Bennelongia
Environmental
Consultants

Hemi Gold Project Subterranean Fauna Survey Report

Prepared for:

De Grey Mining Ltd

December 2022

Final Report

Short-Range Endemics I Subterranean Fauna

Waterbirds I Wetlands

Hemi Gold Project Subterranean Fauna Survey Report

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EXECUTIVE SUMMARY

De Grey Minining Ltd is currently undertaking investigations into the feasibility of the Hemi Gold Project (the Project). Located 85 km south-southwest of Port Headland in the western Pilbara region. The Hemi Gold Project consists of six deposits called Aquila, Brolga, Crow, Diucon, Eagle and Falcon. Gold was first discovered at the Hemi Project, in late 2019.

Overall, the Project will consist of mine pits and associated infrastructure, a mining village and airstrip, process plant and tailings storage facility. In addition to mine excavation, gold mining usually requires groundwater extraction to enable dry mining below the water table and to provide water for gold processing. Both mine pit excavation and groundwater extraction can potentially impact subterranean fauna by removing their habitat.

This report presents the results of the field survey following on from a desktop assessment of the likelihood of occurrence of subterranean fauna in the Project area. The aim of survey was to assess the potential threat to subterranean fauna conservation values in the Hemi mining area.

The survey collected at least 45 stygofauna species. The major groups of stygofauna collected were amphipods, isopods, syncarids, ostracods, copepods, oligochaete worms along with nematode worms and rotifers. Twenty-seven species were collected from within the Project impact area (defined as the area of ≥2 m of Project-associated groundwater drawdown), with five species known only from within the area of ≥2 m groundwater drawdown associated with mine pit dewatering. The five species (all crustaceans) are:

- *Brevisomabathynella* \`BSY226\` (syncarid),
- Microcerberidae \`BIS464\` (isopod),
- Microcerberidae \`BIS544\` (isopod),
- *Parastenocaris \`BHA392\`* (harpacticoid), and
- Paramelitidae \`BAM210\` (amphipod).

It is probable that *Brevisomabathynella* \`BSY226\`and and Paramelitidae \`BAM210\` have local occurrence outside the Project. Existing information suggests that *Parastenocaris* 'BHA392', Microcerberidae 'BIS544' and Microcerberidae \`BIS464\`are likely to have small ranges and may be restricted to areas of groundwater drawdown.

It is anticipated that excess dewatered groundwater will be reinjected in the aquifer north and south of the mine pit. This is considered unlikely to change the chemical composition of receiving groundwater (data still to be provided) and, consequently, no impact on stygofauna is expected. Thus, the main threat to any restricted stygofauna species is likely to come from dewatering.

The one species of troglofauna collected was the dipluran Parajapygidae \`BDP208\`, which is known only from a proposed mine pit. Two specimens were collected from the same hole five months apart. Little can be said about the likely distribution of the species. However, sampling results very strongly indicate that the troglofauna community of the Project area is depauperate and it may be inferred that in such circumstances any troglofauna species present will be a wide-ranging, rather than an endemic, species. Thus, despite the collection of one species from the mine pit, the threat to troglofauna conservation values due to pit excavation and reinjection and mounding of groundwater is considered to be low.

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1. INTRODUCTION

De Grey Minining Ltd is currently undertaking investigations into the feasability of the Hemi Gold Project (the Project). Located 85 km south-southwest of Port Headland in the western Pilbara region, (Figure 1). The Hemi Gold Project consists of six deposits called Aquila, Brolga, Crow, Diucon, Eagle and Falcon. Gold was first discovered at the Hemi Project, in late 2019.

As a prospective gold mine, the Project will consist of mining pits and associated infrastructure, a mining village and airstrip, process plant and tailings storage facility (TSF). Mining is planned to be via open pit. Groundwater will need to be pumped from around the pit to enable dry mining and, in addition, there may be a requirement for extra water for processing of the gold ore. Both pit excavation and water abstraction are activities that can potentially impact the subterranean fauna that utilises the below ground environment.

This report follows from a desktop assessment of the likelihood of occurrence of subterranean fauna in the Project area and presents the results of the field survey undertaken to assess the potential ecological and conservation values of subterranean fauna in the Hemi mining area.

The objectives of this report are to:

1. Compile and evaluate records of subterranean fauna species collected from the three rounds of survey conducted,
2. Assess the significance of stygofauna and troglofauna species and/or communities collected from within the Hemi mining area, and
3. Assess the potential impacts that the Project may have on subterranean fauna species and/or communities present.

2. SUBTERRANEAN FAUNA FRAMEWORK

2.1. Conservation Framework

Native flora and fauna in Western Australia are protected at State and Commonwealth levels. At the national level, a legal framework to protect and manage nationally and internationally important fauna and ecological communities (among other factors) is provided via the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

At the state level, protection occurs under the *Biodiversity Conservation Act 2016* (BC Act). This provides a legal framework for protection of species, particularly for species listed by the Minister for the Environment as threatened. In addition to the formal list of threatened species under the BC Act, the Department of Biodiversity, Conservation and Attractions (DBCA) also maintains a list of priority fauna species that are of conservation importance but, for various reasons, do not meet the criteria for listing as threatened. Additionally, there is a gazetted state list of threatened ecological communities (TECs) that are protected under the BC Act. Other communities of potential conservation concern, but for which there is little information, are listed informally by DBCA as priority ecological communities (PECs).

The Environmental Protection Authority (EPA) also recognises the importance of subterranean fauna in Western Australia and its sensitivity to disturbance. Accordingly, the EPA requires that subterranean fauna be considered as part of environmental impact assessments for mining developments and similar operations (EPA 2016a, b, c; EPA 2021).

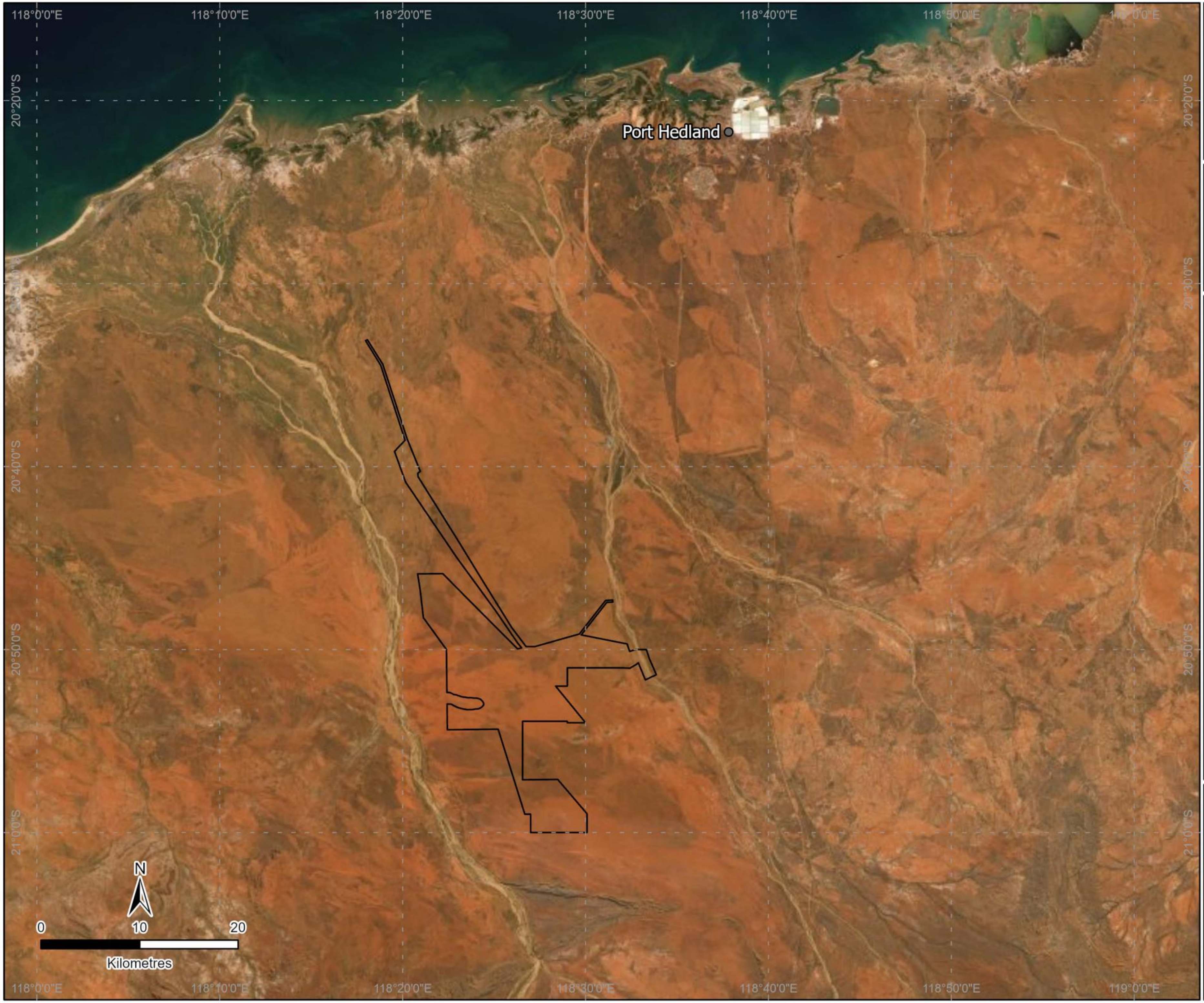

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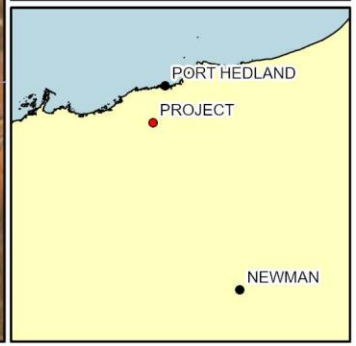
Figure 1. Location of the Project

Legend

Development Envelope



2.2. Subterranean Fauna

The term subterranean fauna encompasses two distinct animal communities: aquatic stygofauna and air-breathing troglofauna. Both groups are highly adapted to life underground and typically exhibit distinct morphological and physiological characteristics, such as reduced or absent eyes, lack of pigmentation, loss or reduction of wings, elongate sensory structures, increased lifespan, a shift towards K-selection breeding strategy and lower metabolic rate (Gibert and Deharveng 2002). Most subterranean fauna species in Western Australia are invertebrates, although a few species of stygofaunal fish and troglofaunal reptiles have been recorded (e.g. Aplin 1998; Whitley 1974).

While a large proportion of subterranean species spend their entire life cycles in groundwater (stygobites) or deep subterranean spaces above the water table (troglobites), others use these habitats only for a proportion of their life cycle (stygophiles and troglophiles) although they are equally reliant on subterranean habitat for persistence. Stygophiles and troglophiles usually have larger distributions than stygobites and troglobites as a result of greater dispersal opportunities.

Although inconspicuous, subterranean fauna contributes markedly to the overall biodiversity of Australia. The Pilbara, Yilgarn and neighbouring regions of Western Australia are globally important for subterranean fauna, with an estimated 4,500 or more subterranean species likely to occur (Guzik *et al.* 2010; Halse 2018a), the vast majority of which remain undescribed. Furthermore, subterranean fauna typically exhibit high rates of short-range endemism, with most subterranean species satisfying Harvey's (2002) criteria for short-range endemism. This includes having total range size of less than 10,000 km^2 and occupying discontinuous or fragmented habitats (Gibert and Deharveng 2002).

Eberhard *et al.* (2009) proposed a range of 1,000 km^2 (i.e. linear range of just over 30 km) as the criterion for Pilbara groundwater SREs. Halse and Pearson (2014) did not provide a threshold but pointed out that many troglofauna appear to have linear ranges of only a few kilometres (i.e. possibly a range of 100 km^2 is a suitable small range threshold in troglofauna). Given that locally restricted species are more vulnerable to extinction following habitat loss or degradation than wider-ranging species (Ponder and Colgan 2002), it follows that subterranean species are potentially more susceptible to habitat loss caused by mining and groundwater abstraction than surface species.

The occurrence and abundance of subterranean fauna is closely tied to geological structure. Both troglofauna and stygofauna require subterranean spaces such as interstices, voids, vughs, and fissures in which to live. The connectivity of these spaces both vertically and laterally is important. Vertical connectivity facilitates water movement from the surface to recharge aquifers and to transport carbon and nutrients into the vadose zone and then into underlying aquifers (Korbel and Hose 2011). Lateral connectivity allows animals to move about and interact in viable-sized species populations. Topographic features such as valleys and geological features such as dykes may act as barriers to dispersal of subterranean fauna.

The most productive known stygofauna habitats in the Pilbara are saturated alluvial and calcrete aquifers associated with palaeochannel deposits. Greenstone granitic geologies in the northern Pilbara can also be productive, especially where sandstone and to a lesser extent mafic volcanics are present. Aquifers in some iron formation, particularly channel iron deposit, may also support moderate abundances of stygofauna (Halse *et al.* 2014). In addition, stygofauna occur in the alluvium of hyporheic zones (the confluence of groundwater and surface-water habitats) as well as in groundwater-fed springs.

Apart from salinity, the physiochemical tolerances of stygofauna have not been well defined. Most stygofauna assemblages have been recorded in aquifers with fresh to brackish water, although they have been reported in salinities of up to 50,000 mg/L TDS or more (Bennelongia 2016; Reeves *et al.* 2007; Watts and Humphreys 2006).

Important habitats for troglofauna in the Pilbara include mineralized or weathered iron formations along with calcrete and detrital deposits (Edward and Harvey 2008; Mokany *et. al* 2019). Additionally, the high relative humidity of the habitat is important for troglofauna (Howarth 1983).

2.2.1. Threats to Subterranean fauna

For stygofauna, the primary threat from mining is typically the habitat removal resulting from dewatering and drawdown. It is possible for persistence of species with very small ranges to be threatened by groundwater drawdown if their range is mostly, or entirely, encompassed by the drawdown zone. Depending on the depth of drawdown, it is possible for all the habitat of a highly restricted species to be dewatered. Altered water chemistry resulting from aquifer recharge may also pose a significant threat in some cases.

For troglofauna, the primary threat from mining is usually excavation of available habitat during mining operations, while augmenting the groundwater table via reinjection also has the potential to flood (and therefore remove) existing troglofauna habitat.

3. HABITAT ASSESSMENT

3.1. Geology

The Project is located in the north-western part of the Pilbara Craton and contains rocks belonging to the Pilbara granitic-greenstone terrain. Clastic sedimentary rocks of the De Grey Group dominate outcrops and include coarse to fine-grained subarkose, wacke and shale. Four basement rock types exist in the area, including metamorphosed siliciclastic rocks, metamorphosed silicified (mafic) volcanic rocks, metamorphosed ultramafic rocks, and surrounding granitic rock types.

The Project lies in an area of anastomosing faults that form a low ridge of calcreted and silicified rocks of the De Grey Group and an east trending, 1 km wide zone of shearing termed the Mallina Shear Zone lies west of the Project (Smithies, 1999). Most rocks of the De Grey Group north of the faults are wacke and shale of the Mallina Formation. The De Grey Group south of the faults includes rocks assigned to the Constantine Sandstone, which underlies the Mallina Formation. In the southern area, peridotite and other ultramafic rocks belonging to the Millindinna Intrusion intrude the De Grey Group. In the northern area the Portree Granitoid Complex intrudes the De Grey Group and the Peawah Granodiorite intrudes in the southwestern part. Ferruginous chert and banded iron-formation in the south-eastern corner of the Yule are interpreted to underlie the De Grey Group, but no stratigraphic contacts are exposed.

Surface geology at the scale of 1:100,000 (Figure 2) is dominated by alluvial sand, silt, and clay in floodplains (Qao, Qaoc), with areas of Eolian sand (Qs), Turbiditic wacke (Adt), Serpentine and serpentine-actinolite schists (AaMus) and Siliceous caprock (Czru) (Figure 2). Further detail about the geological units is provided in Appendix 1.

The surface geologies present at the Project, particularly the areas of alluvium, are prospective habitat for subterranean fauna. Furthermore, deeper geologies such as sandstone are also prospective habitat and, more generally, areas around the fault lines potentially have voids owing to extensive zones of fracturing associated with faulting and sedimentary-igneous bedrock contacts.

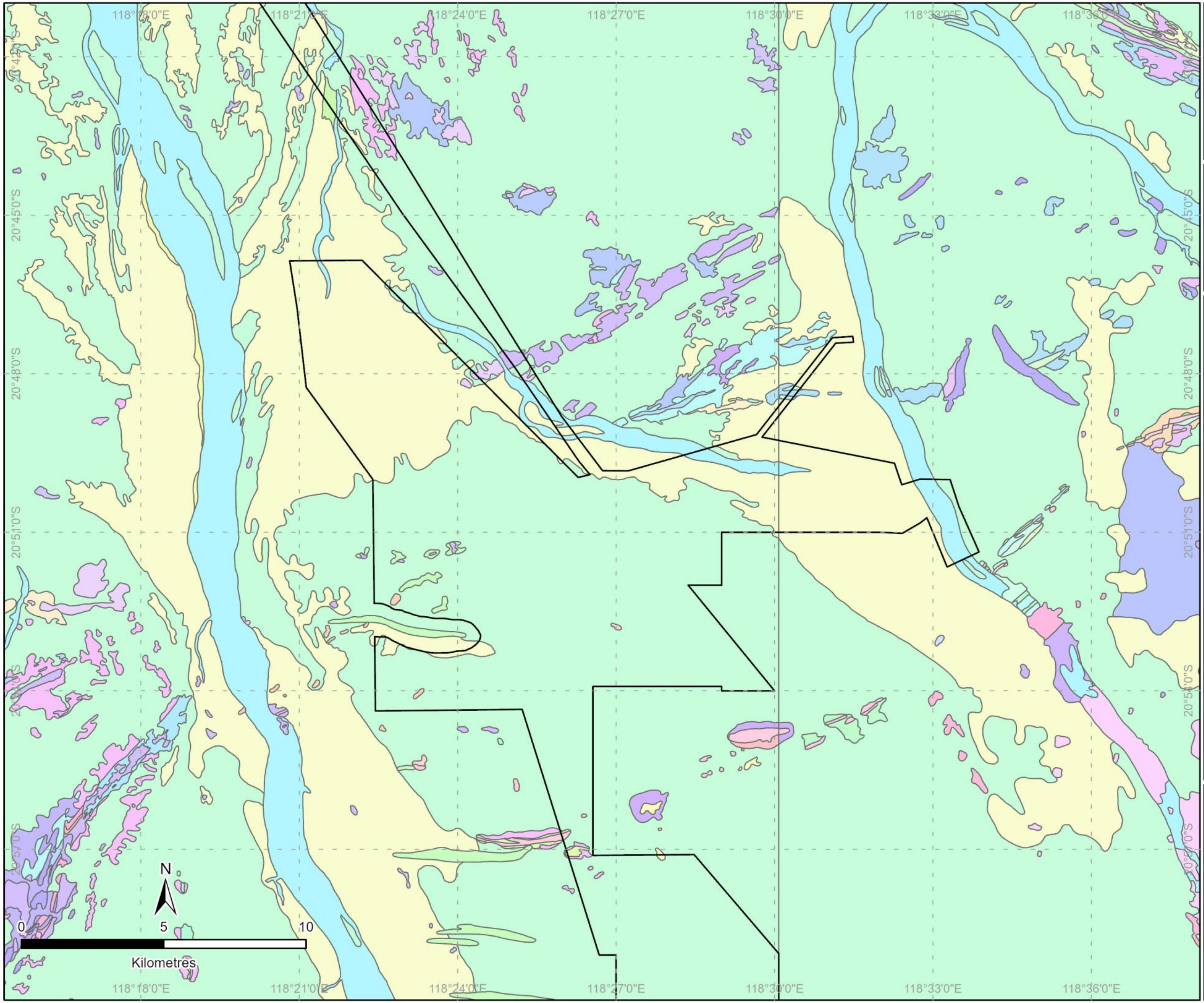


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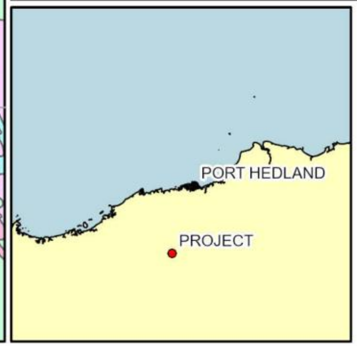
Figure 2. Surface geology at the Project

Geology of the Yule 1:100 000 sheet (Geological Survey of Western Australia)



3.2. Hydrogeology

A recent scoping study of 11 shallow monitoring bores (Geowater Consulting unpublished data) revealed that the water table in the Project area is 5-6 m below ground level (mbgl). Groundwater appears to be stored in a shallow unconfined aquifer system at the Hemi deposit and surrounds, with high permeability and storage in the relatively unconsolidated alluvials. Additionally, a palaeovalley axis with very high permeability also runs NNW through the Hemi area.

Groundwater within the shallow aquifer is fresh and slightly alkaline. The salinity in the Project area increases gradually in an eastward direction from 600 mg/L to 1,100 mg/L. At Hemi, the shallow groundwater salinity is typically 800 – 950 mg/L.

It is expected that dewatering will be required for mining and that the associated groundwater zone will have a diameter of about 5 km. It is likely that the shallow aquifer at Hemi is hydraulically connected to the water table aquifer near the Yule River over a large river reach. The Project area is located across two water catchments: the Yule River to the west and Turner River to the east, respectively.

4. DESKTOP ASSESSMENT

The prevalence of subterranean fauna sampling in the wider vicinity of the Project is described in a desktop assessment by Bennelongia (2021). This desktop collated all known records of subterranean fauna from within a search area of 100 km X 100 km surrounding the Project (Appendix 2). The desktop found records of 96 stygofauna species within the search area, including representatives of the rotifers, nematodes, oligochaete and polychaete worms, ostracods, copepods, syncarids, amphipods and isopods. Crustaceans accounted for 78 of the 96 species (Appendix 3)

Additionally, 20 species of troglofauna have been recorded in the search area including, pseudoscorpions, isopods, diplurans, cockroaches, true bugs and silverfish (Appendix 4). Records indicate troglofauna species were collected from colluvial deposits, basalt, silicified amphibolite and banded iron formation.

The records and distribution of stygofauna and troglofauna within the search area are available in Appendix 2. Most records in the search area are concentrated in the north-east and south-east, reflecting sampling of other mining leases. The desktop assessment showed the search area does not contain any subterranean species listed under the BC Act; nor are there any subterranean fauna-based PECs or TECs.

The conclusion of the Bennelongia (2021) desktop assessment was that geologies present within the Project are prospective habitat for stygofauna and to a lesser extent, troglofauna. This was primarily attributed to the occurrence of a shallow alluvial aquifer (water table level 2.8 m – 6.7 mbgl). While a shallow aquifer is highly prospective for stygofauna, it has low prospectivity for troglofauna (due to lack of available habitat above the water table). Prospective habitat for troglofauna is in the ore deposit. As such, Bennelongia recommended a Level 2 stygofauna survey and a Level 1 troglofauna survey to be undertaken.

5. FIELD SURVEY

5.1. Sampling Effort

Sampling for subterranean fauna conducted by Bennelongia consisted of three rounds of sampling for stygofauna and a single round of sampling for troglofauna. Sampling occurred between October 2021 and May 2022 with a total of 20 troglofauna and 120 stygofauna samples collected during the survey (Table 1, Figure 3).

Forty bores and drill holes were sampled three times for stygofauna, with 19 of these being in the proposed mine pits or nearby in areas expected to be affected by dewatering. The other 21 were outside the area of groundwater disturbance and are treated as 'reference' sites. They were mostly pastoral bores (Figure 3, Appendix 5). No sampling for stygofauna occurred in areas of reinjection, which were not identified at the time of sampling.

Twenty drill holes were sampled once for troglofauna with 13 of the holes being inside the proposed mine pits and seven being outside and treated as 'reference 'sites. There are relatively few uncased holes suitable for troglofauna sampling outside the planned mine pits. No sampling troglofauna occurred in areas of reinjection and groundwater mounding, which were not identified at the time of sampling.

Table 1. Subterranean fauna survey effort

	Round 1 October 2021		Round 2 December 2021		Round 3 March/April/May 2022	
	Impact	Reference	Impact	Reference	Impact	Reference
Stygofauna (net)	19	21	19	21	19	21
Troglofauna (scrape and trap)	13	7	-	-	-	-

5.2. Methods

Sampling was conducted according to the general principles laid out for subterranean fauna sampling by the Environmental Protection Authority (EPA) in *Technical Guidance - subterranean fauna surveys for environmental impact assessment* (EPA 2021).

5.2.1. Stygofauna

Stygofauna were sampled using weighted plankton nets. Six hauls were taken at each site, three using a 50 µm mesh net and three with a 150 µm mesh net. The net was lowered to the bottom of the hole and jerked up and down briefly to agitate benthos (increasing the likelihood of collecting benthic species) and then slowly hauled back to the surface.

Contents of the net were transferred to a 125 ml polycarbonate vial after each haul, flushed with bore water to reduce fine sediment content, preserved in 100% ethanol and refrigerated at a 4 °C. Nets were washed between holes to minimise site-to-site contamination.

In situ water quality parameters – temperature, electrical conductance (EC) and pH – were measured at each site. Standing water level was also measured using a Solinst water level meter.

5.2.2. Troglofauna

Troglofauna were sampled using two complementary sampling techniques: scraping and trapping.

1. *Scraping* was done using a weighted net of 150 µm mesh that had an upper diameter approximately 60% of the drill hole diameter. The net was lowered to the bottom of the hole or to the water table, and subsequently scraped back to the surface at least four times. In each of these scrapes a different section of the wall of the hole was targeted (e.g., north, south) to maximize the number of animals retrieved. After each haul, net contents were transferred to a 125 ml vial with refrigerated100% ethanol until return to the laboratory.
2. *Trapping* was done using traps of cylindrical PVC (170 x 65 mm) with holes on the sides and top to function as entrances and a bait of microwaved leaf litter. Traps are lowered on nylon cord to the end of the hole or to a few metres above the water table. For most holes, one trap was set near the bottom of the hole; at a quarter of holes a second trap was set approximately

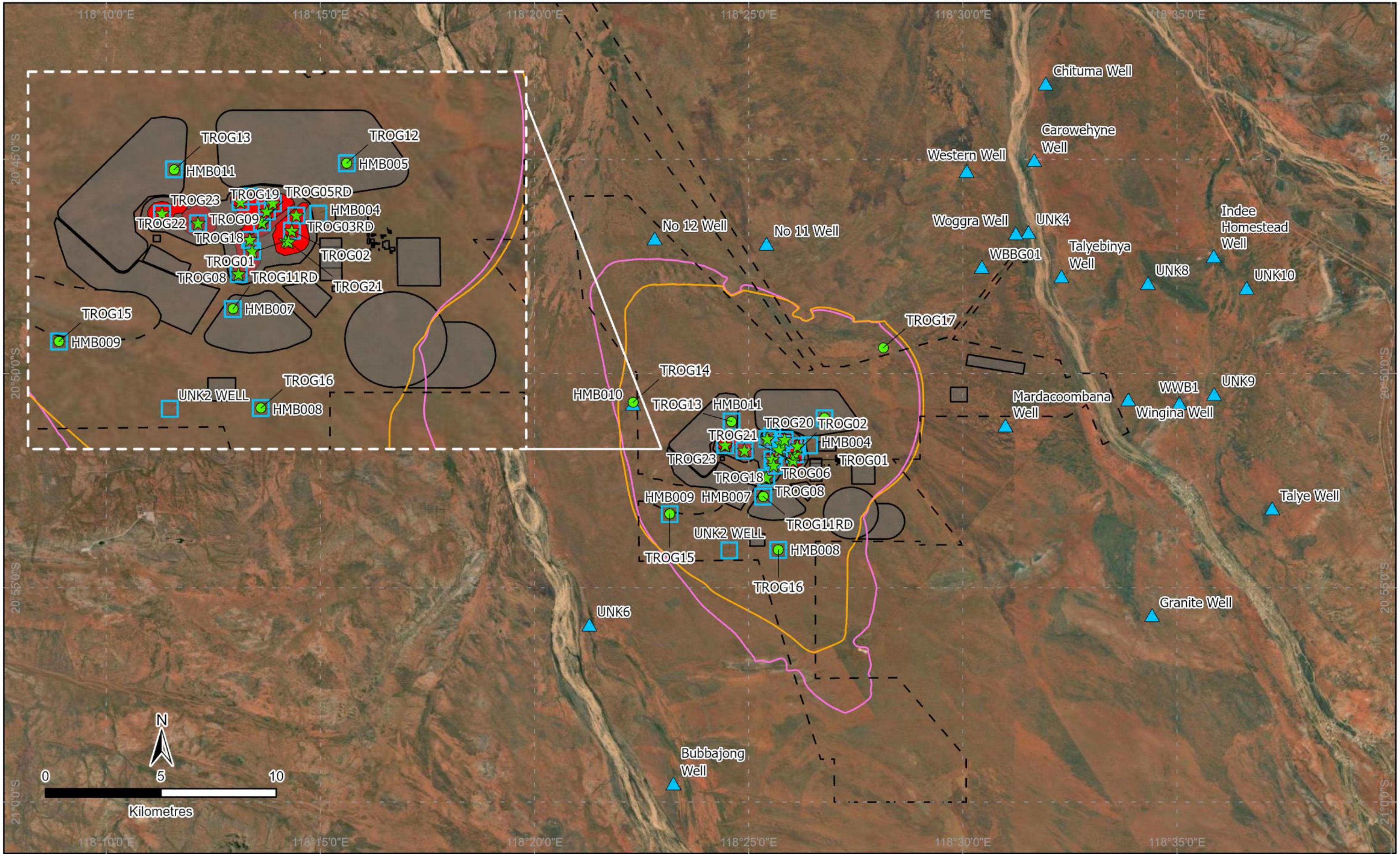


Figure 3. Sites sampled for subterranean fauna at the Project

halfway between the surface and the first trap. Traps were then left in place for approximately eight weeks for troglofauna to colonize them. During that period, the bores were sealed off at the surface to minimise entry of surface animals into the traps. After retrieval the contents of traps were transferred to a zip-lock bag and animals transported alive to the laboratory in Perth.

When calculating troglofauna sampling effort, scraping was considered to represent 0.5 sample and trapping was also considered to be 0.5 sample, irrespective of the number of traps used. The reason for treating scraping and trapping as sub-samples is that troglofaunal yields are low and a diversity of methods is required to collect a moderately comprehensive sample (Halse and Pearson 2014; Halse 2018b).

5.2.3. Laboratory Processing

All samples were processed by Bennelongia laboratory staff in Perth. Leaf litter retrieved from troglofauna traps was processed in Berlese funnels under halogen lamps for 72 hours, during which time the light and heat drives animals downwards, towards a vial containing 100% ethanol as a preservative. Litter was quickly checked after removal from the funnels to ensure no invertebrates remained. Samples in ethanol from the Berlese funnels were carefully screened under a dissecting microscope to pick out troglofaunal animals.

Stygofauna net and troglofauna scrape samples were elutriated to separate animals from sediment and put through sieves to fractionate the contents according to size (250, 90 and 53 µm) to improve searching efficiency. All potential stygofauna and troglofauna animals were removed from these samples for species or morphospecies level identification. Surface animals were identified to Order level and classified as by-catch.

Species identification of stygofauna and troglofauna was conducted using published, unpublished and informal taxonomic keys, as well as species descriptions in the scientific literature. Morphospecies were established using the characters of existing species keys, and the lowest level of identification possible was reached given the constraints of sex, maturity of the specimens (juveniles and females often cannot be identified to species level) and possible damage to body parts. Dissecting and compound microscopes were used during the sorting and identification processes, with specimens dissected as required.

DNA sequencing was completed on seven specimens (from at least five different species) from the study area. Depending on the size of the specimens, legs or whole animals were used for DNA extractions using a Qiagen DNeasy Blood & Tissue kit (Qiagen 2006). Elute volumes were 25 to 40 µL determined by the age, condition and quantity of material. Primers combinations used for PCR amplifications were LCO1490:HCO2198, C1J1718:HCO2198, and LCO1490:HCOoutout for the MT-CO1 gene (Folmer *et al.* 1994; Schwendinger and Giribet 2005) and SRJ14197:SRN1474S for 12S. Next, dual-direction sanger sequencing was undertaken for PCR products by the Australian Genome Research Facility (AGRF). The sequences returned were edited and aligned in Geneious (Kearse *et al.* 2012), where neighbour-joining phylogenetic trees were then calculated using 1000 bootstraps. Genetic distances (using the Tamura-Nei method) between unique sequences were measured as uncorrected p-distances (total percentage of nucleotide differences between sequences). Sequences on GenBank and in grey literature were included in phylogenetic analysis to provide a framework for assessing intra and interspecific variation, as well as to examine levels of differentiation among individuals within described species across their geographic ranges.

5.2.4. Personnel

The field survey was undertaken by Jim Cocking, Jacob Thompson, Sam Chidgzey, Vitor Marques and Huon Clark. Laboratory sorting of samples and species identifications were completed by Jane McRae, Heather McLetchie, Jim Cocking, Melita Pennifold, Monique Moroney, Sam Chidgzey, Vitor Marques and

William Fleming. The desktop review was completed by Melita Pennifold with reporting of the survey completed by Monique Moroney, Melita Pennifold and Stuart Halse.

5.3. Limitations

The spread of sampling for stygofauna within the impact area was constrained by very few holes being available outside the central area of groundwater drawdown. Neither stygofauna nor troglofauna sampling occurred in the area of reinjection and groundwater mounding, which had not been identified when sampling occurred. The impact of reinjection is likely to be minimal for troglofauna because the shallow water table leaves little habitat for troglofauna and few species are likely to be present (as confirmed by survey). It is proposed that no significant chemical changes in groundwater are likely as a result of reinjection.

6. FIELD SURVEY RESULTS

6.1. Groundwater

Depth to groundwater in the mine pit area was mostly 5-6 mbgl, while in surrounding reference areas it was usually greater than 10 mbgl (Appendix 6). The average change in depth to groundwater for the holes sampled for stygofauna and troglofauna was only 0.2 m between late dry season (October 2021) and late season (March to May 2022).

Electrical conductivity (as a measure of salinity) was approximately 1500 µS/cm in the area of groundwater drawdown, although there were occasional values of about 500 µS/cm. Elecrical conductivity values in the references area for stygofauna were usually several times greater than in the impact area (Appendix 6). Electrical conductivity values were 18% lower in March to May 2022 than in December 2021.

Values for pH were neutral or slightly alkaline and showed little change over time (0.07 pH unit between October 2021 and March-May 2022) Appendix 6).

6.2. Stygofauna

Across the three rounds of sampling, 3,358 stygofauna specimens were collected representing at least 45 species (Table 2, Figures 4-6). This includes ostracods (14 species), copepods (12 species), annelid worms (eight species), amphipods (four species), syncarids (two species), isopods (three species), rotifers (one species) and nematodes. Due to poor condition of specimens, sex or life stage some records were identified to higher order only.

Many nematode worms and rotifers were collected in the stygofaunal samples although these groups are typically not considered in environmental impact assessment due to uncertain degrees of groundwater dependence or difficulties of identification. They are included in counts to simplify tracking but are not conservation significant.

Table 2. Stygofauna species collected during survey.
Note: species currently only known from within area of impact are highlighted in orange, and higher-level identifications not representing additional species highlighted in grey.

Higher Classification	Lowest Identification	No. Specimens		Comments
		In impact	Outside impact	
Nematoda	Nematoda spp.	72	105	Treated as widespread
Rotifera				
Bdelloidea	Bdelloidea sp. 3:2	0	30	Treated as widespread
Annelida				

Higher Classification	Lowest Identification	No. Specimens		Comments
		In impact	Outside impact	
Clitellata				
Haplotaxida				
Naididae	*Dero (Aulophorus) furcatus*	5	99	Widespread
	Pristina aequiseta	0	18	Widespread
Phreodrilidae	Phreodrilidae `BOL076` (AP DVC 1H)	3	188	Known linear range 30 km
	Phreodrilidae sp. AP SVC s.l.	1	0	Widespread
Tubificidae	*Monopylephorus* sp. nov. WA29 (ex Pristina WA3) (PSS)	3	30	Widespread in Pilbara
	Tubificidae `BOL075`	3	45	Known linear range 20 km
Enchytraeida				
Enchytraeidae	Enchytraeidae `2 bundle` s.l. (short sclero 4 per seg)	0	6	Widespread
	Enchytraeidae `3 bundle` s.l. (short sclero)	12	425	Widespread
	Enchytraeidae sp.	1	0	
Arthropoda				
Crustacea				
Ostracoda				
Candonidae	*Areacandona akatallele*	0	35	Widespread in Pilbara
	Areacandona incogitata	0	1	Also recorded at Ord Ranges approximately 80 km north-west
	Areacandona iuno	0	18	Widespread in Pilbara
	Areacandona yuleae	7	0	Widespread in Pilbara
	Areacandona ?quasilepte	0	2	Collected at No 11 Well
	Areacandona `BOS1625`	1	16	Known linear range 19 km
	Areacandona `BOS1627`	0	1	Collected at No 11 Well
	Areacandona `BOS1653`	0	25	Known linear range 16 km
	Candonidae `BOS1657`	0	12	Collected at hole WWB1
Cyprididae	*Cypretta seurati*	19	277	Widespread
	Cyprinotus kimberleyensis s.l.	0	120	Widespread
	Riocypris fitzroyi	2	147	Widespread
	Stenocypris malcolmsoni	10	34	Widespread
Darwinulidae	*Vestalenula marmonieri*	15	20	Widespread
	Ostracoda sp.	2	4	
Maxillopoda				
Cyclopoida				
Cyclopidae	*Diacyclops* `BCY087`	50	217	Collected in eight bores current linear range of 21 km

Higher Classification	Lowest Identification	No. Specimens		Comments
		In impact	Outside impact	
	Diacyclops scanloni	0	7	Widespread
	Diacyclops sp.	45	55	
	Dussartcyclops 2222 `BCY093`	4	22	Collected in two bores current linear range of 16 km
	Mesocyclops brooksi	0	11	Widespread
	Mesocyclops notius	1	49	Widespread
	Mesocyclops sp.	0	1	
	Microcyclops varicans	25	98	Widespread
	Orbuscyclops westaustraliensis	1	8	Widespread
Harpacticoida				
Ameiridae	*Megastygonitocrella trispinosa*	1	606	Widespread in Pilbara
	Megastygonitocrella unispinosa	2	0	Widespread in Pilbara
Canthocamptidae	*Elaphoidella humphreysi*	1	34	Widespread
Parastenocarididae	*Parastenocaris* `BHA392`	1	0	Singleton collected at TROG18
	Parastenocaris `BHA393`	0	1	Singleton collected at Tayle Well
	Parastenocaris sp.	3	1	Likely to be *P.* 'BHA392'
	Copepoda sp.	2	2	
Malacostraca				
Syncarida				
Parabathynellidae	*Atopobathynella* `BSY225`	3	10	Known linear range 21 km
	Brevisomabathynella `BSY226`	1	0	Singleton collected at HMB004
Amphipoda				
Eriopisidae	*Nedsia* `*hurlberti* group` sp. 1 spine	0	238	Unknown range
	Nedsia sp.	0	1	
	Eriopisidae `BAM149` (sp. 1 group)	0	11	Known linear range 30 km
Paramelitidae	Paramelitidae `BAM210`	3	0	Known linear range of 7 km
	Paramelitidae Genus 2 `BAM209`	0	8	
Isopoda				
Microcerberidae	Microcerberidae `BIS464`	1	0	Known linear range of 2.3 km
	Microcerberidae `BIS544`	19	0	Known linear range of 2.2 km
	Microcerberidae `BIS545`	0	1	Singleton collected at WBBG01
Total		**319**	**3039**	

6.2.1. Stygofauna Collected Within the Impact Area

At least 27 stygofauna species were collected from the predicted impact area for stygofauna as defined by groundwater drawdown contours provided by De Grey Mining (Figures 4-6). Of these 16 are widespread species, six species are known to have wider local occurrence than the impact area, and five species are currently known only from the impact area (i.e. ≥2 m of groundwater drawdown). The five species are the harpacticoid *Parastenocaris* `BHA392`, syncarid *Brevisomabathynella* `BSY226`, isopods Microcerberidae `BIS464` and Microcerberidae `BIS544' and amphipod Paramelitidae `BAM210`.

***Parastenocaris* `BHA392`,**

Six *Parastenocaris* species were collected from four holes, three in the groundwater drawdown area (TROG09, TROG18, TROG22) and one 20 km east in the reference area (Tayle Well) (Figure 4). Sequencing of all six specimens produced two CO1 sequence on the second attempt. These animals from the impact area (*Parastenocaris* 'BHA392', hole TROG18) and the reference area *(Parastenocaris* 'BHA393', Tayle Well) were 24.5% divergent and represent different species (Appendix 7).

The specimens from holes TROG09 and TROG22, which are within 1.3 km of TROG18 and in the same geology, are highly likely to be *Parastenocaris* 'BHA392' and are trated as conspecific in the report, although shown separately in Table 2. Most species of *Parastenocaris* appear to have small ranges.

***Brevisomabathynella* `BSY226`**

The syncarid *Brevisomabathynella* `BSY226` was collected as a single animal from the bore HMB004 within the proposed drawdown area (Figure 5). Inferring ranges of species represented by single records is an uncertain process, although habitat information and the life history of related species can provide guidance.

The Western Australian syncarid fauna is significantly diverse (Guzik *et al.* 2008; Perina *et al.* 2018). Syncarids often have small ranges (Asmyhr *et al.* 2014; Cook *et al.* 2012) and linear ranges of 5-30 km were observed by Perina *et al.* (2018). The predicted mine pit drawdown at Hemi, with a diameter of about 15 km, has sufficient spatial extent to entirely encompass the ranges of many syncarid species. However, surface geology at the Project is relatively uniform (Figure 3) which suggests *Brevisomabathynella* `BSY226` may have a large range for a syncarid and extend beyond the impact area.

Microcerberidae `BIS464`

Microcerberids were collected from five holes within the impact area (linear range 2.8 km) and at hole WBBG01 approximately 10 km north-east (Figure 5). Morphology suggested that probably a single species (Microcerberidae 'BIS464') was present. Sequencing with CO1 and 12S was undertaken for animas from all holes to confirm this, with two rounds of sequencing yielding sequences for animals from four holes. The sequencing resulted in the recognition of three species; Microcerberidae 'BIS464 at TROG08, Microcerberidae 'BIS544' at the other four impact area holes, and Microcerberidae 'BIS545' in the reference area at hole WBBG01.

Currently Microcerberidae `BIS464` is known from a single animal at hole TROG08 in the area of groundwater drawdown. Microcerberidae `BIS464` is one of three species recorded within a distance of about 10 km, suggesting it may have a very small range.

Microcerberidae `BIS544'

Microcerberidae 'BIS544' is known from 19 specimens from six records at four holes (HMB002, HMB003, HMB004, TROG22) over a distance of 1.6 km in the area of groundwater drawdown (Figure 5). The species appears to have a small range with other species occurring to the south (Microcerberidae 'BIS464') and east (Microcerberidae 'BIS545').

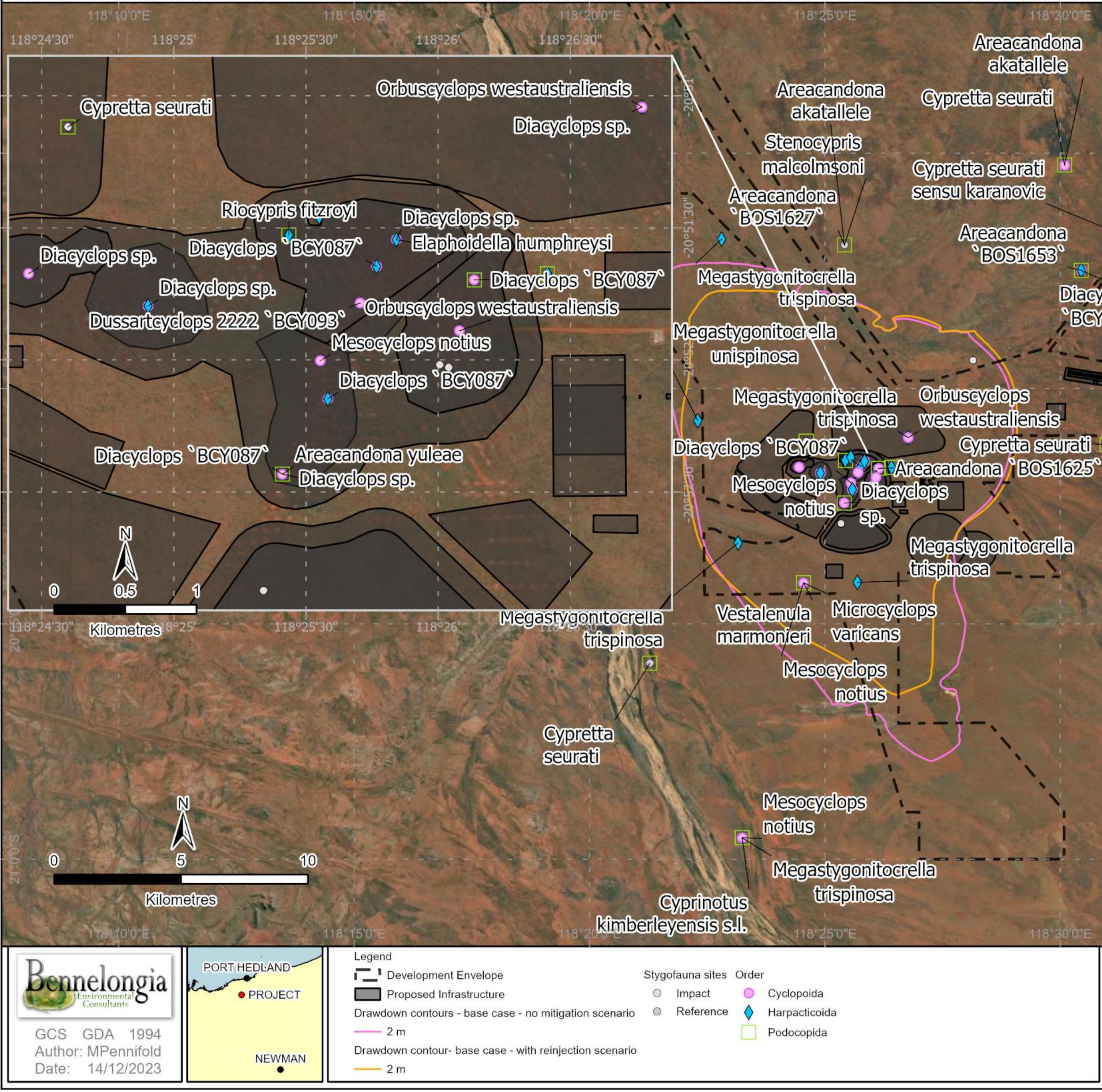


Figure 4. The location of cyclopoid, harpacticoid and ostracod records

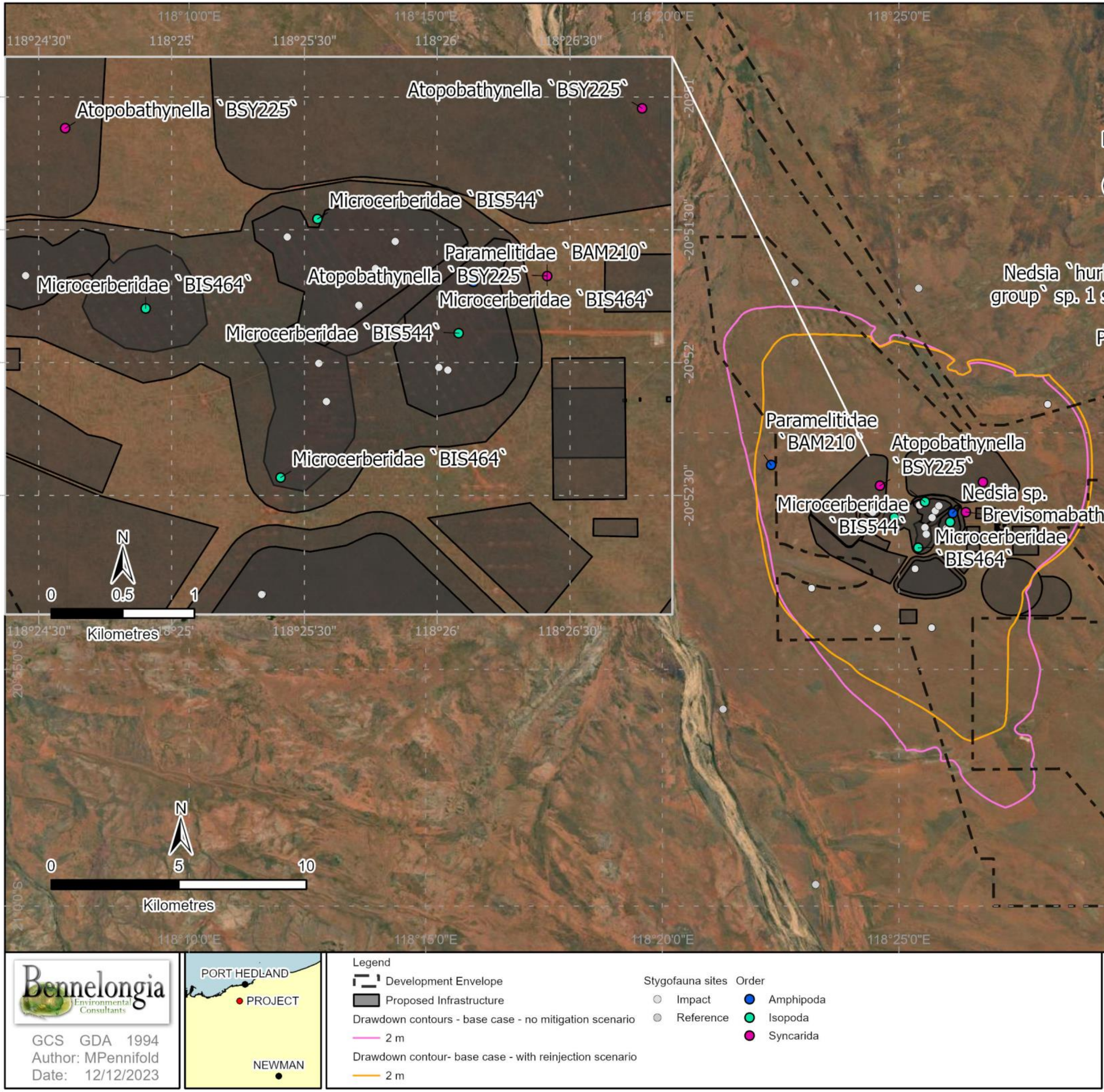
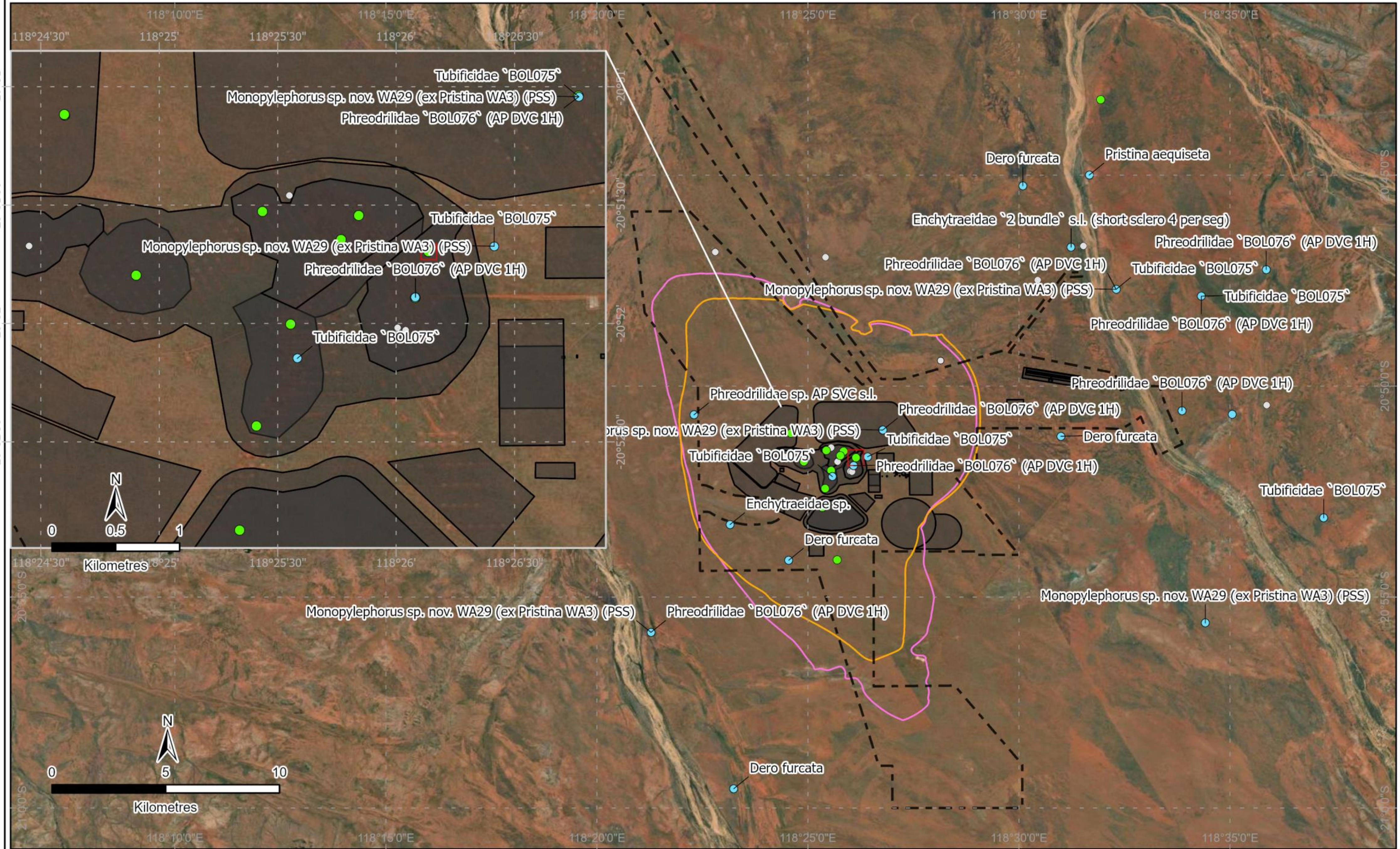
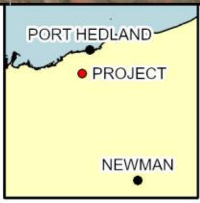


Figure 5. The location of amphipod, isopod and syncarid records





Bennelongia Environmental Consultants

GCS GDA 1994
Author: MPennifold
Date: 14/12/2023

Legend
- Development Envelope
- Proposed Infrastructure
- Drawdown contours - base case - no mitigation scenario
  - 2 m
- Drawdown contour- base case - with reinjection scenario
  - 2 m
- Enchytaeidae '3 bundle' s.l. (short sclero)
- Other Oligochaete spp. (labelled)
- Parajapygidae `BDP208`

Figure 6. The location of oligochaete and troglofauna records

Paramelitidae `BAM210`
The amphipod Paramelitidae `BAM210` is currently known only from two holes (HMB004 and HMB010) in the impact area (Figure 5). The bores are located approximately 7 km apart, with one record close to the western edge of drawdown.

Paramelitid amphipods tend to have catchment-scale ranges reflecting significant creeks or tributaries (Finston *et al*. 2007; Halse *et al*. 2014). It is highly unusual for amphipods to have very small distributions, such as would be required to be restricted to the Project impact area.

6.3. Troglofauna

A single species of troglofauna was collected within the proposed mine pits, namely the dipluran Parajapygidae `BDP208` (Table 4, Figure 6). The low yield of troglofauna species from the Project is attributed to lack of availible habitat because of the shallow water table.

Diplurans are primitive insects. The median linear range of troglofauna species in the Pilbara has been estimated as 5 km (Halse and Pearson 2014). However, the variation in ranges is large and it is likely the species with small ranges mostly occur in rock, while species in various detritals (sand, colluvium, alluvium) probably have relatively large ranges. Parajapygids are typically root-feeding species found in deep subsoil where there is 100% humidity (Sendra *et al*. 2021). Records of parajapygids in the Pilbara are quite common but few species are represented by multiple records. The eight species with at least three records have linear ranges varying from 0.8-49 km (mean 17, median 14). The species with a range of 0.8 km occurs in a Robe mesa; other species with small ranges were associated with strong landscape features, wheile species with larger ranges are in valleys or flat areas. Given the open characteristics of the Project landscape, Parajapygidae `BDP208` is likely to have range substantially larger than the 5 km long mine pit area and the area of groundwater mounding.

Table 3. Troglofauna species collected during survey.

Higher Classification	Lowest Identification	No. Specimens	Comment
Hexapoda			
Entognatha			
Diplura			
Parajapygidae	Parajapygidae `BDP208`	2	Currently only know from survey, collected at site TROG03RD

7. DISCUSSION

Mine pits will need to be dewatered to enable dry mining. Dewatering water can often be used for processing ores and operational duties, including dust suppression. The volume of dewatering however is expected to be significant and likely to exceed requirements for processing, dust suppression and other uses. Excess dewatered groundwater will be reinjected into areas north and south of the mine pits and/or discharged into the Turner River.

Dewatering and reinjection have the potential to remove or degrade subterranean fauna habitat in the following ways:

- **Dewatering** removes stygofauna habitat by drawing down the water table. The current planned dewatering will result in area of about 150 km^2 with groundwater drawdown of ≥2 m (Figure 4; Figure 5).

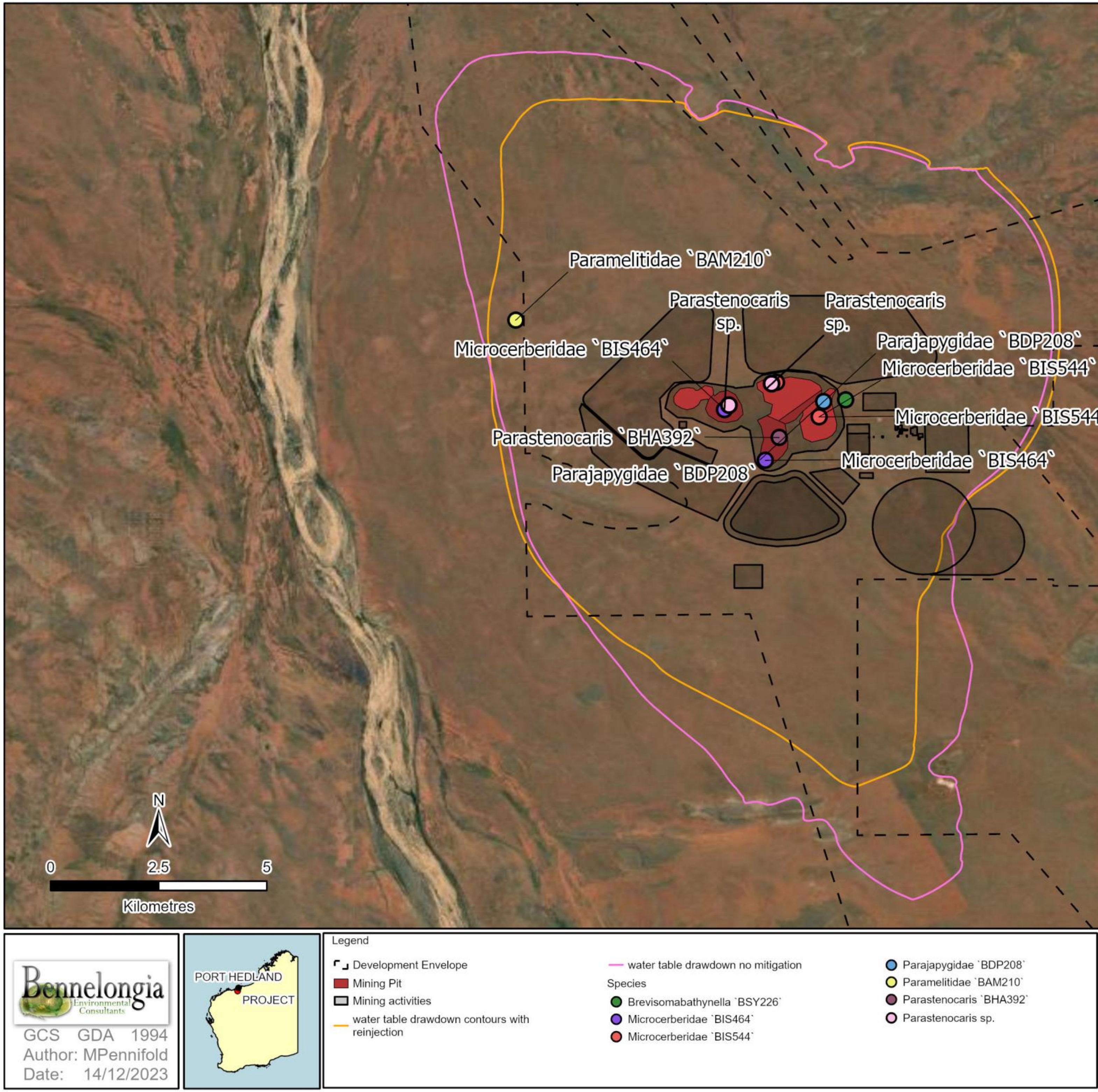


Figure 7. Location of restricted troglofauna and stygofauna species

- **Mounding** can remove troglofauna habitat by saturating it and making it unsuitable for air-breathing species. De Grey Mining is investigating the feasibly of reinjection to bores north and south of the Project. It is planned that the areas of mounding will be smaller in total than the area of dewatering, so that the watertable would be significant lowered in the immediate vicinity of the mine pits. Existing information suggests few troglofauna species are present to be affected by raised water tables.

- **Water quality changes** may occur when groundwater is reinjected into a different aquifer. This has the potential to make the receiving aquifer less hospitable for stygofauna. However, reinjected groundwater at the Project would have essentially the same chemical composition as the receiving groundwater. No impact on stygofauna would be expected.

8. CONCLUSION

The survey resulted in the collection of at least 45 stygofauna species. The major groups of stygofauna collected include amphipods, isopods, syncarids, ostracods, copepods and oligochaete worms as well as rotifers and nematodes. The species collected are typical of a well-structured stygofauna community. At least 26 species were collected from within the predicted area of groundwater drawdown associated with mine pit dewatering. Of these, 14 are widespread species, six were collected locally outside the area of drawdown, and five species are known only from within the predicted area of drawdown. The five species are:

- *Parastenocaris* 'BHA392' (copepod)
- *Brevisomabathynella* `BSY226` (syncarid)
- Microcerberidae `BIS464` (isopod)
- Microcerberidae 'BIS544'
- Paramelitidae `BAM210` (amphipod).

It is probable that *Brevisomabathynella* `BSY226`and and Paramelitidae `BAM210` have local occurrence outside the Project. Existing information suggests that *Parastenocaris* 'BHA392', Microcerberidae 'BIS544' and Microcerberidae `BIS464`are likely to have small ranges.

Injection of dewatered groundwater is considered unlikely to change the chemical composition of receiving groundwater and, consequently, no impact on stygofauna is expected (data still to be provided). Thus, the main threat to any restricted stygofauna species is likely to come from dewatering.

The one species of troglofauna collected was the dipluran Parajapygidae `BDP208`, which is known only from a proposed mine pit. Two specimens were collected from the same hole five months apart. Little can be said about the likely distribution of the species. However, sampling results very strongly indicate that the troglofauna community of the Project area is depauperate and it may be inferred that in such circumstances any troglofauna species present will be a wide-ranging, rather than an endemic, species. Thus, despite the collection of one species from the mine pit, the threat to troglofauna conservation values due to pit excavation and reinjection and mounding of groundwater is considered to be low.

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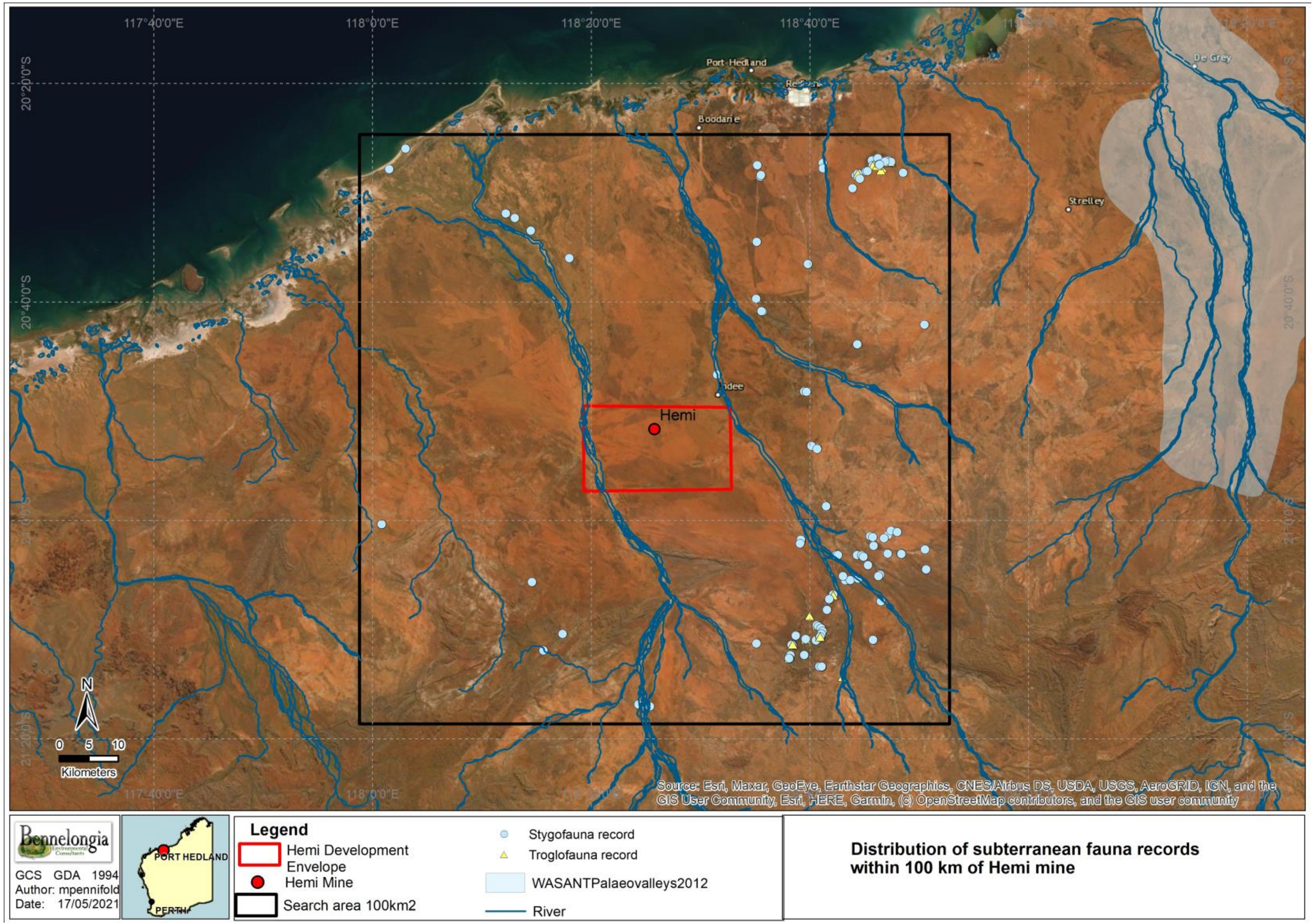
Appendix 1. +Descriptions of geological codes presented in Figure 2

CODE	Description
AaMoe	Melanogabbro and pyroxenite; metamorphosed
AaMu	Ultramafic schist, tremolite- and serpentine-rich schist, and serpentinite after peridotite; includes minor metachert, metasedimentary rock, and serpentinized high-Mg basalt
AaMus	Serpentine and serpentine-actinolite schist; after peridotite
Acf	MONS CUPRI VOLCANICS: metamorphosed felsic volcanic and volcaniclastic rocks; rhyolite, dacite, and minor andesite
AD	Unassigned; sedimentary rock, and minor basalt and high-Mg basalt; metamorphosed
ADcs	Poorly sorted sandstone and shale; minor graded beds
ADh	Shale; local ironstone; chert and arkose
ADm	MALLINA FORMATION: interbedded shale, siltstone, and medium- to fine-grained wacke; minor layers of chert; metamorphosed
ADt	Turbiditic wacke; medium- to coarse-grained; abundant chert clasts; local graded units; minor pebble beds and shale
Czrf	Ferricrete - includes ferruginous and pisolitic ironstone on lateritic surfaces
Czrk	Calcrete - massive, nodular, and cavernous limestone, variably silicified; residual origin
Czrk/AD	Residual calcrete; massive, nodular, and cavernous limestone; mainly silicified
Czrk/AaMu	Calcrete - massive, nodular, and cavernous limestone, variably silicified; residual origin/
Czru	Siliceous caprock over ultramafic rock
Qaa	Alluvium - sand and gravel in rivers and creeks; clay, silt, and sand in channels on floodplains
Qab	Alluvial sand, silt, and clay in floodplains, with gilgai surface in areas of expansive clay
Qac	Claypan deposits on floodplains
Qal	Alluvial sand and gravel in levees and deltaic sandbanks
Qao	Alluvial sand, silt, and clay in floodplains; overbank deposits
Qaoc	Alluvial sand, silt, and clay; mixed floodplain deposits (Qao) characterized by numerous small claypans
Qc	Colluvium - sand, silt, and gravel in outwash fans and scree
Qs	Eolian sand - red-yellow, wind-blown sand; local ridges
Qw	Low-gradient sheetwash deposits - silt, sand, and pebbles on distal outwash fans; no defined drainage
Qws	Quartzofeldspathic sand

+Descriptions as per Smithies, R.H. (1999) Geology of the Yule 1:100 000 Sheet. Western Australia Geological Survey, Geological Series Explanatory Notes

Appendix 2. Distribution of subterranean fauna records within 100 km of Hemi mine



Appendix 3. Records of stygofauna with the desktop search area

*Higher order identifications

Higher Classification	Lowest identification	No. locations in search area	Comments on Range	Approximate Known Distribution
Nematoda				
	Nematoda spp.	15	Not typically assessed	Unknown
Rotifera				
Bdelloidea				
	Bdelloidea sp. 2:2	1	Widespread and likely stygoxenes (non-obligate subterranean species)	WA
Polychaeta				
Aphanoneura				
Aeolosomatidae	*Aeolosoma* sp. 1 (PSS)	1	Widespread morphospecies	400 km
	Aeolosoma sp. 2 (PSS)	1	Widespread morphospecies in Pilbara	150 km
Oligochaeta				
Enchytraeidae	*Enchytraeidae* sp. B23	2	Known from two bores	Wodgina area
	Enchytraeidae sp. B24	1	Known from single bore	Wodgina area
	Enchytraeus sp. AP PSS1 s.l.	4	Widespread morphospecies	1000 km
Naididae	*Dero (Dero) nivea*	2	Widespread species	Global
	Pristina longiseta	3	Widespread species	Global
Phreodrilidae	*Astacopsidrilus* sp. WA31	1	Widespread morphospecies	200 km
	Insulodrilus lacustris s.l. Pilbara type 1 (PSS)	1	Known from 3 bores	130 km
	Insulodrilus lacustris s.l. Pilbara type 2/3 (PSS)	1	Widespread morphospecies	320 km
	Phreodrilidae sp. AP DVC B14	3	Known from 3 bores	Wodgina area
	Phreodrilidae sp. AP DVC B15	1	Known from one bore	Wodgina area
	Phreodrilidae sp. AP DVC s.l.	9	Widespread morphospecies	1000 km
Tubificidae	*Monopylephorus* sp. nov. WA29 (PSS)	5	Widespread morphospecies in Pilbara	180 km
	Tubificidae `stygo type 1` (PSS)	1	Widespread morphospecies in Pilbara	250 km

Higher Classification	Lowest identification	No. locations in search area	Comments on Range	Approximate Known Distribution
	Tubificidae `WA24` (PSS*)*	1	Known from one bore	Yule River Bore
Amphipoda				
Bogidiellidae	Bogidiellidae sp.*	2	Higher Order identification	Unknown
Eriopisidae	*Nedsia douglasi s.l.*	1	Known from 3 bores	Exmouth/Caves Creek/Poondano
	Nedsia hurlberti s.l.	6	Widespread morphospecies in Pilbara	400 km
Melitidae	*Melitidae `BAM147`* (sp. 1 group)	1	Known from one bore	Wodgina area
	Melitidae `BAM149` (sp. 1 group)	2	Known from two bores	Wodgina area
	Melitidae sp. 1 group (PSS) s.l.	7	Widespread morphospecies	600 km
	Melitidae sp. B08 (sp. 1 group)	1	Known from 3 bores	Pilgangoora area
Paramelitidae	*Paramelitidae `BAM144`*	8	Moderately small range	20 km Wodgina area
	Paramelitidae Genus 2 `BAM148`	5	Moderately small range	20 km Wodgina area
	Paramelitidae Genus 2 sp. B14	3	Moderately small range	20 km Tabba Tabba Creek
	Paramelitidae Genus 2 sp. B15	1	Moderately small range	15 km Pilangoora area
	Paramelitidae sp. 2 s.l. (PSS)	1	Widespread morphospecies	600 km
	Pilbarus `BAM145`	3	Moderately small range	20 km Wodgina area
Isopoda				
Microcerberidae	*Microcerberidae `BIS346`*	1	Known from one bore	Pilangoora area
	Microcerberidae sp. B11	1	Moderately small range	15 km Pilangoora area
	Microcerberidae sp. B12	1	Known from two bores	Pilangoora area
	Microcerberidae sp. B18	3	Known from 3 bores	Wodgina area
Syncarida				
Bathynellacea				
Parabathynellidae	*Parabathynellidae* `sp. NS`	6	Moderately small range	North Star area
Bathynellidae	*Bathynella* sp. B25	1	Known from two bores	Pilangoora area
	Bathynellidae `BSY200`	1	Known from one bore	Wodgina area
Parabathynellidae	*Atopobathynella* `A`	1	Widespread morphospecies	500 km

Higher Classification	Lowest identification	No. locations in search area	Comments on Range	Approximate Known Distribution
	Atopobathynella `BSY201`	1	Known from one bore	Wodgina area
	Atopobathynella sp. B36	6	Moderately small range	20 km Wodgina area
	Atopobathynella sp. B37	2	Known from two bores	Wodgina area
	Billibathynella `BSY199`	2	Known from two bores	Wodgina area
	Billibathynella sp. B17	3	Known from 3 bores	Wodgina area
	Brevisomabathynella sp. B11	5	Moderately small range	20 km Wodgina area
	Chilibathynella sp.*	1	Higher Order identification	Unknown
	Hexabathynella `A` (PSS)	1	Known only from 3 bores	Mundabullangana/Telfer
	Hexabathynella `B` (PSS)	2	Known only from 3 bores	Mundabullangana/Marble Bar
	Hexabathynella sp. B13	3	Known only from 3 bores	Wodgina area
	Notobathynella sp.*	1	Higher Order identification	Unknown
	nr *Brevisomabathynella* sp. B12	4	Moderately small range	20 km Wodgina area
	Parabathynellidae gen. nov. 1 sp. B12	7	Small range	10 km Wodgina area
Thermosbaenacea				
Thermosbaenacidae	*Halosbaena* spp. `tulki group`	1	Widespread species	250 km
Copepoda				
Calanoida				
Ridgewayiidae	*Stygoridgewayia trispinosa*	1	Widespread species	500 km
Cyclopoida				
Cyclopidae	*Diacyclops `BCY062` (humphreysi s.l.)*	35	Moderately small range	25 km Wodgina area
	Diacyclops cockingi	1	Widespread species	600 km
	Diacyclops einslei	2	Widespread species	600 km
	Diacyclops humphreysi s.l.	26	Very widespread species, likely to comprise multiple species	1000 km
	Diacyclops humphreysi unispinosus	1	Widespread species	550 km
	Diacyclops scanloni	3	Widespread species	500 km

Higher Classification	Lowest identification	No. locations in search area	Comments on Range	Approximate Known Distribution
	Diacyclops sobeprolatus	5	Widespread species	600 km
	Diacyclops sp. 5 (PSS)	2	Known from two bores	Marble Bar area
	Diacyclops sp. B01 = Diacyclops sp. 4 (PSS)	4	Known from two bores	Marble Bar area
	Mesocyclops brooksi	1	Very widespread	WA
	Microcyclops varicans	4	Widespread	Global
	nr *Goniocyclops* (1222) `BCY061`	2	Species-level identification incomplete	Unknown
	Orbuscyclops westaustraliensis	1	Very widespread	WA
	Halicyclops rochai	7	Widespread species	250 km
Harpacticoida				
Ameiridae	*Megastygonitocrella bispinosa*	5	Very widespread	1000 km
	Megastygonitocrella sp. B05	10	Moderately small range	25 km Wodgina area
	Megastygonitocrella trispinosa	20	Widespread	700 km
	Megastygonitocrella unispinosa	3	Widespread	650 km
Canthocamptidae	*Australocamptus* `BHA258`	1	Small range	5 km West Musgrave/Wodgina
	Elaphoidella humphreysi	15	Widespread species	600 km
	Elaphoidella sp. B09	21	Moderately small range	25 km Wodgina area
Parastenocarididae	*Parastenocarididae* n. gen. `BHA259`	1	Known from one bore	Wodgina area
	Parastenocarididae n. gen. sp. B01	1	Known from one bore	Wodgina area
	Parastenocaris jane	6	Widespread	1000 km
Ostracoda				
Podocopida				
Candonidae	Areacandona ?incogitata	11	Moderately small range	25 km Wodgina area
	Areacandona akatallele	2	Widespread morphospecies in Pilbara	200 km
	Areacandona iuno	1	Widespread morphospecies in Pilbara	200 km
	Areacandona jessicae	4	Widespread morphospecies in Pilbara	200 km

Higher Classification	Lowest identification	No. locations in search area	Comments on Range	Approximate Known Distribution
	Areacandona krypte	2	Known from two bores	Mundabullangana/Marble Bar
	Areacandona nr korallion	2	Known from 3 bores	Sherlock/Rail Compliance
	Areacandona yuleae	4	Moderately small range	50 km
	Candonidae `BOS1292`	3	Known from 3 bores	Wodgina area
	Humphreyscandona fovea	1	Widespread morphospecies in Pilbara	100 km
	Humphreyscandona waldockae	1	Widespread morphospecies in Pilbara	200 km
	Leicacandona mookae	1	Known from one bore	Mooka Siding
	Meridiescandona lucerna	1	Widespread morphospecies in Pilbara	300 km
Cyprididae	*Cypretta seurati*	1	Widespread species	800 km
	Sarscypridopsis sp.	1	Higher Order identification	Unknown
	Strandesia sp. *	1	Higher Order identification	Unknown
Cytherocopina				
Limnocytheridae	*Gomphodella* `2` (PSS)	1	Known from one bore	Indee
Darwinulocopina				
Darwinulidae	Darwinulidae sp. *	1	Higher Order identification	Unknown
	Ostracoda `BOS1293`	1		

Appendix 4. Records of troglofauna with the desktop search area

*Higher order identifications

Higher Classification	Lowest identification	No. locations	Comments on Range	Approximate Known Distribution
Arachnida				
Pseudoscorpiones				
Chthoniidae	*Tyrannochthonius sp. B38*	1	Known from single bore	Wodgina area
Hyidae	*Indohya `BPS201`*	1	Known from single bore	Wodgina area
	Indohya `BPS202`	1	Known from single bore	Wodgina area
Crustacea				
Isopoda				
Armadillidae	*Armadillidae sp. B13*	1	Known from single bore	Wodgina area
Entognatha				
Diplura				
Campodeidae	Campodeidae sp. *	1	Higher Order identification	Unknown
Japygidae	*Japygidae `DPL003`*	2	Known from two bores	Poondano area
Parajapygidae	*Parajapygidae `DPL018`*	2	Known from 3 bores	Poondano area
Insecta				
Blattodea				
Nocticolidae	Nocticola sp. *	8	Higher Order identification	Unknown
	Blattodea sp. *	1	Higher Order identification.	Unknown
Hemiptera				
Meenoplidae	Phaconeura sp. *	2	Higher Order identification	Unknown
Zygentoma				
Nicoletiidae	*Subtrinemura sp. B03*	1	Known from single bore	Wodgina area
	Trinemurodes sp. *	1	Higher Order identification	Unknown
Myriapoda				
Chilopoda				
Schendylidae	*Australoschendyla sp. B01*	2	Known from 3 bores	Poondano/Cape Preston areas
Diplopoda				
Polydesmida	*Polydesmida sp. B02 (polaris)*	4	Known from two bores	Poondano area

Higher Classification	Lowest identification	No. locations	Comments on Range	Approximate Known Distribution
Polyxenidae	Polyxenidae sp. *	1	Higher Order identification.	Unknown
Trigoniulidae	Trigoniulidae sp. *	1	Higher Order identification	Unknown
Pauropoda				
Pauropodidae	*Pauropodidae sp. B01 s.l.*	1	Widespread in Pilbara	250 km
	Pauropodidae sp. B02 (polaris)	2	Known from two bores	Poondano area
Symphyla				
Scolopendrellidae	*Symphylella sp. B01 (polaris)*	3	Known from 3 bores	Poondano area
Scutigerellidae	Scutigerella sp. *	1	Higher Order identification	Unknown

Appendix 5. Sampled bore locations.

Bore ID	Latitude	Longitude
Bubbajong Well	-20.99239	118.38738
Carowehyne Well	-20.74993	118.52777
Chituma Well	-20.72017	118.53223
Granite Well	-20.92693	118.57361
HMB001	-20.86308	118.42842
HMB002	-20.85765	118.42583
HMB003	-20.86482	118.43469
HMB004	-20.86123	118.44023
HMB005	-20.85071	118.44619
HMB007	-20.88123	118.42231
HMB008	-20.90195	118.42816
HMB009	-20.88803	118.38592
HMB010	-20.84467	118.37167
HMB011	-20.85197	118.40999
Indee Homestead Well	-20.78726	118.59762
Mardacoombana Well	-20.85315	118.51655
No 11 Well	-20.78248	118.42358
No 12 Well	-20.78042	118.3801
Talye Well	-20.88538	118.62036
Talyebinya Well	-20.79512	118.53837
TROG03RD	-20.86162	118.43562
TROG06	-20.86672	118.4259
TROG08	-20.87387	118.42352
TROG09	-20.85879	118.42392
TROG18	-20.86912	118.42638
TROG19	-20.86077	118.42945
TROG20	-20.85908	118.4307
TROG22	-20.86326	118.41504
TROG23	-20.86122	118.40751
UNK10	-20.79964	118.61041
UNK2 WELL	-20.90211	118.40911
UNK4	-20.77799	118.52553
UNK6	-20.93061	118.35468
UNK8	-20.79779	118.57203
UNK9	-20.84087	118.59777
WBBG01	-20.79147	118.5074
Western Well	-20.75419	118.5015
Wingina Well	-20.84305	118.56438
Woggra Well	-20.77843	118.52061
WWB1	-20.84447	118.58422

Appendix 6. Water Chemistry

Electrical conductivity (as a measure of salinity), pH and temperature were measured in a water sample collected from the top 1 metre of groundwater using a bailer. Measurements were made using a TPS WP-81 meter.
Depth to groundwater was measured using a Solinst water level meter. The audio readings close to the water table can be difficult to interpret, leading to possible inaccuracies in some readings.

Bore ID	Hole Depth (m)	Depth to Water (m)			Temp (°C)			Electrical Conductivity (µS cm^{-1})			pH		
		R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Bubbajong Well	9	7.33	7.91	6.94	26.3	31.5	29.0	971.3	823.2	984.5	8.10	8.00	7.59
Carowehyne Well	12	8.84	8.84	10.19	28.3	17.8	27.6	1386	963.5	1111	7.37	7.69	6.82
Chituma Well	10	7.85	9.43	9.53	27.2	19.1	31.6	1583	1106	1200	7.27	7.27	6.40
Granite Well	10	4.04	4.04	4.86	28.9	21.2	37.4	12000	9530	1040	7.86	7.65	7.34
HMB001	38	6.61	6.75	6.80	25.8	31.4	29.3	1394	1164	1257	7.77	7.46	7.29
HMB002	33	6.19	6.30	6.38	28.7	34.2	29.5	1535	1395	1578	7.61	7.27	7.28
HMB003	27	6.18	6.35	6.35	25.5	22.8	28.4	1681	1740	1620	7.83	7.75	7.32
HMB004	28	6.16	6.24	6.27	27.4	32.4	28.0	1638	1515	1644	7.58	6.99	7.18
HMB005	31	6.15	6.23	6.25	28.3	32.8	27.7	1723	1640	1784	7.59	7.08	7.20
HMB007	24	7.44	7.59	7.67	27.6	32.6	29.1	1368	1134	1362	7.68	7.38	7.32
HMB008	23	7.18	7.30	7.36	25.8	31.5	30.3	1114	773.8	1063	7.76	7.34	7.21
HMB009	24	6.43	6.55	6.85	28.8	32.2	30.0	1117	938.6	1138	7.60	7.35	7.14
HMB010	16-11	7.86	8.00	8.13	30.0	32.0	28.4	1388	916.2	1165	7.46	7.21	7.23
HMB011	42	6.28	6.39	6.48	32.4	29.4	29.1	1424	1241	1456	7.51	7.38	7.37
Indee Homestead Well	15	10.35	10.35	10.75	28.3	41.6	27.2	3780	3270	3650	7.57	6.83	6.95
Mardacoombana Well	16	11.68	11.68	12.24	26.3	26.9	32.1	3040	2480	3010	7.84	7.28	7.09
No 11 Well	16	10.24	10.34	10.45	24.4	30.2	28.8	2680	2370	2640	8.20	7.08	7.11
No 12 Well	9	6.85	6.36	6.22	25.8	29.7	27.7	1899	1770	2053	7.83	7.14	7.16
Talye Well	8	7.03	7.03	7.38	28.3	34.0	29.2	1711	1270	536.9	7.35	7.18	6.80
Talyebinya Well	13	11.70	11.70	12.62	28.4	28.6	26.7	6360	5870	7130	8.62	7.65	8.42
TROG03RD	7	5.81	5.96	5.95	18.3	32.2	29.5	2166	1630	1668	7.82	6.95	7.04
TROG06	10	6.10	6.21	6.31	23.4	31.3	29.2	1627	1310	1560	7.78	7.27	7.19

Bore ID	Hole Depth (m)	Depth to Water (m)			Temp (°C)			Electrical Conductivity (µS cm^{-1})			pH		
TROG08	9	6.28	6.40	6.50	26.3	32.6	29.0	1209	1010	1279	7.87	7.37	7.33
TROG09	7	5.85	5.95	6.05	25.7	31.7	29.4	1531	1282	1493	7.70	7.22	7.23
TROG18	21	6.83	6.47	6.49	25.5	31.5	*-	1543	1255	*-	7.81	7.39	*-
TROG19	18	5.78	5.78	5.96	26.7	32.1	27.8	1581	1386	1558	7.69	7.34	7.32
TROG20	24	5.70	5.70	5.84	20.7	34.0	28.7	1803	1438	1611	7.90	7.31	7.33
TROG22	20	6.19	6.29	6.39	27.1	29.8	26.9	1410	1195	1454	7.79	7.39	7.24
TROG23	13	5.81	5.87	5.98	25.5	28.3	29.0	1516	1310	1530	7.91	7.48	7.39
UNK10	20-22	11.42	10.95	11.09	31.9	*-	36.4	5070	*-	1850	7.08	*-	6.34
UNK2 WELL	9	6.63	6.59	6.58	27.4	30.5	29.6	1557	1284	1480	7.54	7.94	6.88
UNK4	54	8.47	8.47	9.64	28.4	19.2	29.4	694.8	571.8	712.5	8.25	7.91	7.60
UNK6	11	7.48	7.64	7.80	26.9	42.5	29.8	1024	886.2	1152	7.74	7.77	7.18
UNK8	11	10.07	10.07	10.35	27.3	31.1	28.0	5420	4510	5500	7.47	7.08	7.16
UNK9	11	9.30	9.30	9.61	28.5	31.7	29.6	1072	956.9	1226	8.36	7.73	7.43
WBBG01	46	17.80	17.80	17.88	25.5	28.7	29.5	2530	1980	2400	7.15	6.01	6.75
Western Well	13	11.14	11.14	12.29	29.1	15.8	20.9	806.3	666.2	887.1	7.54	7.81	7.01
Wingina Well	14	11.48	11.48	11.87	27.2	28.5	25.1	4110	3340	3770	7.42	7.14	7.05
Woggra Well	12	10.49	10.49	11.54	29.4	14.7	28.1	851.3	645.2	815.3	7.15	7.46	7.01
WWB1	45	11.36	11.36	11.74	29.1	30.5	30.3	1936	1970	2330	8.73	7.65	7.70

*Water chemistry not recorded as bailer unable to fit to retrieve water sample

Appendix 7. Molecular analyses

DNA sequencing was completed on seven specimens (from at least five different species) from the study area.

***Diacyclops* `BCY087`**

Three *Diacyclops* specimens were sequenced for molecular analysis and compared with other sequences from the same genus in the Bennelongia database and on Genbank. All three specimens matched genetically with each other, with 3.2% to 8.5% intraspecific divergence. No other close matches were found.

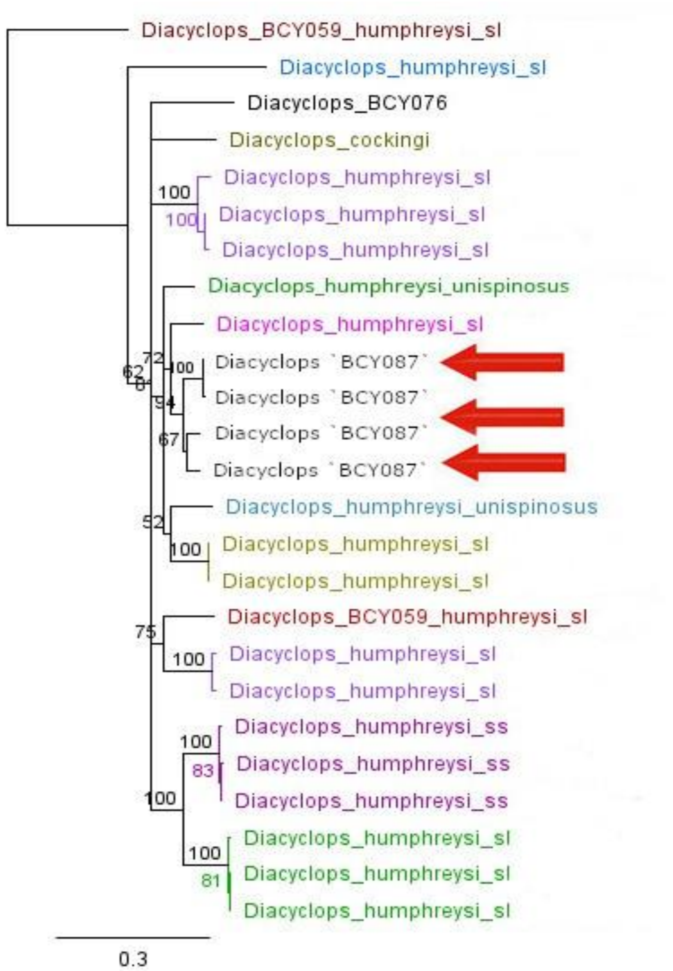


Figure 8. Maximum likelihood tree based on barcoding analysis of sequences from the genus Diacyclops. The species from Hemi are highlighted with red arrows

Melitidae sp. 1 group (PSS) s.l.

One amphipod initially identified morphologically as Melitidae sp. 1 group (PSS) s.l. was sequenced for molecular analysis and compared with other sequences from the same family in the Bennelongia database and on Genbank. The specimen matched closely with other sequences in the Bennelongia database to others collected in the area, and with a specimen identified as Eriopisidae sp. on Genbank (accession code: OK169973). All specimens were assigned the new morphospecies code Eriopisidae `BAM149` (sp. 1 group) with 6.9% to 9.4% intraspecific divergence.

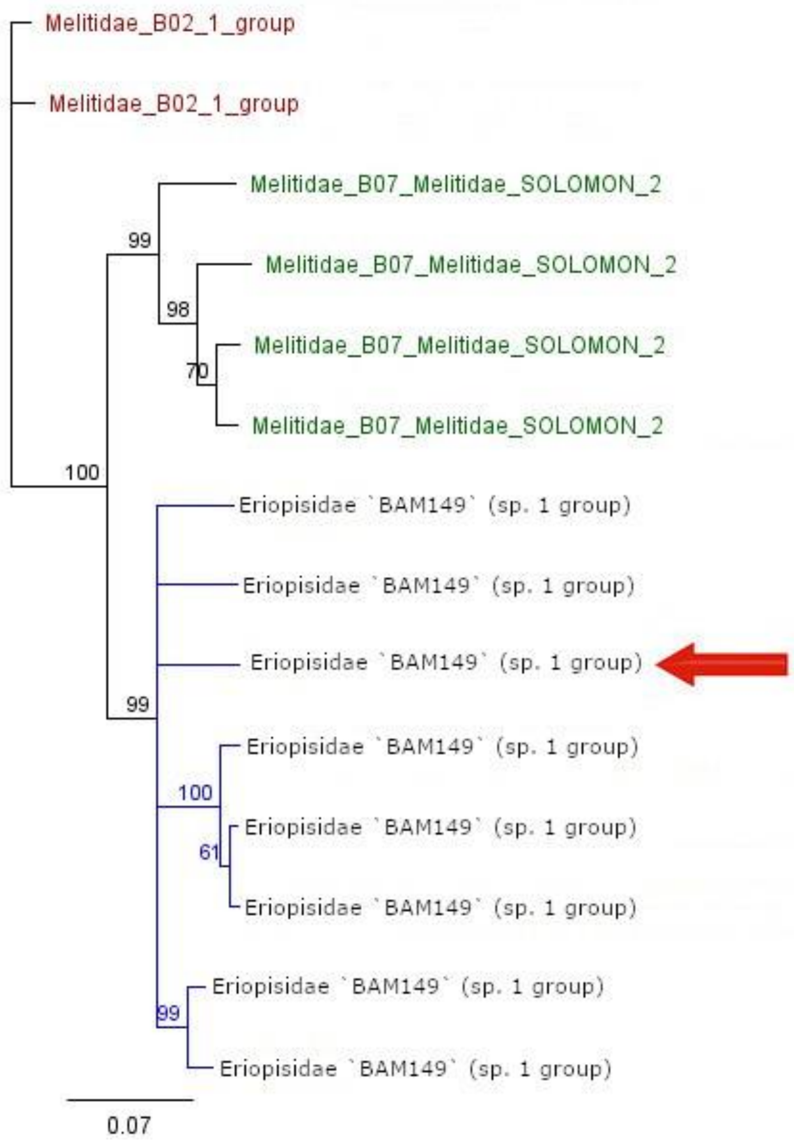


Figure 9. Maximum likelihood tree based on barcoding analysis of sequences from the family Melitidae. The species from Hemi are highlighted with a red arrow.

Microcerberidae `BIS464` and Microcerberidae sp.

12S DNA sequence was obtained for three microcerberid animals. These included two animals that were identified morphologically as Micorcerberidae `BIS464` and collected at sites TROG08 and HMB002. The third animal was a higher order identification Microcerberidae sp. collected from site HMB003. Pairwise estimates based on the 12S gene showed that Microcerberidae `BIS464` collected at HMB002 is different to Micorcerberidae `BIS464` collected at site TROG08 (uncorrected p-distance of 22.4%), but the same as Microcerberidae sp. collected from site HMB003 (uncorrected p-distance of 0%). Microcerberidae `BIS464` (HMB002) and Microcerberidae sp. (HMB003) have therefore been renamed to Microcerberidae `BIS544`. In addition, COI sequence for Microcerberidae sp. from site WBBG01 around 10 km to the north-east showed it to be different from Microcerberidae 'BIS544' (uncorrected p-distance 25.2%) and Microcerberidae 'BIS464'. As a result, Microcerberidae sp. from site WBBG01 has been named Microcerberidae `BIS545'. Neighbour-Joining trees for both the 12S and COI genes using the Tamura-Nei genetic distance and 1000 bootstraps are provided below.

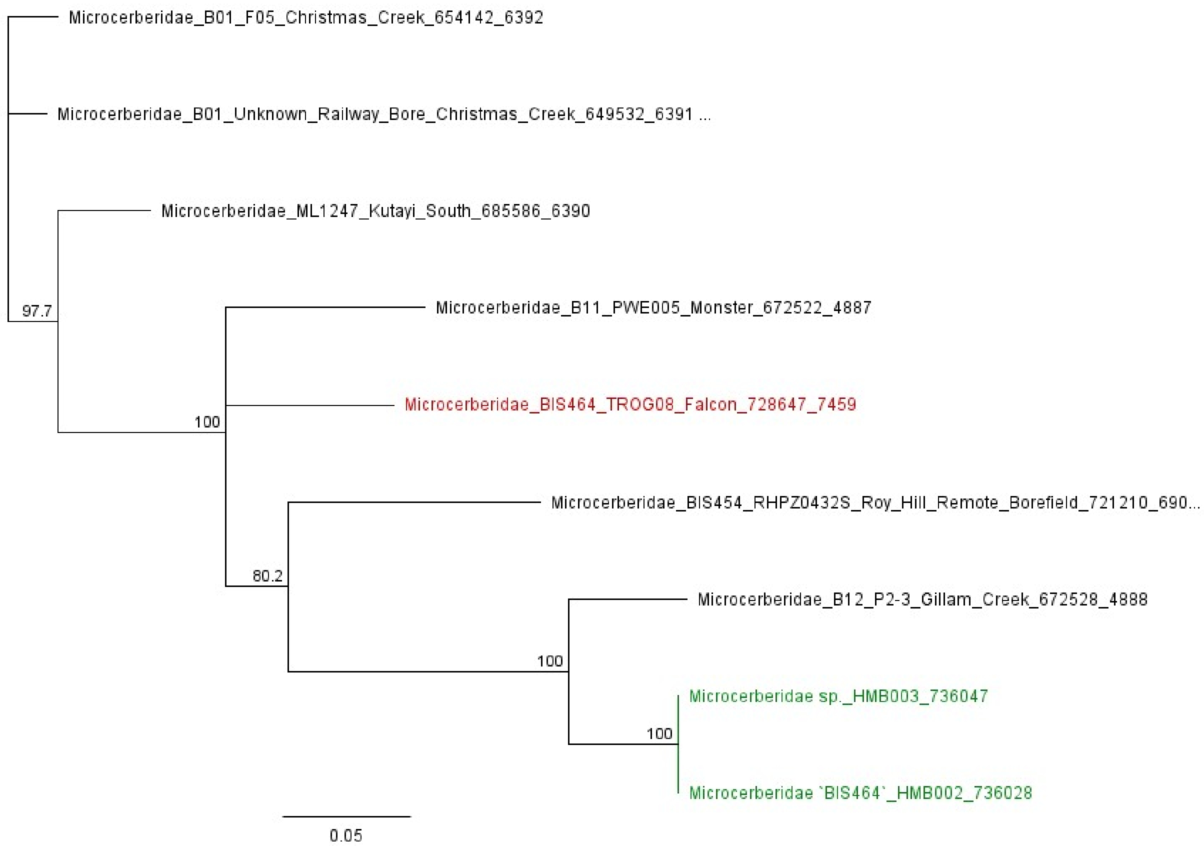


Figure 8. Unrooted Neighbor-Joining tree for Microcerberidae using the 12S gene and the Tamura-Nei genetic distance with 1000 bootstraps.

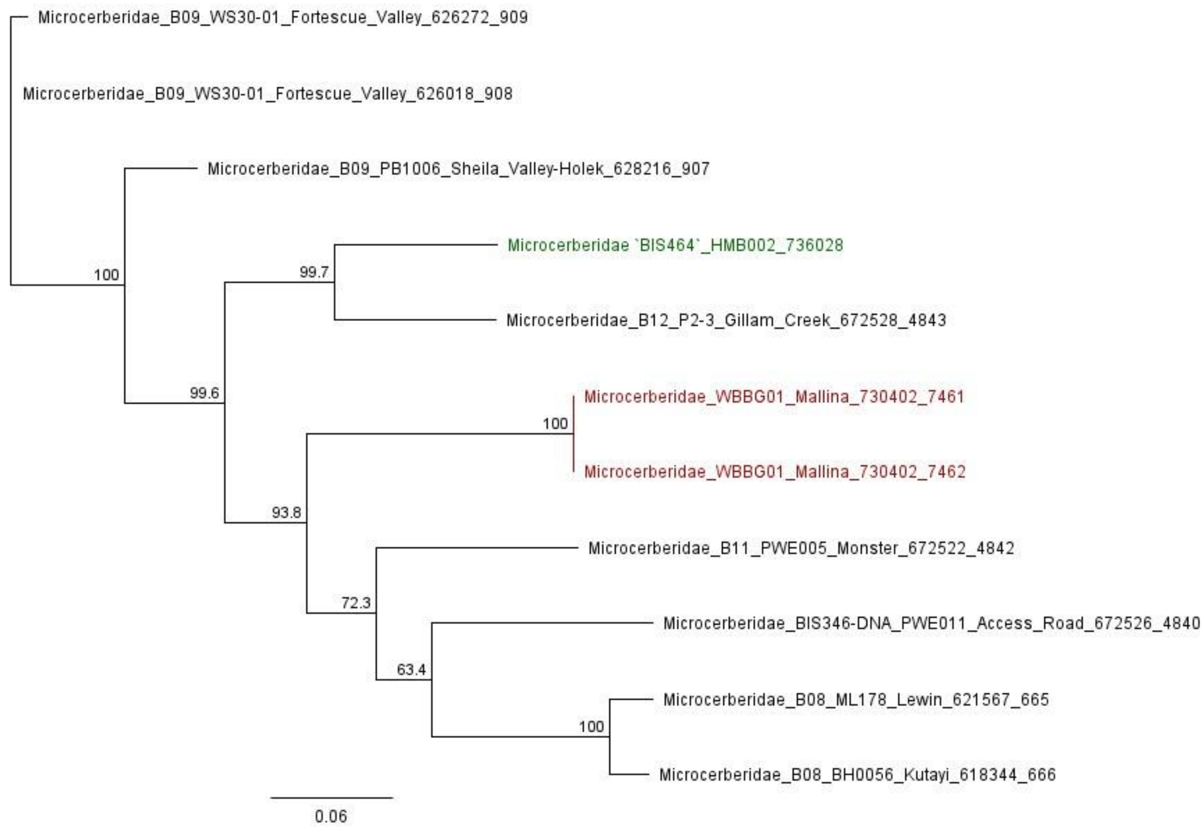


Figure 9. Unrooted Neighbor-Joining tree for Microcerberidae using the COI gene and the Tamura-Nei genetic distance with 1000 bootstraps.

Parastenocaris

COI sequence was obtained for two *Parastenocaris* animals, both *Parastenocaris* sp. higher order identifications. One was collected from site TROG18 and the other 20 km to the east from Tayle Well. Uncorrected pairwise distance between these specimens was 24.5% and consequently they are recognized as sperate species. A Neighbour-Joining tree for the COI gene using the Tamura-Nei genetic distance and 1000 bootstraps is provided below.

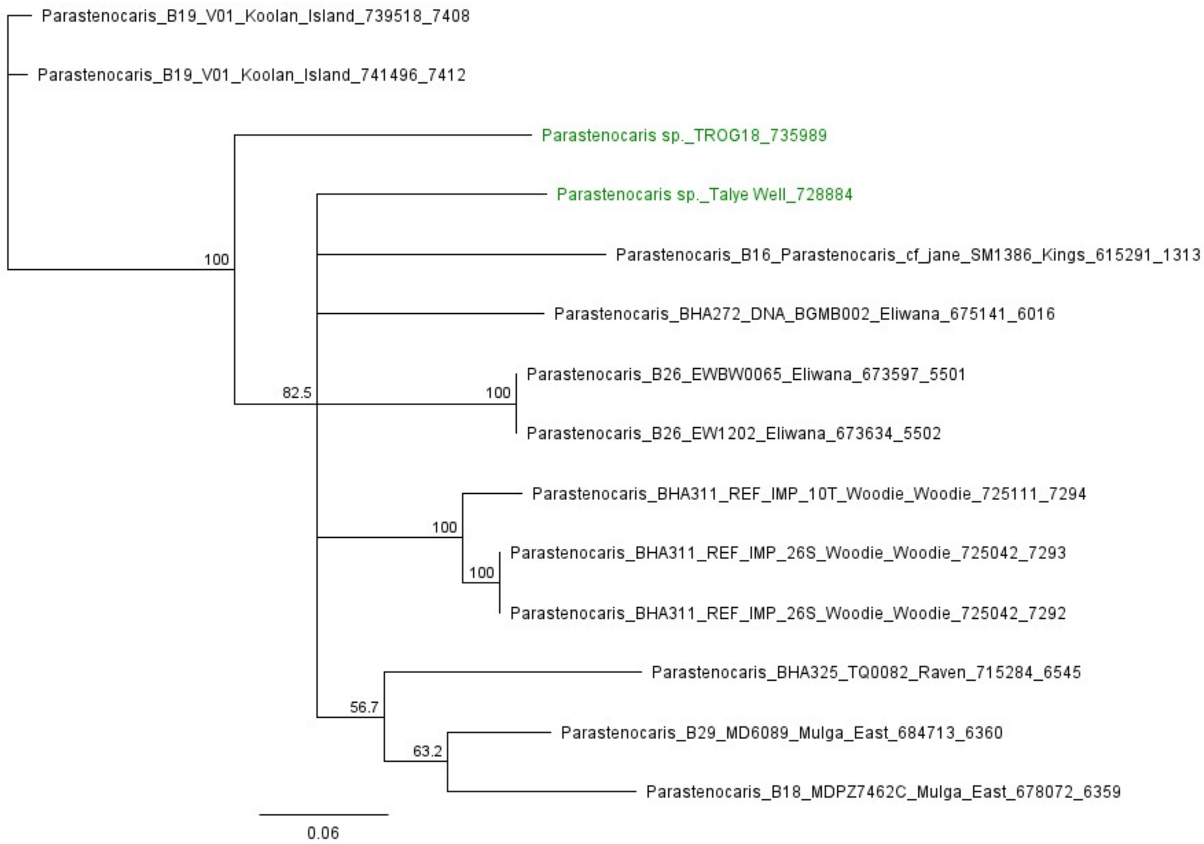


Figure 10. Unrooted Neighbor-Joining tree for Parastenocaris using the COI gene and the Tamura-Nei genetic distance with 1000 bootstraps.

***Nedsia* `hurlberti group` sp. 1 spine and**

The amphipod Nedsia `hurlberti group` sp. 1 spine was also sequenced but unfortunately the sequences returned were of poor quality and could not be used in an informative analysis.