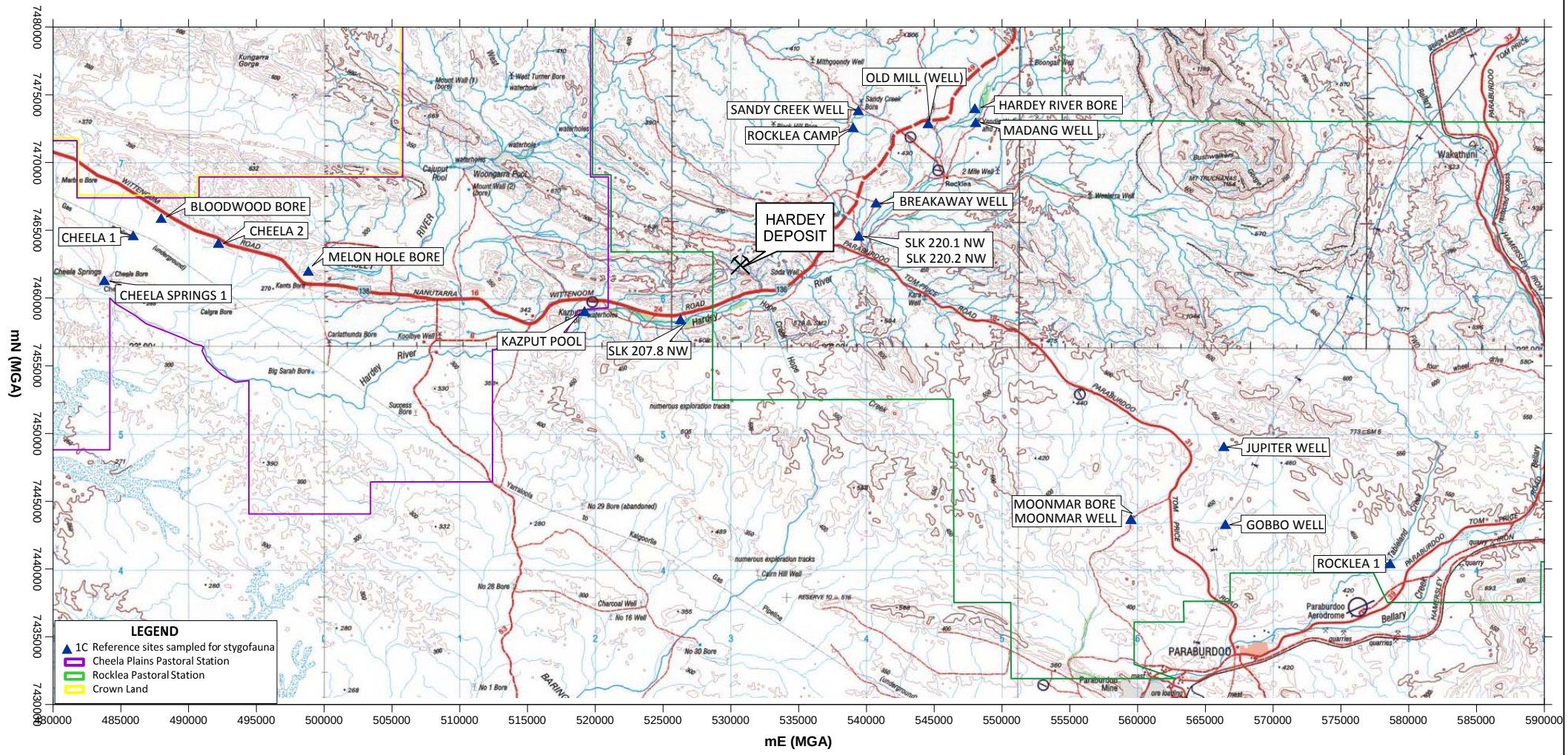
Figure 3



371-1/Surfer/Rpt 11-01 Fig 3 - Sampled Sites - Regional.srf

CLIENT:	API Management Pty Ltd
PROJECT:	Hardey Deopsit Subterranean Fauna Sampling
DATE:	July 2011
Dwg. No:	371-0/11/1-3

HARDEY DEPOSIT
REGIONAL STYGOFAUNA SAMPLING LOCATIONS

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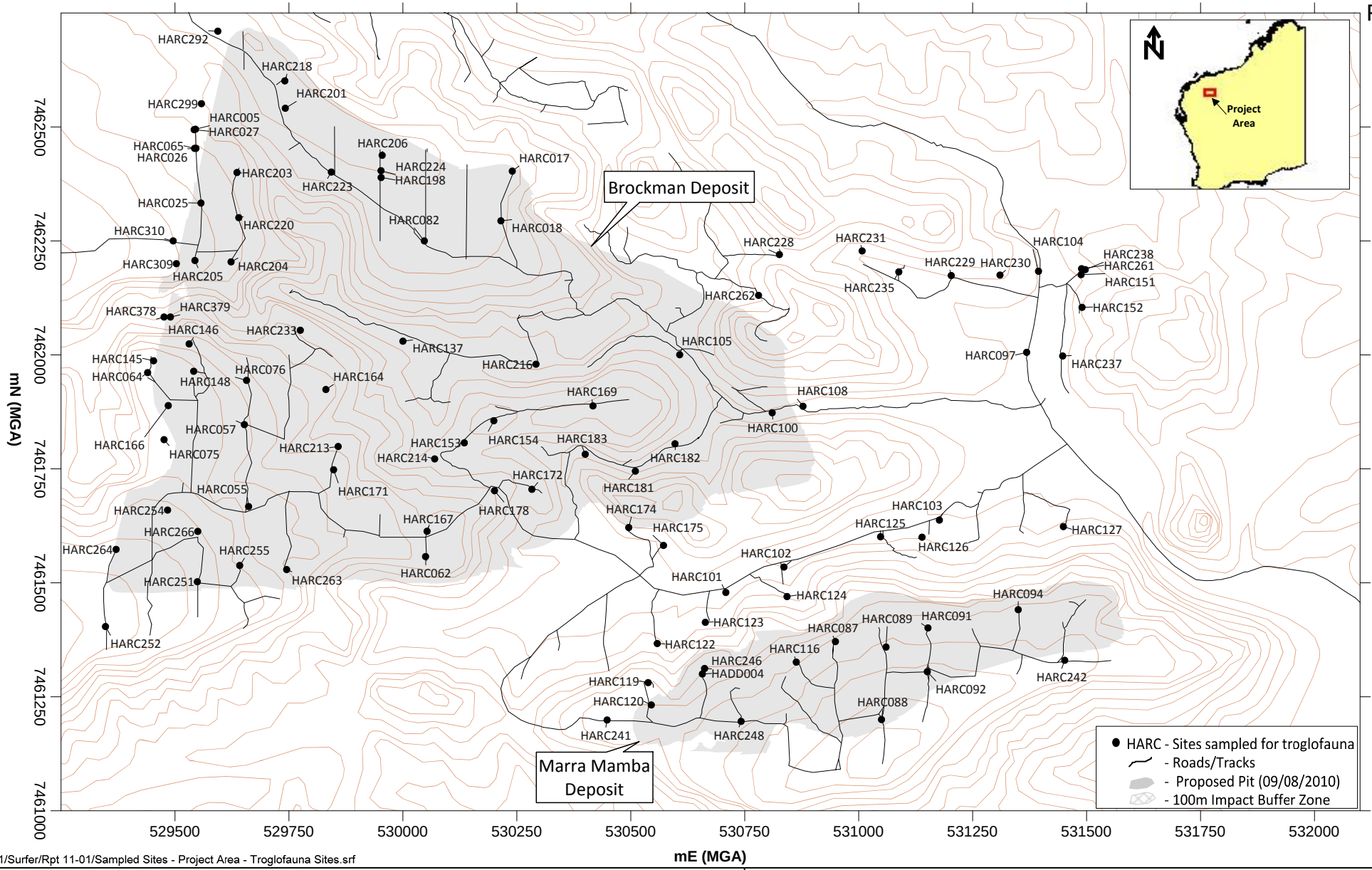
Figure 4



371-1/Surfer/Rpt 11-01/Sampled Sites - Project Area - Troglofauna Sites.srf

CLIENT:	API Management Pty Ltd
PROJECT:	Hardey Deposit Subterranean Fauna Sampling
DATE:	July 2011
Dwg. No:	371-1/11/1-4

HARDEY DEPOSIT
TROGLOFAUNA SAMPLING LOCATIONS

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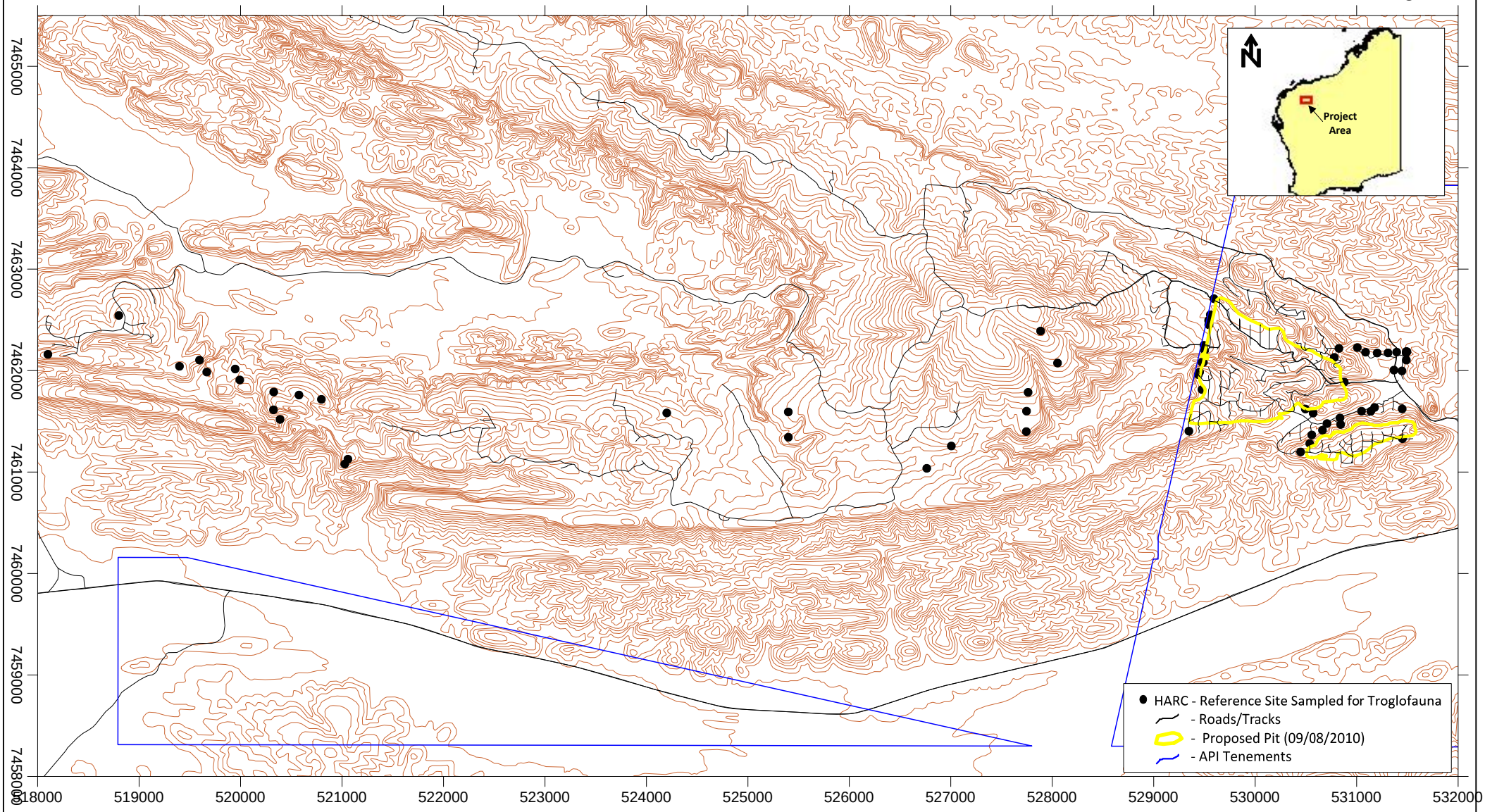
Figure 5



371-1/Surfer/Rpt 11-01/Fig 5 - Trog Sampled Sites - Reference.srf

CLIENT:	API Management Pty Ltd
PROJECT:	Hardey Deposit Subterranean Fauna Sampling
DATE:	July 2011
Dwg. No:	371-1/11/1-5

HARDEY DEPOSIT TROGLOFAUNA REFERENCE SITE LOCATIONS

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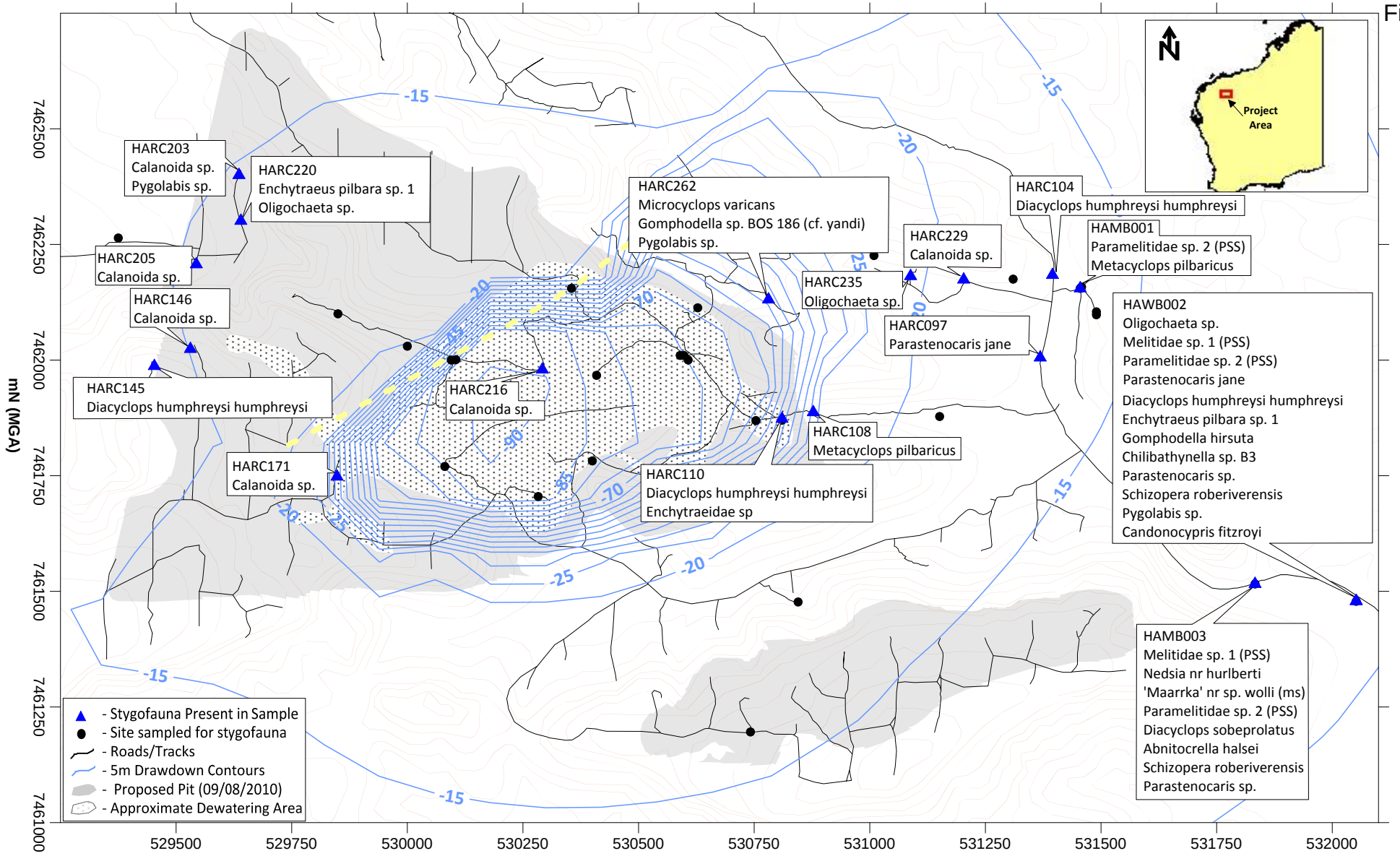
Figure 6



371-1/Surfer/Rpt 11-01/Fig 6 - Stygofauna Results.srf

CLIENT:	API Management Pty Ltd
PROJECT:	Hardey Deposit Subterranean Fauna Sampling
DATE:	July 2011
Dwg. No:	371-1/11/1-6

HARDEY DEPOSIT
STYGOFAUNA SAMPLING RESULTS
WITH 5m MODELLED DRAWDOWN CONTOURS

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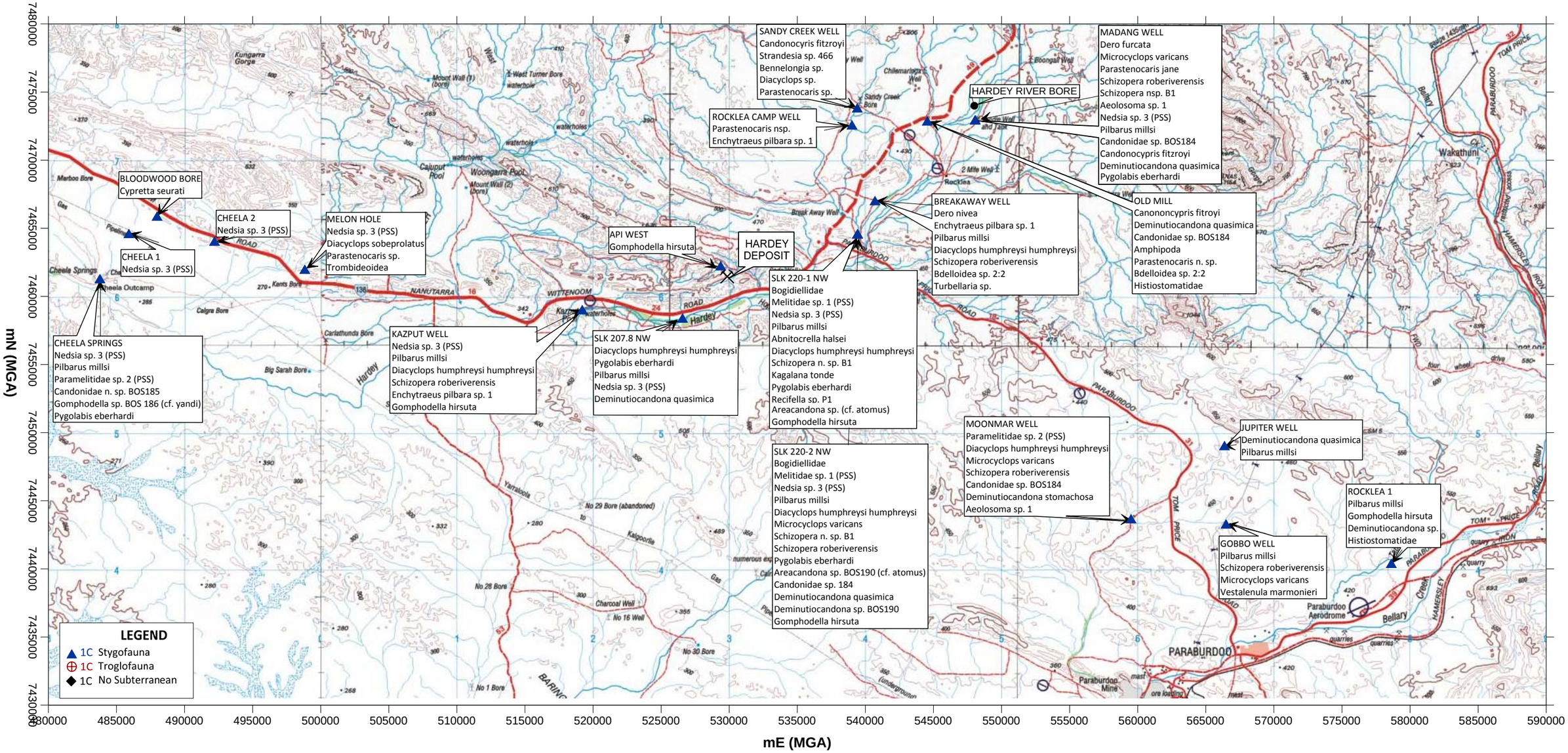
Figure 7



371-1/Surfer/Rpt 11-01/Fig 7 - Results - All Regional.srf

CLIENT:	API Management Pty Ltd
PROJECT:	Hardey Deposit Subterranean Fauna Sampling
DATE:	July 2011
Dwg. No:	371-1/11/1-7

HARDEY DEPOSIT
SUBTERRANEAN FAUNA
STYGOFAUNA RESULTS - REFERENCE SITES

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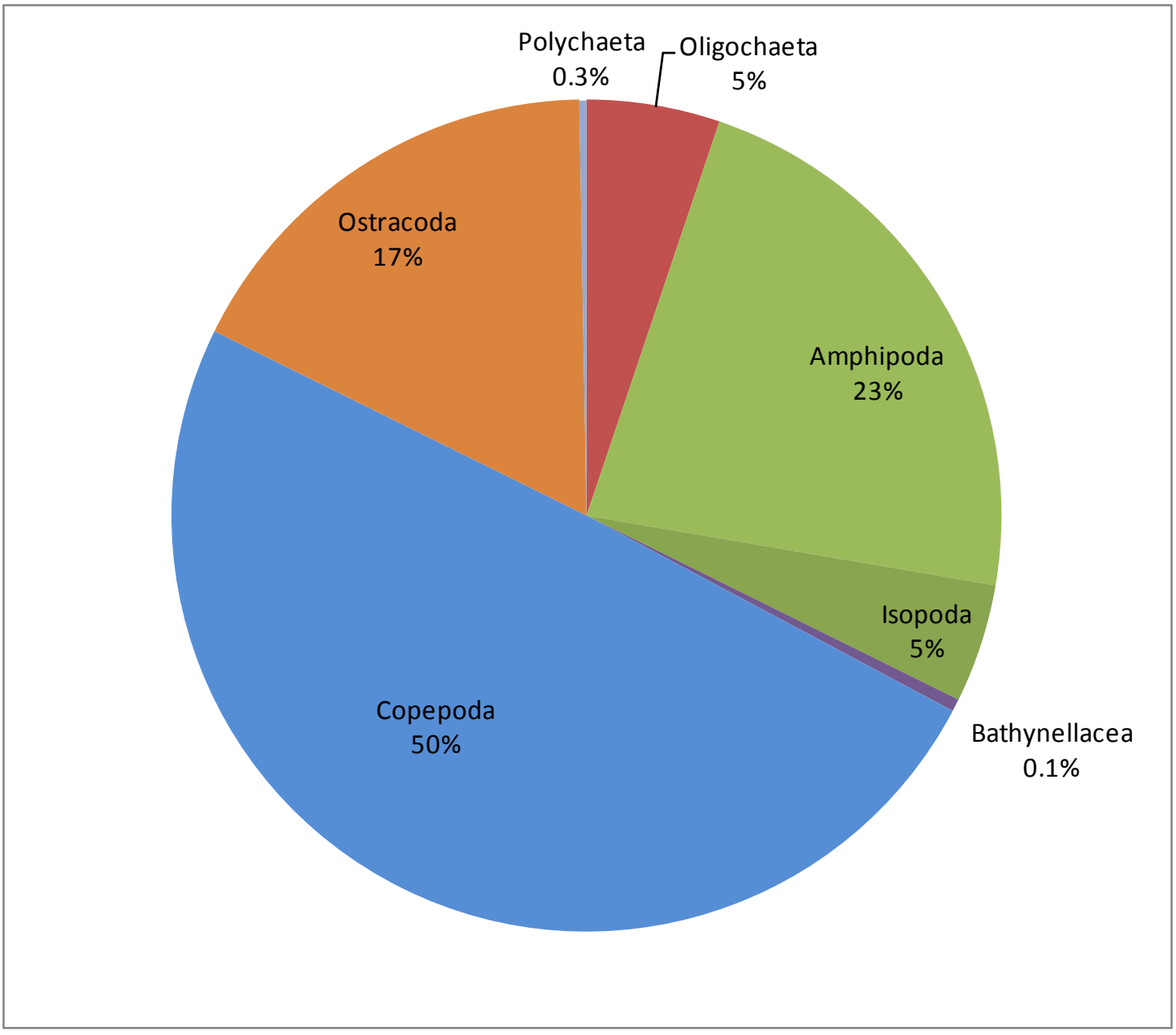
Figure 8



371-1/Surfer/Rpt 11-01/Fig 8 - Species Proportion.srf

CLIENT:	API Management
PROJECT:	Hardey Deposit Subterranean Fauna Sampling
DATE:	July 2011
Dwg. No:	371-1/11/1-8

REPRESENTATION OF HIGHER ORDER STYGAL GROUPS AS A PROPORTION OF ALL STYGOFAUNA RECORDED

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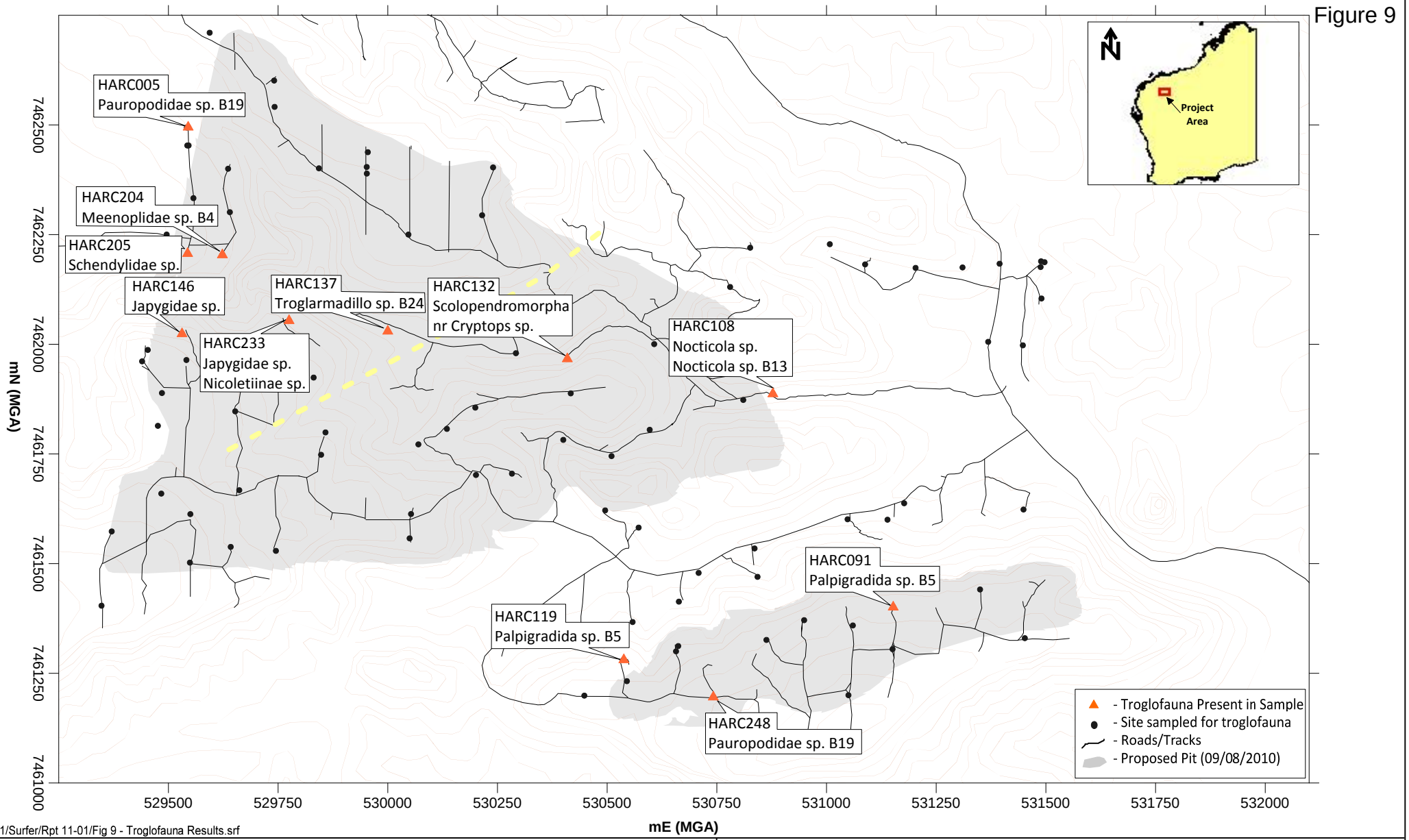
Figure 9



371-1/Surfer/Rpt 11-01/Fig 9 - Troglofauna Results.srf

CLIENT:	API Management Pty Ltd
PROJECT:	Hardey Deposit Subterranean Fauna Sampling
DATE:	July 2011
Dwg. No:	371-1/11/1-9

HARDEY DEPOSIT
TROGLOFAUNA SAMPLING RESULTS

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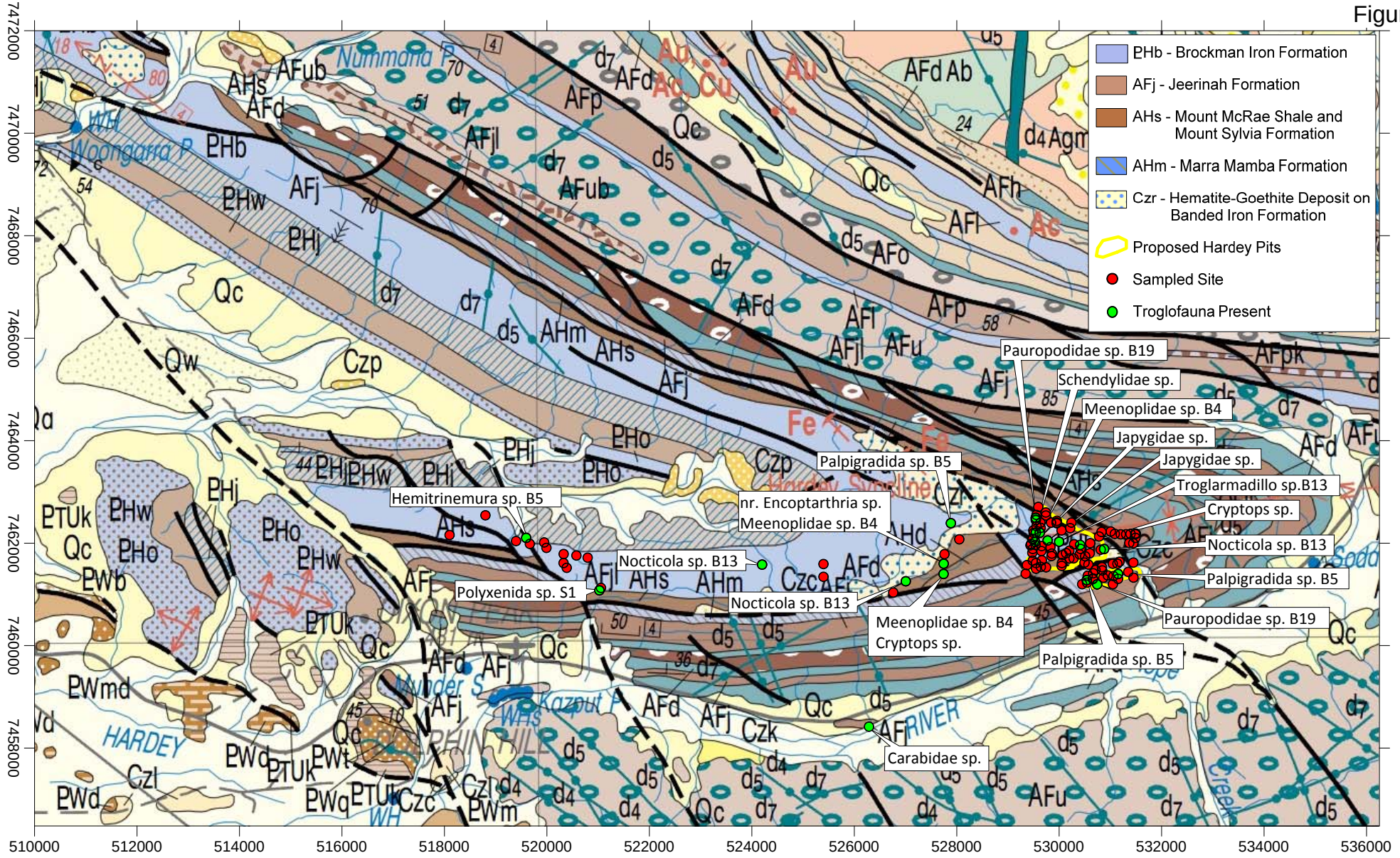
Figure 10



371-1/Surfer/Rpt 11-01/Fig 10 - Regional Trog Sites.srf

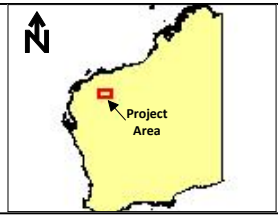
taken from Geological Survey of Western Australia Mt Bruce 1:250,000 map sheet SF 50-11 (2nd ed.)

CLIENT: API Management Pty Ltd

PROJECT: Hardey Deposit Subterranean Fauna Sampling

DATE: July 2011

Dwg. No: 371-1/11/1-10



REGIONAL TROGLOFAUNA SAMPLING SITE LOCATIONS, RESULTS & SURFACE GEOLOGY

Rockwater PROPRIETARY LIMITED

APPENDIX I

Appendix I: Stygofauna Sites – Rounds 1 - 4

Site Name	Site ID	Easting	Northing	Sampled In			
				Round 1	Round 2	Round 3	Round 4
API West Steel	Project Area	529375	7462264		✓		
HAMB001	Project Area	531454	7462150			✓	✓
HAMB002	Project Area	530810	7461870				✓
HAMB003	Project Area	531833	7461516				✓
HAMB004	Project Area	530628	7462113				✓
HAMB005	Project Area	530590	7462010				✓
HAMB006	Project Area	530081	7461770				✓
HAMB007	Project Area	531151	7461878				✓
HAMB008	Project Area	530095	7462000				✓
HAMB009	Project Area	529850	7462100				✓
HARC097	Project Area	531368	7462006	✓	✓	✓	
HARC104	Project Area	531395	7462184			✓	
HARC105	Project Area	530607	7462000	✓			
HARC108	Project Area	530878	7461887	✓	✓		
HARC110	Project Area	530810	7461873		✓	✓	
HARC112	Project Area	530754	7461869		✓		
HARC124	Project Area	530845	7461477			✓	
HARC132	Project Area	530409	7461967		✓		
HARC137	Project Area	530000	7462030		✓		
HARC152	Project Area	531490	7462104	✓	✓	✓	
HARC172	Project Area	530283	7461705	✓	✓		
HARC183	Project Area	530400	7461782			✓	
HARC203	Project Area	529636	7462400		✓	✓	
HARC216	Project Area	530292	7461980		✓		
HARC220	Project Area	529640	7462301		✓	✓	
HARC227	Project Area	530355	7462155		✓		
HARC230	Project Area	531310	7462175		✓	✓	
HARC231	Project Area	531009	7462226			✓	
HARC239	Project Area	531490	7462098			✓	
HARC248	Project Area	530742	7461196	✓			
HARC262	Project Area	530781	7462131		✓	✓	
HAWB001	Project Area	531409	7461901	✓	✓		
HAWB002	Project Area	532052	7461479	✓	✓	✓	
HAWB003	Project Area	530598	7462010				✓
HAWB004	Project Area	530105	7462001				✓
HAWB005	Project Area	531457	7462156			✓	✓
Subtotal (Project Area)				**8**	**17**	**16**	**15**
Bloodwood Bore	Reference	487985	7465898		✓		
Breakaway Well	Reference	540709	7467039		✓		
Cheela 1	Reference	485915	7464625		✓		
Cheela 2	Reference	492205	7464062		✓		
Cheela Springs 1	Reference	483792	7461312		✓		
Gobbo Well	Reference	566487	7443309		✓		
Hardey River Bore	Reference	548000	7474000		✓		
Jupiter Well	Reference	566375	7449059		✓		
Kazput Pool	Reference	519209	7459037		✓		
Madang Well	Reference	548062	7472971		✓		
Melon Hole Bore	Reference	498831	7462002		✓		
Moonmar Well	Reference	559515	7443690		✓		
Old Mill (Well)	Reference	544555	7472888		✓		
Rocklea 1	Reference	578630	7440419		✓		
Rocklea Camp	Reference	539020	7472600		✓		
Sandy Creek Well	Reference	539407	7473848		✓		
SLK 207.8 NW	Reference	526288	7458420		✓		
SLK 220.1 NW	Reference	539436	7464607		✓		
SLK 220.2 NW	Reference	539420	7464587		✓		
			Sub-Total (Reference)	**0**	**19**	**0**	**0**
			Total	**8**	**36**	**16**	**15**

APPENDIX II

Appendix II: Troglofauna Sites – Rounds 1 - 7

Site id	Reference	Easting	Northing	Round 1		Round 3		Round 4	Round 5	Round 6		Round 7
				Scrape	Trap	Scrape	Trap	Scrape	Scrape	Scrape	Trap	Scrape
HADD004	Impact	530657	7461300			✓	✓					
HARC017	Impact	530240	7462403				✓					
HARC018	Impact	530215	7462294			✓	✓					
HARC025	Impact	529557	7462333			✓	✓					
HARC055	Impact	529662	7461667					✓				
HARC057	Impact	529652	7461847					✓				
HARC062	Impact	530050	7461557					✓				
HARC076	Impact	529657	7461944			✓	✓					
HARC082	Impact	530047	7462250			✓						
HARC087	Impact	530949	7461371			✓	✓					
HARC088	Impact	531050	7461200			✓	✓					
HARC089	Impact	531060	7461359			✓	✓					
HARC091	Impact	531152	7461401			✓	✓					
HARC092	Impact	531150.5	7461305	✓	✓							
HARC094	Impact	531350	7461441			✓	✓					
HARC105	Impact	530607.4	7462000	✓	✓							
HARC116	Impact	530863	7461326			✓	✓					
HARC120	Impact	530545	7461232			✓	✓					
HARC137	Impact	530000	7462030	✓	✓							
HARC146	Impact	529531	7462024			✓	✓					
HARC148	Impact	529541	7461964				✓	✓				
HARC153	Impact	530134.9	7461807	✓	✓							
HARC154	Impact	530199.6	7461856		✓							
HARC164	Impact	529831	7461924				✓					
HARC166	Impact	529485	7461889					✓				
HARC167	Impact	530053	7461613			✓	✓					
HARC169	Impact	530417	7461888		✓							
HARC171	Impact	529848	7461748			✓	✓					
HARC172	Impact	530283	7461705		✓							
HARC178	Impact	530201	7461702	✓	✓	✓	✓					
HARC181	Impact	530510	7461745			✓	✓					
HARC182	Impact	530597	7461805			✓	✓					
HARC183	Impact	530400	7461782			✓	✓					
HARC198	Impact	529952	7462389			✓	✓					
HARC201	Impact	529742	7462541			✓	✓					
HARC203	Impact	529636	7462400			✓	✓					
HARC204	Impact	529623	7462204			✓	✓					
HARC205	Impact	529544	7462207			✓	✓					
HARC206	Impact	529955	7462438			✓	✓					
HARC213	Impact	529858	7461799			✓	✓					
HARC214	Impact	530069.7	7461772	✓	✓							
HARC216	Impact	530292	7461980	✓	✓							
HARC218	Impact	529741	7462601			✓	✓					
HARC220	Impact	529640	7462301			✓	✓					
HARC223	Impact	529843	7462401			✓	✓					
HARC224	Impact	529952	7462404				✓					
HARC233	Impact	529775	7462054			✓	✓					
HARC246	Impact	530662	7461312			✓	✓					
HARC248	Impact	530742	7461196	✓	✓	✓	✓					
HARC251	Impact	529549	7461502					✓				
HARC254	Impact	529484	7461660					✓				
HARC255	Impact	529642	7461538					✓				
HARC263	Impact	529745	7461529	✓	✓							
HARC264	Impact	529370.9	7461573					✓				
HARC266	Impact	529550	7461613					✓				

Site id	Reference	Easting	Northing	Round 1		Round 3		Round 4	Round 5	Round 6		Round 7
				Scrape	Trap	Scrape	Trap	Scrape	Scrape	Scrape	Trap	Scrape
Sub-Total (Impact)				**9**	**12**	**32**	**35**	**10**	**0**	**0**	**0**	**0**
HARC005	Reference	529545	7462495			✓	✓					
HARC026	Reference	529546	7462453			✓	✓					
HARC027	Reference	529542	7462494			✓						
HARC064	Reference	529440	7461961			✓	✓			✓		
HARC065	Reference	529543	7462453			✓						
HARC075	Reference	529476	7461814							✓	✓	✓
HARC097	Reference	531368.4	7462006	✓	✓				✓			
HARC100	Reference	530810.4	7461873						✓			
HARC101	Reference	530708.4	7461479						✓			
HARC102	Reference	530836.1	7461535						✓			
HARC103	Reference	531177.1	7461638						✓			
HARC104	Reference	531394.5	7462183						✓	✓		
HARC108	Reference	530877.8	7461887	✓	✓							
HARC119	Reference	530538	7461281			✓	✓					
HARC122	Reference	530558	7461367						✓			
HARC123	Reference	530663.6	7461413						✓			
HARC124	Reference	530842.9	7461470						✓			
HARC125	Reference	531048	7461601						✓			
HARC126	Reference	531139	7461600						✓			
HARC127	Reference	531448.9	7461623						✓			
HARC145	Reference	529453	7461987			✓	✓					
HARC151	Reference	531488	7462176						✓			
HARC152	Reference	531490.1	7462104	✓	✓				✓			
HARC174	Reference	530495	7461621						✓			
HARC175	Reference	530572	7461582						✓			
HARC228	Reference	530826	7462220						✓			
HARC229	Reference	531203	7462174	✓	✓	✓	✓		✓			
HARC230	Reference	531310	7462175	✓	✓	✓	✓		✓	✓	✓	✓
HARC231	Reference	531008	7462228						✓	✓	✓	✓
HARC235	Reference	531088	7462182			✓	✓		✓			
HARC237	Reference	531448	7461998						✓			
HARC238	Reference	531497	7462187			✓	✓		✓	✓	✓	✓
HARC241	Reference	530448	7461199	✓	✓	✓	✓					
HARC242	Reference	531452	7461330	✓	✓							
HARC252	Reference	529348	7461404						✓			
HARC261	Reference	531489	7462189			✓	✓		✓			
HARC262	Reference	530780.4	7462131						✓			
HARC292	Reference	529594	7462710							✓	✓	✓
HARC299	Reference	529558	7462551							✓	✓	✓
HARC309	Reference	529503	7462200							✓	✓	✓
HARC310	Reference	529496	7462250							✓	✓	✓
HARC378	Reference	529476	7462083							✓	✓	✓
HARC379	Reference	529490	7462083							✓	✓	✓
RKR092	Reference	518801	7462544							✓	✓	✓
RKR102	Reference	519398	7462043							✓	✓	✓
RKR103	Reference	519596	7462104							✓	✓	
RKR104	Reference	518102	7462161							✓	✓	✓
RKR121	Reference	520576	7461760							✓	✓	✓
RKR123	Reference	520797	7461717							✓	✓	✓
RKR126	Reference	520325	7461614							✓	✓	✓
RKR128	Reference	519993	7461909							✓	✓	✓
RKR129	Reference	519947	7462016							✓	✓	✓
RKR130	Reference	519667	7461987							✓	✓	✓
RKR135	Reference	520389	7461520							✓	✓	✓

Site id	Reference	Easting	Northing	Round 1		Round 3		Round 4	Round 5	Round 6		Round 7
				Scrape	Trap	Scrape	Trap	Scrape	Scrape	Scrape	Trap	Scrape
RKR139	Reference	520327	7461790							✓	✓	✓
RKR156	Reference	524201	7461583							✓	✓	✓
RKR161	Reference	526763	7461038							✓	✓	✓
RKR164	Reference	527006	7461258							✓	✓	✓
RKR166	Reference	525400	7461344							✓	✓	✓
RKR177	Reference	521027	7461080							✓	✓	✓
RKR178	Reference	521058	7461128							✓	✓	✓
RKR185	Reference	525399	7461593							✓	✓	✓
RKR187	Reference	527745	7461400							✓	✓	✓
RKR189	Reference	527747	7461601							✓	✓	✓
RKR195	Reference	528052	7462075							✓	✓	✓
RKR198	Reference	527886	7462391							✓	✓	✓
RKR201	Reference	527762	7461787							✓	✓	✓
Sub-Total (Reference)				**7**	**7**	**13**	**11**	**0**	**26**	**36**	**34**	**33**
Total				**16**	**19**	**45**	**46**	**10**	**26**	**36**	**34**	**33**

APPENDIX III

Appendix III: Water quality, site and sampling details for sites sampled in Round 1.

Site Details											Sampling Details				Water Levels			Water Quality							
Site id	Easting (MGA 94)	Northing (MGA 94)	Location	RL (m AHD)	Depth (m)	Collar Height (m agl)[1]	EOH RL (mAHD)	Target Formation/ Aquifer	Drill Date	Collar dip (angle, degrees)	Sampling Date	Trog (T) and/or Stygo (S)[2]	Number of Traps Installed	Trap Depth (m)	Measured WL (mbtc)[3]	WL (mAHD)	Water Column (m)	Method[4]	Pumped Volume (L)	Temperature (°C)	EC (mS/cm)	Salinity (ppt)	pH	DO (mg/L)	DO %
HARC092	531151	7461305	Project Area	506.3	72.0	-	434.3	Marra Mamba	9/12/2006	-90	15/01/2010	T (T+S)	2	8, 50	-	-	-	N/A	-	-	-	-	-	-	-
HARC097	531368	7462006	Project Area	394.2	114.0	0.02	280.2	Marra Mamba	22/11/2008	-90	13/01/2010	T (T+S) + S	2	15, 20	21.264	372.9	92.7	Bailed	-	31.09	1.405	3.74	6.88	2.435	18.04
HARC105	530607	7462000	Project Area	397.0	118.0	-	279.0	Brockman (Dales Gorge)	29/04/2009	-90	14/01/2010	T (T+S) + S	2	21, 23	27.195	369.9	90.8	Bailed	-	35.14	1.001	0.53	6.54	3.655	25.01
HARC108	530878	7461887	Project Area	393.1	66.0	0.22	327.1	Mt Mac Rae	5/03/2009	-90	14/01/2010	T (T+S) + S	2	15, 20	22.62	370.5	43.4	Bailed	-	30.18	1.22	0.65	6.25	2.183	16.41
HARC137	530000	7462030	Project Area	408.3	95.0	0.13	326.0	Brockman	2/06/2009	-60	14/01/2010	T (T+S)	2	40, 45	50.551	364.5	44.4	N/A	-	-	-	-	-	-	-
HARC152	531490	7462104	Project Area	405.5	94.0	0.03	311.5	Marra Mamba	25/05/2009	-90	15/01/2010	T (T+S) + S	2	26.5, 30	31.432	374.0	62.6	Bailed	-	31.52	1.392	0.73	6.99	2.445	17.94
HARC153	530135	7461807	Project Area	443.2	124.0	-	319.2	Brockman (Dales Gorge)	26/05/2009	-90	15/01/2010	T (T+S)	3	7, 27, 57	64.95	378.3	59.1	Bailed	-	30.47	1.289	0.68	6.97	2.233	16.71
HARC154	530200	7461856	Project Area	448.4	83.0	-	365.4	Brockman (Dales Gorge)	29/05/2009	-90	-	T (T)	2	30, 69	70.255	378.1	12.7	N/A	-	-	-	-	-	-	-
HARC169	530417	7461888	Project Area	444.8	133.0	-	329.7	Brockman	14/07/2009	-60	15/01/2010	T (T)	1	14	-	-	-	N/A	-	-	-	-	-	-	-
HARC172	530283	7461705	Project Area	431.0	160.0	-	271.0	Brockman	18/07/2009	-90	15/01/2010	T (T) + S	2	55, 60	61.2	369.8	98.8	Bailed	-	33.22	-	-	6.72	2.786	20.6
HARC178	530201	7461702	Project Area	443.7	88.0	0.04	367.5	Brockman	26/07/2009	-60	14/01/2010	T (T+S)	2	36, 46	83.01	371.8	5.0	N/A	-	-	-	-	-	-	-
HARC214	530070	7461772	Project Area	431.0	118.0	0.07	328.8	Brockman (Dales Gorge)	10/05/2009	-60	14/01/2010	T (T+S)	2	28, 43	68.645	371.5	49.4	N/A	-	-	-	-	-	-	-
HARC216	530292	7461980	Project Area	407.9	190.0	0.26	217.9	Brockman (Dales Gorge)	10/08/2009	-90	14/01/2010	T (T+S)	2	35, 40	38.116	369.8	151.9	Bailed	-	31.71	1.182	0.62	6.95	2.495	18.27
HARC229	531203	7462174	Project Area	405.7	81.0	0.11	335.6	Marra Mamba	27/10/2009	-60	15/01/2010	T (T+S)	2	34, 36	37.095	373.6	43.9	N/A	-	-	-	-	-	-	-
HARC230	531310	7462175	Project Area	407.8	70.0	-	347.1	Marra Mamba	28/10/2009	-60	15/01/2010	T (T+S)	2	36.25,	37.77	375.1	32.2	N/A	-	-	-	-	-	-	-
HARC241	530448	7461199	Project Area	479.2	94.0	-	397.8	Marra Mamba	1/11/2009	-60	15/01/2010	T (T+S)	3	8, 40, 44	-	-	-	N/A	-	-	-	-	-	-	-
HARC242	531452	7461330	Project Area	500.0	88.0	-	423.8	Marra Mamba	2/11/2009	-60	14/01/2010	T (T+S)	1	36	-	-	-	N/A	-	-	-	-	-	-	-
HARC248	530742	7461196	Project Area	495.0	136.0	-	377.3	Marra Mamba	8/11/2009	-60	15/01/2010	T (T+S) + S	2	8, 28	-	-	-	N/A	-	-	-	-	-	-	-
HARC263	529745	7461529	Project Area	494.9	100.0	-	408.3	Brockman	11/11/2009	-60	14/01/2010	T (T+S)	2	40, 50	-	-	-	N/A	-	-	-	-	-	-	-
HAWB001	531409	7461901	Project Area	390.9	96.0	0.135	294.9	Wittenoom	18/04/2009	-90	13/01/2010	S	-	-	13.897	377.0	82.1	Bailed	-	42.51	1.146	0.6	7.26	5	34.27
HAWB002	532052	7461479	Project Area	384.1	40.0	0.307	344.1	Jeerinah	19/04/2009	-90	13/01/2010	S	-	-	13.75	370.3	26.3	Pumped	1125	30.69	1.299	0.69	7.12	2.206	16.89

[1] m agl = metres above ground level
[2] S = Stygofauna, T = Troglofauna. Sampling method in parenthesis (N = Net, S = Scrape, T = Trap)
[3] m btc = metres below ground level
[4] Bailed and pumped samples have been by a representative 2L sample, therefore DO levels may not be accurate.

APPENDIX IV

Appendix IV: Water quality, site and sampling details for sites sampled in Round 2.

Site Details											Sampling Details				Water Levels			Water Quality							
Site id	Easting (MGA 94)	Northing (MGA 94)	Location	RL (m AHD)	Depth (m)	Collar Height (m agl)[1]	EOH RL (mAHD)	Target Formation/Aquifer	Pastoral Lease	Collar dip (angle, degrees)	Sampled Date	Trog (T) and/or Stygo (S)[2]	Sampling Method	Trap Depth (m)	Measured WL (mbtc)[3]	WL (mAHD)	Water Column (m)	Method[4]	Filtered Volume	Temperature (°C)	EC (mS/cm)	Salinity (ppt)	pH	DO (mg/L)	DO %
API West Steel	529375	7462264	Project Area	510.0	-	0.12	-	Brockman	-	-90	14/03/2010	S	Netted	-	-	-	-	-	-	-	-	-	-	-	-
HARC097	531368	7462006	Project Area	394.2	114.0	0.02	280.2	Mt Silvia/ Wittenoom/Marra Mamba	-	-90	12/03/2010	S	Airlift	-	21.48	372.7	92.5	Probe	-	29.9	1.44	0.76	8.39	6.4	84
HARC108	530878	7461887	Project Area	393.1	66.5	0.22	326.6	Mount Silvia	-	-90	10/03/2010	S	Airlift	-	-	-	-	Airlift	330	29.17	1.172	0.62	8.4	8.43	110
HARC110	530810	7461873	Project Area	394.8	31.0	-	367.9	Brockman/Mt McRae/Mt Silvia	-	-60	10/03/2010	S	Netted	-	28.33	370.3	2.7	-	-	-	-	-	-	-	-
HARC112	530754	7461869	Project Area	395.4	112.0	-	298.4	Brockman (Dales Gorge)	-	-60	10/03/2010	S	Airlift	-	-	-	-	Airlift	230	30.88	0.9825	0.51	-	6.47	87.4
HARC132	530409	7461967	Project Area	401.0	70.0	-	340.3	Brockman	-	-60	-	S	1 Net	-	35.67	370.1	34.3	-	-	-	-	-	-	-	-
HARC137	530000	7462030	Project Area	408.3	95.0	0.13	326.0	Brockman	-	-60	9/03/2010	S	Netted	-	-	-	-								
HARC152	531490	7462104	Project Area	405.5	94.0	0.03	311.5	Marra Mamba	-	-90	8 &	S	Netted & Airlifted	-	31.66	373.8	62.3	Airlift	600	29.96	1.345	0.71	7.6	6.04	80.8
HARC172	530283	7461705	Project Area	431.0	160.0	-	271.0	Brockman/Mt McRae	-	-90	11/03/2010	S	Airlift	-	61.25	369.8	98.8	Airlift	90	29.6	1.181	0.62	7.7	9.04	120
HARC203	529636	7462400	Project Area	469.2	172.0	0.26	297.2	Brockman	-	-90	16/03/2010	S	Netted	-	105.65	363.6	66.4	-	-	-	-	-	-	-	-
HARC216	530292	7461980	Project Area	407.9	190.0	0.26	217.9	Brockman (Dales Gorge)	-	-90	14/03/2010	S	Netted	-	-	-	-	-	-	-	-	-	-	-	-
HARC220	529640	7462301	Project Area	475.8	165.0	0.14	-	Brockman	-	-90	16/03/2010	S	Netted	-	111.935	363.9	53.1	-	-	-	-	-	-	-	-
HARC227	530355	7462155	Project Area	443.5	202.0	0.23	241.5	Brockman	-	-90	14/03/2010	S	Netted	-	73.91	369.6	128.1	Probe	-	31.58	1.32	0.7	6.68	3.38	46.3
HARC230	531310	7462175	Project Area	407.8	142.0		284.8	Marra Mamba	-	-60	9/03/2010	S	Netted	-	-	-	-								
HARC262	530781	7462131	Project Area	418.6	94.0	0.16	337.2	Mt McRae	-	-60	16/03/2010	S	Netted	-	54.72	371.2	39.3	-	-	-	-	-	-	-	-
HAWB001	531409	7461901	Project Area	390.9	96.0		294.9	Wittenoom	-	-90	10/03/2010	S	Netted	-	-	-	-		-						
HAWB002	532052	7461479	Project Area	384.1	40.0	0.307	344.1	Jeerinah	-	-90	9,10 & 16/03/10	S	Netted & Airlifted	-	13.812 & 13.83	370.3	26.2	Probe	-	30.5	1.293	0.68	7.7	6.22	83.3
BLOODWOOD BORE	487985	7465898	Reference	271.0	-	0.62	-	-	Cheela Plains	-90	15/03/2010	S	Pumped	-	18.15	-	-	Pumped	4138	33.58	0.8804	0.46	7.14	5.42	75.6
BREAKAWAY WELL	540709	7467039	Reference	-	9.8	-	-	-	Rocklea	-90	13/03/2010	S	Netted	-	6.58	-	3.3	Probe	-	30.04	1.81	0.96	-	3.02	40.2
CHEELA 1	485915	7464625	Reference	259.0	49.1	0.09	209.9	-	Cheela Plains	-90	15/03/2010	S	Netted	-	7.51	251.5	41.6	Probe	-	32.3	0.652	0.34	6.48	2.6	35.9
CHEELA 2	492205	7464062	Reference	-	25.1	0.01	-	-	Cheela Plains	-90	15/03/2010	S	Netted	-	23.8	-	1.3	Probe	-	33.25	1.411	0.75	7.03	2.54	35.7
CHEELA SPRINGS 1	483792	7461312	Reference	-	15.0	0.6	-	-	Cheela Plains	-90	15/03/2010	S	Netted	-	3.56	-	11.4	Probe	-	31.34	2.475	1.33	6.7	2.74	36.3
GOBBO WELL	566487	7443309	Reference	-	23.0	0.3	-	-	Rocklea	-90	14/03/2010	S	Pumped	-	18.05	-	5.0	Pumped	432	30.25	0.6561	0.34	6.98	4.99	66.6
Hardey River Bore	548000	7474000	Reference	455.0	40.0	0.7	415.0	-	Rocklea	-90	13/03/2010	S	Netted	-	8.7	446.3	31.3	Probe	-	32.04	1.397	0.74	8.03	3.98	55.1
JUPITER WELL	566375	7449059	Reference	428.0	25.2	0.1	402.8	-	Rocklea	-90	14/03/2010	S	Netted	-	22.59	405.4	2.6	Probe	-	28.85	1.374	0.73	7.14	3.32	43.2
KAZPUT POOL	519209	7459037	Reference	333.0	10.1	-	323.0	-	Cheela Plains	-90	15/03/2010	S	Netted	-	6.91	326.1	3.1	Probe	-	30.16	1.61	0.86	7.11	1.85	24.7
MADANG WELL	548062	7472971	Reference	452.0	11.5	0.08	440.5	-	Rocklea	-90	13/03/2010	S	N + P	-	9.00	443.0	2.5	Probe	300	30.4	1.308	0.69	7.5	5.31	71.2
MELON HOLE BORE	498831	7462002	Reference	289.0	39.0	0.08	250.1	-	Cheela Plains	-90	15/03/2010	S	Netted	-	7.725	281.3	31.2	Probe	-	31.72	1.408	0.75	6.92	4.95	67.5
MOONMAR BORE	559515	7443690	Reference	-	12.5	0.3	-	-	Rocklea	-90	14/03/2010	S	Pumped	-	6.315	-	6.2	-	-	-	-	-	-	-	-
MOONMAR WELL	559515	7443690	Reference	-	10.5	0.28	-	-	Rocklea	-90	14/03/2010	S	Netted	-	6.53	-	4.0	Probe	-	29.26	1.215	0.64	7.12	3.25	42.7
OLD MILL (WELL)	544555	7472888	Reference	-	6.6	0.63	-	-	Rocklea	-90	13/03/2010	S	Pumped	-	5.15	-	1.5	Pumped	453.22	31.63	2.027	1.08	7.34	4.85	66.9
ROCKLEA 1	578630	7440419	Reference	443.0	15.5	0.54	427.5	-	Rocklea	-90	14/03/2010	S	Pumped	-	9.36	433.6	6.1	Pumped	588	29.82	1.414	0.75	7	5.21	69.9
Rocklea Camp	539020	7472600	Reference	-	48.0	0.725	-	-	Rocklea	-90	13/03/2010	S	Netted	-	5.97	-	42.0	Probe	-	30.67	2.292	1.23	7.5	-	37.6
SANDY CREEK WELL	539407	7473848	Reference	-	7.0	0.45	-	-	Rocklea	-90	13/03/2010	S	Pumped	-	3.74	-	3.3	Pumped	1056	31.24	3.056	1.65	7.5	4.2	57.2
SLK 207.8 NW	526574	7458421	Reference	-	16.8	0.075	-	-	VCL	-90	12/03/2010	S	Netted	-	7.29	-	9.5	Probe	-	30.11	2.011	1.08	-	2.93	39.3
SLK 220.1 NW	539436	7464607	Reference	-	17.8	0.48	-	-	Rocklea	-90	15/03/2010	S	Netted	-	3.905	-	13.9	Probe	-	29.3	3.036	1.64	7.59	1.61	21.3
SLK 220.2 NW	539420	7464587	Reference	405.0	30.1	-	375.0	-	Rocklea	-90	15/03/2010	S	Netted	-	4.06	400.9	26.0	Probe	-	30.08	0.925	0.48	7.24	0.76	10.1

[1] m agl = metres above ground level
[2] S = Stygofauna, T = Troglofauna. Sampling method in parenthesis (N = Net, S = Scrape, T = Trap)
[3] m btc = metres below ground level
[4] Those labelled 'probe' have been measured down-hole, remaining sites were measured by a representative 2L sample while airlifting, therefore DO levels may not be accurate.

APPENDIX V

Appendix V: Water quality, site and sampling details for sites sampled in Round 3

Site Details											Sampling Details				Water Levels			Water Quality							
Site id	Easting (MGA 94)	Northing (MGA 94)	Location	RL (m AHD)	Depth (m)	Collar Height (m agl)[1]	EOH RL (mAHD)	Target Formation/Aquifer	Drilled Date	Collar dip (angle, degrees)	Sampling Date	Trog (T) and/or Stygo (S)[2]	Number of Traps Installed	Trap Depth (m)	Measured WL (mbtc)[3]	WL (mAHD)	Water Column (m)	Method	Pumped Volume (L)	Temperature (degrees)	EC (mS/cm)	Salinity (ppt)	pH	DO (mg/L)	DO %
HAMB001	531455	7462155	Project Area	393.2	89	0.7	304.9	Marra Mamba	31/05/2010	-90	24/07/2010	S (N)	-	-	21.315	371.9	67.7	Probe	29.27	1384	0.8854	-*	5.43	70.1	
HAWB005	531458	7462158	Project Area	393.6	136	0.84	258.4	Marra Mamba	9/07/2010	-90	24/07/2010	S (N)	-	-	21.47	372.1	114.5	Probe	29.36	1371	0.8773	7.08	1.09	14.1	
HARC097	531370	7462007	Project Area	394.2	114	0.02	280.2	Mt Silvia/Wittenoom/Marra Mamba	23/11/2008	-90	23/07/2010	S (N)	-	-	21.77	372.4	92.2	Probe	29.19	1596	1.021	5.69	3.62	46.2	
HARC104	531395	7462184	Project Area	395.0	105	-	304	Marra Mamba	30/11/2008	-60	24/07/2010	S (N)	-	-	26.00	372.5	79.0	Probe	29.49	1496	0.9575	6.2	5.45	71.1	
HARC110	530810	7461873	Project Area	394.8	76	-	329	Brockman overlying Mt McRae	5/05/2009	-60	24/07/2010	S (N)	-	-	28.38	370.2	47.6	Probe	29.6	1196	0.7658	4.87	2.54	32.9	
HARC124	530845	7461477	Project Area	421.0	100	0.1	334	Marra Mamba	16/05/2009	-60	25/07/2010	S (N)	-	-	54.43	373.9	45.6	Probe	31.33	996.7	0.638	11.49*	6.33	84.9	
HARC152	531490	7462104	Project Area	405.5	94	0.03	311.457	Marra Mamba	25/05/2009	-90	23/07/2010	S (N)	-	-	33.10	372.4	60.9	Probe	29.88	1333	0.8529	6.01	6.6	86.1	
HARC231	531009	7462226	Project Area	407.2	100	-	321	Wittenoom	29/10/2009	-60	24/07/2010	S (N)	-	-	39.69	372.8	60.3	Probe	29.49	1263	0.8083	6.5	4.46	58.1	
HARC239	531490	7462098	Project Area	405.8	94	-	324	Marra Mamba	7/11/2009	-60	23/07/2010	S (N)	-	-	38.79	372.2	55.2	Probe	29.85	1295	0.8306	6	6.84	89.1	
HARC262	530780	7462131	Project Area	418.6	94	0.16	337	Mt McRae	10/11/2009	-60	25/07/2010	S (N)	-	-	54.92	371.1	39.1	Probe	30.19	1020	0.6531	2.42*	1.9	25.2	
HAWB002	532052	7461479	Project Area	384.1	40	0.307	344	Jeerinah		-90	28/07/2010	S (N)	-	-	14.43	369.6	25.6	Probe	28.71	-*	-*	-*	2.08	26.5	
HARC183	530400	7461782	Project Area	404.6	130	-	292	Brockman	10/08/2009	-60	24/07/2010	S (N) + T (S + T)	1	38	39.85	370.1	90.2	Probe	29.54	1159	0.7418	5.62	1.47	19.3	
HARC203	529636	7462400	Project Area	469.2	172	0.26	297	Brockman	16/09/2009	-90	26/07/2010	S (N) + T (S + T)	1	30	105.56	363.7	66.4	Too Deep for cable							
HARC220	529640	7462301	Project Area	475.8	165	0.14		Brockman	16/10/2009	-90	26/07/2010	S (N) + T (S + T)	2	12, 82	111.85	364.0	53.2	Too Deep for cable							
HARC230	531308	7462176	Project Area[4]	407.8	142	-	285	Marra Mamba	28/10/2009	-60	24/07/2010	S (N) + T (S + T)	2	22, 39	39.63	373.5	102.4	Probe	29.97	1401	0.8953	2.18*	6.03	78.8	
HADD004	530657	7461300	Project Area	465.8	47	-	425	Marra Mamba	11/01/2007	-60	25/07/2010	T (S + T)	1	17	DRY	-	-								
HARC005	529545	7462495	Project Area	474.3	115	-	375	Brockman	21/07/2006	-60	26/07/2010	T (S + T)	1	15	-	-	-								
HARC017	530240	7462403	Project Area	468.5	31	-	442	Brockman	29/07/2006	-60	28/07/2010	T (T)	1	14	-	-	-								
HARC018	530215	7462294	Project Area	465.6	60	0.00	414	Brockman	29/07/2006	-60	27/07/2010	T (S + T)	1	18	-	-	-								
HARC025	529557	7462333	Project Area	483.7	133	-	368	Brockman	1/08/2006	-60	26/07/2010	T (S + T)	1	28	-	-	-								
HARC026	529546	7462453	Project Area	477.3	143	-	354	Brockman	1/08/2006	-60	26/07/2010	T (S + T)	1	16	-	-	-								
HARC027	529542	7462494	Project Area	474.5	4	-	471	Brockman	2/08/2006	-60	26/07/2010	T (S)	-	-	DRY	-	-								
HARC064	529440	7461961	Project Area	512.5	98	-	428	Brockman	4/09/2006	-60	27/07/2010	T (S + T)	1	26	DRY	-	-								
HARC065	529543	7462453	Project Area	477.6	153	-	345	Brockman	5/09/2006	-60	26/07/2010	T (S)	-	-	DRY	-	-								
HARC076	529657	7461944	Project Area	487.0	141	-	365	Brockman	3/12/2006	-60	27/07/2010	T (S + T)	1	15	DRY	-	-								
HARC082	530047	7462250	Project Area	469.3	128	0.2	358	Brockman	6/12/2006	-60	27/07/2010	T (S)		24	-	-	-								
HARC087	530949	7461371	Project Area	488.2	70	-	418	Marra Mamba	7/12/2006	-90	25/07/2010	T (S + T)	1	9	DRY	-	-								
HARC088	531050	7461200	Project Area	520.7	52	-	469	Marra Mamba	8/12/2006	-90	25/07/2010	T (S + T)	1	11	DRY	-	-								
HARC089	531060	7461359	Project Area	498.4	70	-	428	Marra Mamba	8/12/2006	-90	25/07/2010	T (S + T)	2	20, 70	DRY	-	-								
HARC091	531152	7461401	Project Area	493.5	76	-	417	Marra Mamba	9/12/2006	-90	25/07/2010	T (S + T)	1	60	DRY	-	-								
HARC094	531350	7461441	Project Area	490.3	90	-	400	Marra Mamba	10/12/2006	-90	25/07/2010	T (S + T)	1	19	-	-	-								
HARC116	530863	7461326	Project Area	484.5	154	-	351	Marra Mamba	11/05/2009	-60	24/07/2010	T (S + T)	1	7	-	-	-								
HARC119	530538	7461281	Project Area	464.6	124	0.176	357	Marra Mamba	12/05/2009	-60	25/07/2010	T (S + T)	2	11, 72	103.09	375.3	20.9								
HARC120	530545	7461232	Project Area	473.5	94	-	392	Marra Mamba	12/05/2009	-60	25/07/2010	T (S + T)	1	50	DRY	-	-								
HARC145	529453	7461987	Project Area	509.5	184	-	350	Brockman	22/06/2009	-60	27/07/2010	T (S + T)	1	18	DRY	-	-								
HARC146	529531	7462024	Project Area	494.3	206	-	316	Brockman	25/06/2009	-60	27/07/2010	T (S + T)	1	10	-	-	-								
HARC148	529541	7461964	Project Area	504.6	214	-	319	Brockman	27/06/2009	-60	27/07/2010	T (T)	1	12	-	-	-								
HARC164	529831	7461924	Project Area	467.9	202	-	293	Brockman	4/07/2009	-60	27/07/2010	T (T)	1	19	-	-	-								
HARC167	530053	7461613	Project Area	471.4	274	-	234	Brockman	9/07/2009	-60	27/07/2010	T (S + T)	1	8	-	-	-								
HARC171	529848	7461748	Project Area	477.3	190	0.2	287	Brockman	17/07/2009	-90	27/07/2010	T (S + T)	1	14	107.76	369.5	82.2								
HARC178	530204	7461700	Project Area	443.7	88	0.04	367	Brockman	26/07/2009	-60	27/07/2010	T (S + T)	1	34	DRY	-	-								
HARC181	530510	7461745	Project Area	400.9	30	-	375	Brockman	4/08/2009	-60	24/07/2010	T (S + T)	1	11	DRY	-	-								
HARC182	530597	7461805	Project Area	399.0	17	-	384	Brockman	9/08/2009	-60	24/07/2010	T (S + T)	1	14	DRY	-	-								
HARC198	530238	7462387	Project Area	473.7	142	0.14	351	Brockman	9/09/2009	-60	27/07/2010	T (S + T)	2	10, 30	-	-	-								
HARC201	529742	7462541	Project Area	477.5	94	-	396	Brockman	14/09/2009	-60	27/07/2010	T (S + T)	1	12	-	-	-								
HARC204	529623	7462204	Project Area	478.4	142	-	336	Brockman	17/09/2009	-90	26/07/2010	T (S + T)	1	10	-	-	-								
HARC205	529544	7462207	Project Area	489.81	130.0	-	377	Brockman	18/09/2009	-90	26/07/2010	T (S + T)	1		-	-	-								
HARC206	529752	7462703	Project Area	478.0	9	-	470	Brockman	18/09/2009	-60	27/07/2010	T (S + T)	1	9	DRY	-	-								
HARC213	529858	7461799	Project Area	468.7	196	-	299	Brockman	3/10/2009	-60	27/07/2010	T (S + T)	1	10	DRY	-	-								
HARC218	529741	7462601	Project Area	479.1	9	-	471	Brockman	14/10/2009	-60	27/07/2010	T (S + T)	1	9	DRY	-	-								
HARC223	529843	7462401	Project Area	468.9	162	0.154	307	Brockman	20/10/2009	-90	27/07/2010	T (S + T)	2	10, 54	-	-	-								
HARC224	529952	7462404	Project Area	475.1	94	-	394	Brockman	21/10/2009	-60	28/07/2010	T (T)	1	12	-	-	-								
HARC229	531200	7462174	Reference	405.7	46	0.11	366	Marra Mamba	27/10/2009	-60	24/07/2010	T (S + T)	1	10	DRY	-	-								
HARC233	529775	7462054	Project Area	454.0	160	0.275	294	Brockman	2/11/2009	-90	27/07/2010	T (S + T)	1	16	90.38	363.7	69.6								
HARC235	531088	7462182	Reference	401.9	100	0.18	315	Marra Mamba	5/11/2009	-60	24/07/2010	T (S + T)	1	34	35.25	371.3	64.8								
HARC238	531497	7462187	Reference	398.8	20	-	381	Marra Mamba	7/11/2009	-60	24/07/2010	T (S + T)	1	?	DRY	-	-								
HARC241	530451	7461184	Project Area	479.2	94	-	398	Marra Mamba	1/11/2009	-60	25/07/2010	T (S + T)	1	10	-	-	-								
HARC246	530662	7461312	Project Area	465.2	116	-	365	Marra Mamba	6/11/2009	-60	25/07/2010	T (S + T)	1	8	DRY	-	-								
HARC248	530742	7461205	Project Area	495.0	145	-	369	Marra Mamba	8/11/2009	-60	25/07/2010	T (S + T)	1	24	DRY	-	-								
HARC261	531489	7462189	Reference	398.4	33	-	370	Marra Mamba	8/11/2009	-60	24/07/2010	T (S + T)	1	-	30.32	372.1	2.7								

* inaccurate data

[1] m agl = metres above ground level
[2] S = Stygofauna, T = Troglofauna. Sampling method in parenthesis (N = Net, S = Scrape, T = Trap)
[3] m btc = metres below ground level
[4] Reference site for troglofauna, impact site for troglofauna

APPENDIX VI

Appendix VI: Site and sampling details for sites sampled in Round 4.

Site Details												Sampling Details		Water Levels		
Site id	Easting (MGA 94)	Northing (MGA 94)	Location	RL (m AHD)	Depth (m)	Collar Height (m agl)[1]	EOH RL (mAHD)	Slotted Section(s) (m)	Target Formation/Aquifer	Drilled Date	Collar dip (angle, degrees)	Sampling Date	Trog (T) and/or Stygo (S)[2]	Measured WL (mbtc)[3]	WL (mAHD)	Water Column (m)
HAMB001	531455	7462155	Project Area	393.2	89	0.7	304.9	17-23, 29-35, 41-53, 59-65, 71-77, 83-89	Marra Mamba	31/05/2010	-90	18/09/2010	S	20.93	372.3	68.1
HAMB002	530810	7461870	Project Area	394.8	178.5	0.6	216.9	58.5-64.5, 76.5-82.5, 94.5-100.5, 148.5-154.5, 166.5-178.5	Brockman/Mt McRae/Mt Silvia	21/05/2010	-90	18/09/2010	S	25.04	369.8	153.5
HAMB003	531833	7461516	Project Area	385.4	17	0.7	369.1	11-17	Jeerinah	1/06/2010	-90	17/09/2010	S	13.17	372.2	3.8
HAMB004	530628	7462113	Project Area	401.0	107.8	0.87	294.1	59.8-107.8	Brockman/Mt McRae	3/06/2010	-90	18/09/2010	S	30.93	370.1	76.9
HAMB005	530590	7462010	Project Area	397.0	71.5	0.91	326.4	17.5-23.5, 29.5-35.5, 41.5-71.5	Brockman (Dales Gorge)	24/05/2010	-90	18/09/2010	S	28.31	368.7	43.2
HAMB006	530081	7461770	Project Area	431.1	73.7	0.6	358.0	55.7-73.7	Brockman (Dales Gorge)	6/06/2010	-90	18/09/2010	S	62.00	369.1	11.7
HAMB007	531151	7461878	Project Area	392.0	131.2	0.4	261.2	35.2-41.2, 113.2-131.2	Mt Sylvia Shale	7/06/2010	-90	18/09/2010	S	21.84	370.2	109.4
HAMB008	530095	7462000	Project Area	407.2	143	0.7	264.9	77-83, 89-95, 101-119, 125-143	Brockman (Mt Whaleback/Dales Gorge)	29/05/2010	-90	18/09/2010	S	38.19	369.0	104.8
HAMB009	529850	7462100	Project Area	410.8	152	0.5	259.3	98-152	Brockman (Mt Whaleback/Dales Gorge)	27/05/2010	-90	18/09/2010	S	46.93	363.9	105.1
HAWB003	530598	7462010	Project Area	397.3	119	0.3	278.6	58-100: open end	Brockman (Dales Gorge)	14/06/2010	-90	20/09/2010	S	28.43	368.9	90.6
HAWB004	530105	7462001	Project Area	407.4	150.84	0.86	257.5	89.14-101.14, 107.14-149.14	Brockman (Dales Gorge)	25/06/2010	-90	20/09/2010	S	38.34	369.1	112.5
HAWB005	531458	7462158	Project Area	393.6	136	0.84	258.4	53.16-77.16, 95.16-113.16, 107.1-131.16	Marra Mamba	9/07/2010	-90	20/09/2010	S	21.06	372.5	114.9
HARC108	530877.8	7461887	Project Area	393.1	66.5	-	326.6	24.52-66.52	-	10/03/2010	-90	18/09/2010	S	24.01	369.1	42.5
HARC055	529661.7	7461667	Project Area	501.97	87.0	-	426.6	-	-	24/08/2006	-60	19/09/2010	T	Dry	-	-
HARC057	529652.4	7461847	Project Area	497.2	153.0	-	364.7	-	-	25/08/2006	-60	19/09/2010	T	Dry	-	-
HARC062	530049.9	74615577	Project Area	475.84	129.0	-	364.1	-	-	3/09/2006	-60	19/09/2010	T	Dry	-	-
HARC148	529540.6	7461960	Project Area	504.57	214.0	-	319.2	-	-	27/06/2009	-60	19/09/2010	T	Dry	-	-
HARC166	529485.2	7461889	Project Area	510.06	154.0	0.06	376.7	-	-	7/07/2009	-60	19/09/2010	T	151.48	358.6	2.5
HARC251	529549.2	7461502.	Project Area	530.35	94.0	-	448.9	-	-	14/11/2009	-60	19/09/2010	T	Dry	-	-
HARC254	529483.8	7461660	Project Area	526.81	94.0	-	445.4	-	-	17/11/2009	-60	19/09/2010	T	Dry	-	-
HARC255	529642.1	7461538	Project Area	515.87	94.0	-	434.5	-	-	17/11/2009	-90	19/09/2010	T	Dry	-	-
HARC264	529370.9	7461573	Project Area	537.03	94.0	-	455.6	-	-	11/11/2009	-60	19/09/2010	T	Dry	-	-
HARC266	529550	7461613	Project Area	525.48	94.0	-	444.1	-	-	13/11/2009	-60	19/09/2010	T	Dry	-	-

[1] m agl = metres above ground level
[2] S = Stygofauna, T = Troglofauna. Sampling method in parenthesis (N = Net, S = Scrape, T = Trap)
[3] m btc = metres below ground level

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APPENDIX VII

Appendix VII: Site and sampling details for sites sampled in Round 5.

Site Details												Sampling Details		Water Levels			Water Levels							
Site id	Easting (MGA 94)	Northing (MGA 94)	Location	RL (m AHD)	Depth	Collar Height (m agl)[1]	EOH RL (mAHD)	Slotted Section(s) (m)	Target Formation/Aquifer	Drilled Date	Collar dip (angle, degrees)	Sampling Date	Trog (T) and/or Stygo (S)[2]	Measured WL (mbtc)[3]	WL (mAHD)	Water Column (m)	Method	Probe Depth	Temp (degrees)	EC (uS/cm)	Salinity (g/L)	pH	DO (mg/L)	DO %
HAMB001	531455	7462155	Project Area	393.2	89	0.7	304.9	17-23, 29-35, 41-53, 59-65, 71-77, 83-89	Marra Mamba	31/05/2010	-90	25/11/2010	S	20.55	372.7	68.5	Probe	21.5	30.4	1285	0.8	7.2	4.88	65.3
HAMB002	530810	7461870	Project Area	394.8	178.5	0.6	216.9	58.5-64.5, 76.5-82.5, 94.5-100.5, 148.5-154.5, 166.5-178.5	Brockman/Mt McRae/Mt Silvia	21/05/2010	-90	25/11/2010	S	24.76	370.0	153.7	Probe	25.7	30.4	1284	0.8	6.7	1.31	17.4
HAMB003	531833	7461516	Project Area	385.4	17	0.7	369.1	11-17	Jeerinah	1/06/2010	-90	25/11/2010	S	13.26	372.1	3.7	Probe	14.5	29.8	1210	0.8	7.2	1.69	22.8
HAMB004	530628	7462113	Project Area	401.0	107.8	0.87	294.1	59.8-107.8	Brockman/Mt McRae	3/06/2010	-90	26/11/2010	S	30.96	370.1	76.8	Probe	32.0	30.6	850.1	0.5	6.6	62.10	4.6
HAMB005	530590	7462010	Project Area	397.0	71.5	0.91	326.4	17.5-23.5, 29.5-35.5, 41.5-71.5	Brockman (Dales Gorge)	24/05/2010	-90	26/11/2010	S	28.22	368.8	43.3	Probe	29.2	30.8	890.5	0.6	6.6	6.48	87.4
HAMB006	530081	7461770	Project Area	431.1	73.7	0.6	358.0	55.7-73.7	Brockman (Dales Gorge)	6/06/2010	-90	26/11/2010	S	61.89	369.2	11.8	Probe	63.0	31.4	1269.	0.8	7.2	0.62	8.6
HAMB007	531151	7461878	Project Area	392.0	131.2	0.4	261.2	35.2-41.2, 113.2-131.2	Mt Sylvia Shale	7/06/2010	-90	25/11/2010	S	21.50	370.5	109.7	Probe	22.5	30.9	983.2	0.6	6.4	1.62	22.3
HAMB008	530095	7462000	Project Area	407.2	143	0.7	264.9	77-83, 89-95, 101-119, 125-143	Brockman (Mt Whaleback/Dales Gorge)	29/05/2010	-90	26/11/2010	S	38.04	369.2	105.0	Probe	39.0	30.8	1148.	0.7	6.8	1.20	17.4
HAMB009	529850	7462100	Project Area	410.8	152	0.5	259.3	98-152	Brockman (Mt Whaleback/Dales Gorge)	27/05/2010	-90	26/11/2010	S	46.89	363.9	105.1	Probe	48.0	31.9	775.3	0.5	6.5	4.59	63.9
HAWB003	530598	7462010	Project Area	397.3	119	0.3	278.6	58-100: open end	Brockman (Dales Gorge)	14/06/2010	-90	26/11/2010	S	28.31	369.0	90.7	Probe	29.3	30.6	1075	0.7	7.4	0.31	4.1
HAWB004	530105	7462001	Project Area	407.4	150.84	0.86	257.5	89.14-101.14, 107.14-149.14	Brockman (Dales Gorge)	25/06/2010	-90	26/11/2010	S	38.14	369.3	112.7	Probe	39.0	31.1	1087	0.7	7.5	3.48	47.3
HAWB005	531458	7462158	Project Area	393.6	136	0.84	258.4	53.16-77.16, 95.16-113.16, 107.1-131.16	Marra Mamba	9/07/2010	-90	25/11/2010	S	21.07	372.5	114.9	Probe	22.0	29.9	1378	0.9	7.7	0.99	13.0
HARC097	531370	7462007	Reference	394	114.0	-	280.0	-	-	23/11/2008	-90	27/11/2010	T	22.18	371.8	91.8								
HARC100	530810	7461873	Reference	394.8	76.0	-	329.0	-	-	27/11/2008	-60	28/11/2010	T	Dry	-	-								
HARC101	530708	7461479	Reference	412	144.0	0.1	287.4	-	-	28/11/2008	-60	28/11/2010	T	Dry	-	-								
HARC102	530836	7461535	Reference	407.1	168.0	0	261.7	-	-	29/11/2008	-60	28/11/2010	T	39.29	373.1	128.7								
HARC103	531177	7461638	Reference	397.9	109.0	-	303.5	-	-	30/11/2008	-60	28/11/2010	T	Dry	-	-								
HARC104	531394	7462183	Reference	395	105.0	0.26	304.3	-	-	30/11/2008	-60	27/11/2010	T	25.63	373.0	79.4								
HARC122	530558	7461367	Reference	427.9	112.0	0.11	331.0	-	-	14/05/2009	-60	28/11/2010	T	61.77	374.5	50.2								
HARC123	530664	7461413	Reference	421.8	88.0	0.1	345.7	-	-	15/05/2009	-60	28/11/2010	T	54.88	374.4	33.1								
HARC124	530843	7461470	Reference	421	100.0	0.11	334.5	-	-	16/05/2009	-60	28/11/2010	T	54.61	373.8	45.4								
HARC125	531048	7461601	Reference	406.9	88.0	0.12	330.8	-	-	17/05/2009	-60	28/11/2010	T	36.19	375.7	51.8								
HARC126	531139	7461600	Reference	408.3	154.0	0.12	275.0	-	-	18/05/2009	-60	28/11/2010	T	34.13	378.8	119.9								
HARC127	531449	7461623	Reference	404.8	100.0	0.09	318.3	-	-	19/05/2009	-60	28/11/2010	T	36.70	373.1	63.3								
HARC151	531488	7462176	Reference	399.2	112.0	0	302.2	-	-	24/05/2009	-60	27/11/2010	T	29.05	374.1	83.0								
HARC152	531490	7462104	Reference	405.5	94.0	0.05	311.5	-	-	25/05/2009	-90	27/11/2010	T	32.74	372.8	61.3								
HARC174	530495	7461621	Reference	422.4	94.0	0.19	341.1	-	-	20/07/2009	-60	28/11/2010	T	53.86	375.9	40.1								
HARC175	530572	7461582	Reference	421.6	244.0	0.1	210.4	-	-	22/07/2009	-60	28/11/2010	T	58.87	370.7	185.1								
HARC228	530826	7462220	Reference	432	178.0	0.16	278.0	-	-	26/10/2009	-60	27/11/2010	T	68.05	373.2	110.0								
HARC229	531204	7462178	Reference	405.7	148.0	0	277.5	-	-	27/10/2009	-60	27/11/2010	T	38.10	372.7	109.9								
HARC230	531308	7462176	Reference	407.8	142.0	-	284.8	-	-	28/10/2009	-60	27/11/2010	T	39.23	373.8	102.8								
HARC231	531008	7462228	Reference	407.2	100.0	0.15	320.7	-	-	29/10/2009	-60	27/11/2010	T	40.06	372.6	59.9								
HARC235	531088	7462182	Reference	401.9	100.0	-	315.3	-	-	5/11/2009	-60	27/11/2010	T	33.66	372.7	66.3								
HARC237	531448	7461998	Reference	391.8	94.0	0.11	297.9	-	-	6/11/2009	-60	27/11/2010	T	22.99	372.0	71.0								
HARC238	531495	7462189	Reference	398.8	82.0	-	327.7	-	-	7/11/2009	-60	27/11/2010	T	Dry	-	-								
HARC252	529348	7461404	Reference	548.1	94.0	-	466.7	-	-	15/11/2009	-60	28/11/2010	T	Dry	-	-								
HARC261	531488	7462189	Reference	398.4	94.0	0.2	317.2	-	-	8/11/2009	-60	27/11/2010	T	29.87	372.7	64.1								
HARC262	530780	7462131	Reference	418.6	94.0	0.16	337.351	-	-	10/11/2009	-60	27/11/2010	T	55.15	370.995	38.9								

[1] m agl = metres above ground level
[2] S = Stygofauna, T = Troglofauna. Sampling method in parenthesis (N = Net, S = Scrape, T = Trap)
[3] m btc = metres below ground level

APPENDIX VIII

Appendix VIII: Site and sampling details for sites sampled in Round 6.

Site Details								Sampling Details			
Site id	Easting (MGA 94)	Northing (MGA 94)	RL (m AHD)	Depth (m)	Collar Height (m agl)[1]	Collar dip (angle, degrees)	Measured WL (mbtc)[2]	Sample Date	Trog (T) and/or Stygo (S)[3]	Number of Traps	Trap Depth (m)
HARC064	529440	7461965	520	98	-	-60	Dry	5/05/2011	T (S)	0	-
HARC075	529476	7461814	510.93	58	-	-90	Dry	5/05/2011	T (S +T)	1	8
HARC104	531398	7462184	394.97	105	0.26	-60	24.0	5/05/2011	T (S)	0	-
HARC230	531310	7462177	407.77	142	-	-60	37.6	5/05/2011	T (S +T)	1	8
HARC231	531010	7462227	407.16	100	0.15	-60	Dry	5/05/2011	T (S +T)	1	20
HARC238	531492	7462190	398.75	82	-	-60	Dry	5/05/2011	T (S +T)	1	11
HARC292	529594	7462710	481	58	-	-60	Dry	5/05/2011	T (S +T)	1	11
HARC299	529558	7462551	466	46	-	-60	Dry	5/05/2011	T (S +T)	1	8
HARC309	529503	7462200	496.12	216	-	-60	Dry	5/05/2011	T (S +T)	1	10
HARC310	529496	7462250	496.19	174	-	-60	Dry	5/05/2011	T (S +T)	1	20
HARC378	529476	7462083	447	150	0.3	-60	101.7	5/05/2011	T (S +T)	1	10
HARC379	529490	7462083	465	150	-	-60	101.8	5/05/2011	T (S +T)	1	12
RKR092	518801	7462544	501	225	-	-60	Dry	4/05/2011	T (S +T)	2	10, 25
RKR102	519398	7462043	439	135	0	-60	87.6	4/05/2011	T (S +T)	2	9, 19
RKR103	519596	7462104	432	87	-	-60	Dry	4/05/2011	T (S +T)	2	10, 15
RKR104	518102	7462161	496	171	0	-90	131.6	4/05/2011	T (S +T)	2	8, 17
RKR121	520576	7461760	511.65	111	-0.9	-60	Dry	4/05/2011	T (S +T)	2	12, 22
RKR123	520797	7461717	474.32	165	0	-60	Dry	4/05/2011	T (S +T)	2	9, 17
RKR126	520325	7461614	498.4	141	-	-60	Dry	4/05/2011	T (S +T)	2	10, 20
RKR128	519993	7461909	440	78	-1	-60	92.1	4/05/2011	T (S +T)	2	10, 22
RKR129	519947	7462016	444	171	0	-60	83.0	4/05/2011	T (S +T)	2	10, 15
RKR130	519667	7461987	404	153	-	-60	46.7	4/05/2011	T (S +T)	2	10, 32
RKR135	520389	7461520	455.86	141	-	-60	108.6	4/05/2011	T (S +T)	2	8, 16
RKR139	520327	7461790	483.53	138	-	-60	Dry	4/05/2011	T (S +T)	2	12, 22
RKR156	524201	7461583	488	87	-	-60	Dry	3/05/2011	T (S +T)	1	10
RKR161	526763	7461038	532	99	0.12	-60	98.7	3/05/2011	T (S +T)	2	8, 15
RKR164	527006	7461258	550	232	0.1	-60	193.7	3/05/2011	T (S +T)	2	10, 15
RKR166	525400	7461344	521	189	-	-60	Dry	3/05/2011	T (S +T)	2	6, 14
RKR177	521027	7461080	489	87	-	-60	Dry	3/05/2011	T (S +T)	2	8, 18
RKR178	521058	7461128	485	93	-	-60	Dry	3/05/2011	T (S +T)	2	8, 16
RKR185	525399	7461593	519	159	-	-60	Dry	3/05/2011	T (S +T)	2	12, 22
RKR187	527745	7461400	574	270	-	-60	Dry	2/05/2011	T (S +T)	2	15, 30
RKR189	527747	7461601	575.96	135	-	-60	Dry	2/05/2011	T (S +T)	2	10.5, 20
RKR195	528052	7462075	636.01	111	-	-60	Dry	2/05/2011	T (S +T)	2	15, 30
RKR198	527886	7462391	685.44	141	-	-60	Dry	2/05/2011	T (S +T)	2	10, 20
RKR201	527762	7461787	611	171	-	-60	Dry	2/05/2011	T (S +T)	1	8.5

[1] m agl = metres above ground level
[2] S = Stygofauna, T = Troglofauna. Sampling method in parenthesis (N = Net, S = Scrape, T = Trap)
[3] m btc = metres below ground level

APPENDIX IX

Appendix VIII: Site and sampling details for sites sampled in Round 7

Site Details								Sampling Details	
Site id	Easting (MGA 94)	Northing (MGA 94)	RL (m AHD)	Depth (m)	Collar Height (m agl)[1]	Collar dip (angle, degrees)	SWL m btc[2]	Sample Date	Trog (T) and/or Stygo (S)[3]
HARC075	529476	7461814	510.93	58.0	-	-90	Dry	18/06/2011	T (S)
HARC230	531310	7462177	407.768	142.0	-	-60	37.6	18/06/2011	T (S)
HARC231	531010	7462227	407.163	100.0	0.15	-60	Dry	18/06/2011	T (S)
HARC238	531492	7462190	398.752	82.0	-	-60	Dry	18/06/2011	T (S)
HARC292	529594	7462710	481	58.0	-	-60	Dry	18/06/2011	T (S)
HARC299	529558	7462551	466	46.0	-	-60	Dry	17/06/2011	T (S)
HARC309	529503	7462200	496.122	216.0	-	-60	Dry	17/06/2011	T (S)
HARC310	529496	7462250	496.195	174.0	-	-60	Dry	17/06/2011	T (S)
HARC378	529476	7462083	447	150.0	0.3	-60	101.7	18/06/2011	T (S)
HARC379	529490	7462083	465	150.0	-	-60	101.8	18/06/2011	T (S)
RKR092	518801	7462544	501	225.0	-	-60	Dry	17/06/2011	T (S)
RKR102	519398	7462043	439	135.0	0	-60	87.6	17/06/2011	T (S)
RKR104	518102	7462161	496	171.0	0	-90	131.6	17/06/2011	T (S)
RKR121	520576	7461760	511.65	111.0	-0.9	-60	Dry	18/06/2011	T (S)
RKR123	520797	7461717	474.32	165.0	0	-60	Dry	18/06/2011	T (S)
RKR126	520325	7461614	498.4	141.0	-	-60	Dry	18/06/2011	T (S)
RKR128	519993	7461909	440	78.0	-1	-60	92.1	18/06/2011	T (S)
RKR129	519947	7462016	444	171.0	0	-60	83.0	18/06/2011	T (S)
RKR130	519667	7461987	404	153.0	-	-60	46.7	18/06/2011	T (S)
RKR135	520389	7461520	455.86	141.0	-	-60	108.6	18/06/2011	T (S)
RKR139	520327	7461790	483.53	138.0	-	-60	Dry	18/06/2011	T (S)
RKR156	524201	7461583	488	87.0	-	-60	Dry	17/06/2011	T (S)
RKR161	526763	7461038	532	99.0	0.12	-60	98.7	17/06/2011	T (S)
RKR164	527006	7461258	550	232.0	0.1	-60	193.7	17/06/2011	T (S)
RKR166	525400	7461344	521	189.0	-	-60	Dry	17/06/2011	T (S)
RKR177	521027	7461080	489	87.0	-	-60	Dry	18/06/2011	T (S)
RKR178	521058	7461128	485	93.0	-	-60	Dry	18/06/2011	T (S)
RKR185	525399	7461593	519	159.0	-	-60	Dry	17/06/2011	T (S)
RKR187	527745	7461400	574	270.0	-	-60	Dry	16/06/2011	T (S)
RKR189	527747	7461601	575.96	135.0	-	-60	Dry	16/06/2011	T (S)
RKR195	528052	7462075	636.01	111.0	-	-60	Dry	16/06/2011	T (S)
RKR198	527886	7462391	685.44	141.0	-	-60	Dry	16/06/2011	T (S)
RKR201	527762	7461787	611	171.0	-	-60	Dry	16/06/2011	T (S)

[1] m agl = metres above ground level
[2] m btc = metres below ground level
[3] S = Stygofauna, T = Troglofauna. Sampling method in parenthesis (N = Net, S = Scrape, T = Trap)

APPENDIX X

Appendix X: Stygofauna sampling results for all sites.

Taxonomy				Bores Collected From	Total Individuals
Phylum	**Class**	**Order**	**Taxon**		
Round 1					
Crustacea	Malacostraca	Bathynellacea	Chilibathynella sp.	HAWB002 (1)	1
	Copepoda	Harpacticoida	Parastenocaris sp.	HAWB002 (1)	1
					2
Round 2					
Annelida	Oligochaeta			HARC205 (1), HARC220 (5), HARC235 (3), HAWB002 (4)	13
		Haplotaxida	Enchytraeidae sp	HARC110 (1)	1
			Enchytraeus pilbara sp. 1	HARC220 (3), HARC220 (1), HAWB002 (36), Breakaway Well (1), Madang Well (2) Rocklea Camp Well (1)	44
			Dero furcata	Madang Well (18)	18
			Dero nivea	Breakaway Well (8)	8
	Polychaeta		*Aeolosoma sp. 1*	Madang Well (3), Moonmar Well (1)	4
Crustacea	Malacostraca	Amphipoda	Amphipoda	Old Mill (1)	1
			Bogidiellidae	SLK 220-1 NW (3), SLK 220-2 NW (1)	4
			'*Maarrka*' nr sp. *wolli*	HAMB003 (1)	1
			Melitidae sp. 1 (PSS)	HAWB002 (1), HAMB003 (1), SLK 220-1 NW (2), SLK 220-2 NW (2)	5
			Nedsia nr *hurlberti* (PSS)	HAMB003 (1)	1
			Nedsia sp. 3 (PSS)	Cheela 1 (2), Cheela 2 (1), Cheela Springs (21), Kazput Well (43), Madang Well (5), Melon Hole (1), SLK 207.8 NW (4), SLK 220-1 NW (22), SLK 220-2 NW (28)	127
			Paramelitidae sp. 2 (PSS)	HAWB002 (4), HAMB001 (2), HAMB003 (11), Cheela Springs (4), Moonmar Well (65)	86
			Pilbarus millsi	Breakaway Well (2), Cheela Springs (2), Gobbo Well (1), Jupiter Well (9), Kazput Well (1), Madang Well (11), Rocklea 1 (28), SLK 207.8 NW (6), SLK 220-1 NW (42), SLK 220-2 NW (1)	103
		Isopoda	*Kagalana tonde*	SLK 220-1 NW	13
			Pygolabis eberhardi	Cheela Springs (5), Madang Well (1), SLK 207.8 NW (17), SLK 220-1 NW (27), SLK 220-2 NW (1)	51
			Pygolabis sp.	HARC203 (1), HARC262 (1), HAWB002 (1)	3
		Bathynellacea	Chilibathynella sp.	HAWB002 (6)	6

Taxonomy				Bores Collected From	Total Individuals
Phylum	**Class**	**Order**	**Taxon**		
Crustacea	**Rounds 3 - 5**				
	Copepoda	Cyclopoida	*Diacyclops humphreysi humphreysi*	HARC104 (1), HARC110 (3), HARC145 (1), HAWB002 (50), Breakaway Well (40), Kazput Well (50), Moonmar Well (10), SLK 207.8 NW (30), SLK 220-1 NW (100), SLK 220-2 NW (5)	290
			Diacyclops pilbaricus	HAMB001 (12), HARC108 (1)	13
			Diacyclops sobeprolatus	HAMB003 (150), Melon Hole (1)	151
			Diacyclops sp.	Sandy Creek Well (1)	1
			Microcyclops varicans	HARC262 (1), Gobbo Well (5), Madang Well (10), Moonmar Well (20), SLK 220-2 NW (20)	56
		Harpacticoida	*Abnitocrella halsei*	HAMB003 (1), SLK 220-1 NW (5)	5
			Parastenocaris jane	HARC097 (5), HAWB002 (37), Madang Well (1)	43
			Parastenocaris n. sp.	Old Mill (1), Rocklea Camp Well (50)	51
			Parastenocaris sp.	HAWB002 (1), HAMB003 (2), Melon Hole (1), Sandy Creek Well (1)	5
			Schizopera n. sp. B1	Madang (1), SLK 220-1 NW (5), SLK 220-2 NW (2)	8
			Schizopera roberiverensis	HAWB002 (1), HAMB003 (12), Breakaway Well (10), Gobbo Well (1), Kazput Well (1), Madang Well (32), Moonmar Well (5), SLK 220-2 NW (10)	72
	Ostracoda	Podocopida	Areacandona sp. (cf. atomus)	SLK 220-1 NW (50)	50
			Areacandona sp. BOS190 (cf. atomus)	SLK 220-2 NW (3)	3
			Candonidae sp. BOS184	Madang Well (1), Moonmar Well (1), Old Mill (1), SLK 220-2 NW (1)	4
			Candonidae n. sp. BOS185	Cheela Springs (6)	6
			Deminutiocandona sp.	Rocklea 1 (1)	1
			Deminutiocandona quasimica	Jupiter Well (10), Madang Well (3), Old Mill (2), SLK 207.8 NW (30), SLK 220-1 NW (1)	46
			Deminutiocandona sp. BOS190	SLK 220-2 NW (10)	10
			Deminutiocandona stomachosa	Moonmar Well (10)	10
			Candonocypris fitzroyi	HAWB002 (10), Madang Well (1), Old Mill (1), Sandy Creek Well (30)	42
			Cypretta seurati	Bloodwood Bore (5)	5
			Strandesia sp. 466	Sandy Creek Well (30)	30

Taxonomy				Bores Collected From	Total Individuals
Phylum	**Class**	**Order**	**Taxon**		
			Gomphodella hirsuta	HAWB002 (2), API West (1), Kazput Well (1), Rocklea 1 (1), SLK 220-1 NW (1), SLK 220-2 NW (10)	16
			Gomphodella sp. BOS 186 (cf. yandi)	HARC262 (2), Cheela Springs (5)	7
			Vestalenula marmonieri	Gobbo Well (2)	2
			Bennelongia sp.	Sandy Creek Well (20)	20
					1,428