J5 and Bungalbin East Iron Ore Proposal
Response to Submissions – Appendix E
Supplementary Troglofauna Report

J5 and Bungalbin East Project: Additional Troglofauna Investigation

Prepared for:

Mineral Resources Limited

February 2017

Final Report

Short-Range Endemics I Subterranean Fauna

Waterbirds I Wetlands

J5 and Bungalbin East Project: Additional Troglofauna Investigation

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EXECUTIVE SUMMARY

Mineral Resources Limited proposes to develop the Jackson 5 (J5) and Bungalbin East Iron Ore Project (the Project) in the Mt Manning – Helena Aurora Ranges Conservation Park. The Project includes the development of open cut mines, waste rock dumps and supporting mine infrastructure at two deposits, namely J5 and Bungalbin East.

This report presents the results of additional troglofaunal sampling in October 2016, DNA analysis of specimens and subterranean habitat characterisation using an optical televiewer in drill holes. The report supplements previous troglofauna sampling undertaken in 2015 by Bennelongia, as well as earlier work.

Scrape samples were collected from 85 drill holes, with 66 of the samples collected from J5, 15 from Bungalbin East and four from the reference area at Bungalbin Central. Excluding nematodes, an additional 39 troglofaunal animals were collected from J5. They represented at least 14 species, including six that had not been collected previously. No specimens were collected from Bungalbin East or Bungalbin Central.

DNA sequencing for part of the CO1 gene was attempted for 109 animals from the Project area and seven nearby localities. Sixty-nine animals yielded CO1 sequences of between 344 and 856 base pairs. The most significant changes resulting from the DNA work was that *Trichorhina* sp. B28 may be restricted to J5, with a different species (*Trichorhina* sp. B30) at Bungalbin East. The CO1 results also suggest there is a high level of genetic differentiation (and speciation) in subterranean habitats between southern Yilgarn banded iron formation ranges.

The potential of the subterranean habitat to support troglofauna was assessed in 10 drill holes by lowering a camera down each drill hole and recording video footage of the walls of the holes. Footage confirms subterranean habitat is prospective for troglofauna at J5 (as is known to be the case from sampling). Footage suggested habitat around the drill hole was marginally prospective at three of the five holes examined at Bungalbin East, with prospective habitat at the other two holes. Footage suggested subterranean habitat at Bungalbin Central was more prospective than at the other two deposits.

In conclusion, the additional troglofaunal sampling in 2016 increased the number of troglofaunal morphospecies known from J5 by five species. However, subsequent molecular work revised the total number of species at J5 to 16. One species remains at Bungalbin Central and five from Bungalbin East (which includes Nematode worms provisionally treated as a species of troglofauna). CO1 analyses supported the conclusion of earlier reports that J5 and Bungalbin East support different troglofaunal communities. However, despite the suggested isolation between deposits, habitat characterisation demonstrated that several lithologies in each range either support or are prospective for troglofauna. Habitat at both Bungalbin Central and J5 appears to be more prospective than habitat at Bungalbin East. The results, however, suggest prospectivity at J5 and Bungalbin East is likely to be similar for lithologies inside and outside the proposed mine pits, noting that only holes inside the proposed mine pits could be examined.

Based on the evidence of moderate to high prospectivity in several lithologies, and the pattern of occurrence of suitable habitat in drill holes across the deposits, it is highly likely that at both J5 and Bungalbin East there is habitat connectivity between the proposed mine pits and the surrounding parts of each range.

As a result of revisions to the Proposal since referral and advertising of the PER, the proposed impact of the J5 mine pit covers 61 ha and constitutes only 2.2% of the landforms of the Helena-Aurora Range, while the proposed pit area at Bungalbin East covers 111 ha and constitutes 3.2% of the landforms of the Helena Aurora Range. Given habitat connectivity between the mine pits and surrounding ranges, it is unlikely that troglofaunal species at J5 and Bungalbin East have ranges as small as the proposed mine pits. It is considered likely that the ranges of all species extend beyond the two deposits into the contiguous ranges. Hence, mining in the Project area is unlikely to pose a significant conservation threat to troglofauna at either J5 or Bungalbin East.

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1. INTRODUCTION

Mineral Resources Limited (MRL) aims to develop the Jackson 5 (J5) and Bungalbin East Iron Ore Project (the Project) in the Mt Manning – Helena Aurora Ranges Conservation Park. The Project includes the development of open cut mines, waste rock dumps and supporting mine infrastructure at two deposits, namely J5 and Bungalbin East (Figure 1). The Project is presently being assessed by the WA Environmental Protection Agency under Part IV of the *Environmental Protection Act 1986*.

The likely impacts of the two new mines on troglofauna have been examined by ecologia (2014) and Bennelongia (2016). This report presents the results of additional troglofaunal sampling, DNA analysis of specimens and subterranean habitat characterisation using an optical televiewer (OTV) in drill holes.

The additional work was requested by the Office of the Environmental Protection Authority (OEPA) with the following broad guidelines:

- Troglofauna sampling effort at J5 should be sufficient to "maximise the sampling efficiency from this round of survey, and to increase the probability of capturing species from multiple drill holes and within different lithologies. The holes selected should target those in areas within J5 that were previously not sampled, and with a spread of sites over the J5 development envelope."
- "The priorities for genetic analysis should be to:
    - Confirm the identification of morphologically similar specimens that are found throughout, and in both, the J5 and Bungalbin East proposal areas; and
    - Test for gene flow between individuals of the same species, where multiple specimens are available."
- "The use of the downhole OTV is a suitable method to characterise troglofauna habitat ... where possible, a spread of drill holes should be selected to give a broad understanding of the habitat over the development envelopes and include drill holes in all lithologies."

2. METHODS

2.1. Additional sampling

Using a formula where both a trap and a scrape (sub)sample were needed from a drill hole to constitute a full sample from the hole (see Halse and Pearson 2014), Bennelongia (2008), ecologia (2014) and Bennelongia (2016) collected 41 troglofauna samples from 41 holes in the proposed mine pit (impact) area at J5, 26 samples from 12 holes at Bungalbin East and one sample from Bungalbin Central (Table 1).

From the available drill holes (Figure 2), additional scrape samples were collected from 85 drill holes between 25 and 28 October 2016, with 66 of the samples collected from the proposed mine pit at J5, 15 from the proposed pit at Bungalbin East and four from the reference area at Bungalbin Central (Figure 3). The following information provides rationale for the sampling effort in 2016. All holes had been rehabilitated and needed to be dug up to allow access to the hole:

- One-hundred-and-twenty-three holes have been drilled at J5, of which four are vertical holes drilled in the 1970s and 119 are angled holes drilled by Portman in 2005/06. Thirty-two holes were sampled in 2008 (one vertical) and 10 in 2015 by Bennelongia. The surveys found no evidence of the holes drilled in the 1970s despite utilising all available resources (satellite imagery, a wide search arc to account for datum errors, historic drill pad and track logs). It is considered likely that these holes were overlooked or cleared during the drilling by Portman in 2005/06. Approximately 90% of the holes drilled by Portman were checked during the 2016 survey but many could not be sampled because they were collapsed at very shallow depths. Only two vertical holes were found and both were sampled and examined by OTV. It is thought that these two holes were drilled by Portman rather than being holes drilled in the 1970s, although this is uncertain.

- Thirty-six vertical holes were drilled at Bungalbin East in the 1970s. Ten holes were found and sampled in 2012/13 and an extra hole was found in 2015, when 11 holes were sampled. During the 2016 sampling, further efforts were made to find all 36 holes. However, only four additional holes in a condition to allow sampling were found (some additional, collapsed holes were re-located). Ten of the 15 holes sampled in 2016 could be accessed only by foot owing to extremely overgrown terrain.
- Four vertical holes were drilled at Bungalbin Central in the 1970s. One hole was sampled in 2015. The remaining three holes were re-located, dug up and sampled in 2016. One of these could only be accessed on foot owing to rugged terrain and extensive regrowth.

Details of collecting and sample processing methods are described in Bennelongia (2016).

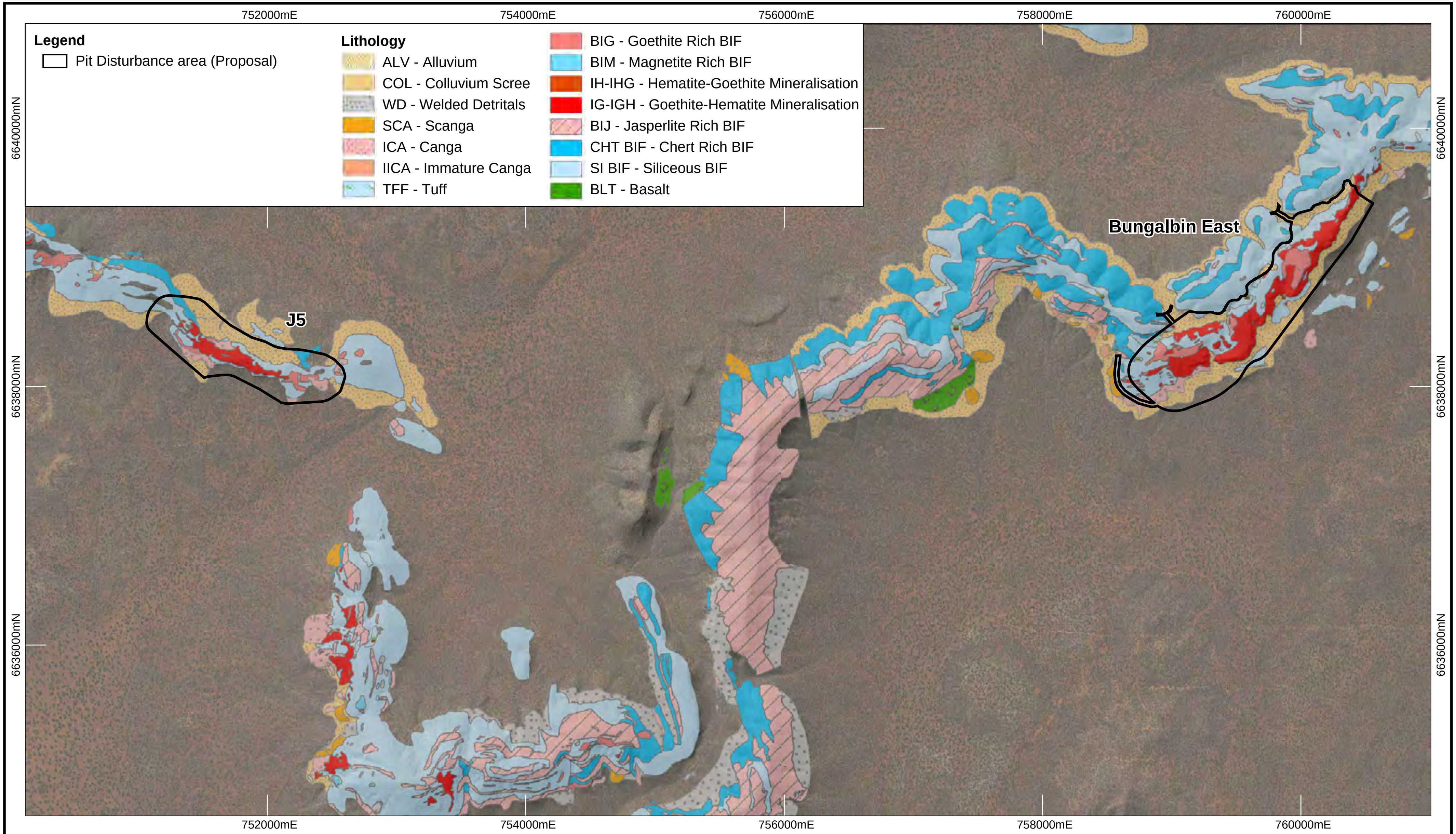
Table 1. Troglofauna sampling effort at the Project.
S Trap = single trap, D Trap = double trap. *The number of samples collected in an area is calculated as samples = (no. of scrape + no. of S trap or D trap) / 2 (see text).

	In-pit			Out-of-pit	
	Scrape	**S Trap**	**D Trap**	**Scrape**	**D Trap**
Bungalbin Central					
2015				1	1
2016				**4**	
Bungalbin East					
2012	10	10			
2013			10		
2015	11	8	3		
2016	**15**				
J5 Deposit					
2007-08	32	23	9		
2015	8	8	2		
2016	**66**				

2.2. DNA analyses

DNA sequencing was attempted for 109 animals from the Project area and seven nearby localities. The seven localities were Jackson Range (deposits J1 and J4), Koolyanobbing, Lake Deborah, Parker Range, Ularring and Windarling. The animals belonged to eight orders and this, together with the fact some animals had been preserved for more than eight years at room temperature, made it difficult to successfully sequence all animals using the same techniques.

Not all animals for which species-identifications were uncertain were sequenced because not all animals were available for sequencing. Table 2 lists animals collected in various sampling programs and lodged at the Western Australian Museum that museum staff could not locate. The notable exception to this was the provision of 27 isopods via the Crustacean Department (21 returned from Italy by Stefano Taiti) for this report and the loan of one symphylan from the Arachnology Department. In some other cases, animals were stored in ways that were unsuitable for DNA extraction (e.g. diplurans mounted on slides or in a few cases alcohol in vials of specimens collected early had evaporated). Sequencing was not attempted for certain groups, especially weevils, in which species were considered to have unique morphologies and were represented by singletons or by animals within one deposit.



Source: Infrastructure supplied by Mineral Resources (July 2016)
Imagery: Landgate (2012)

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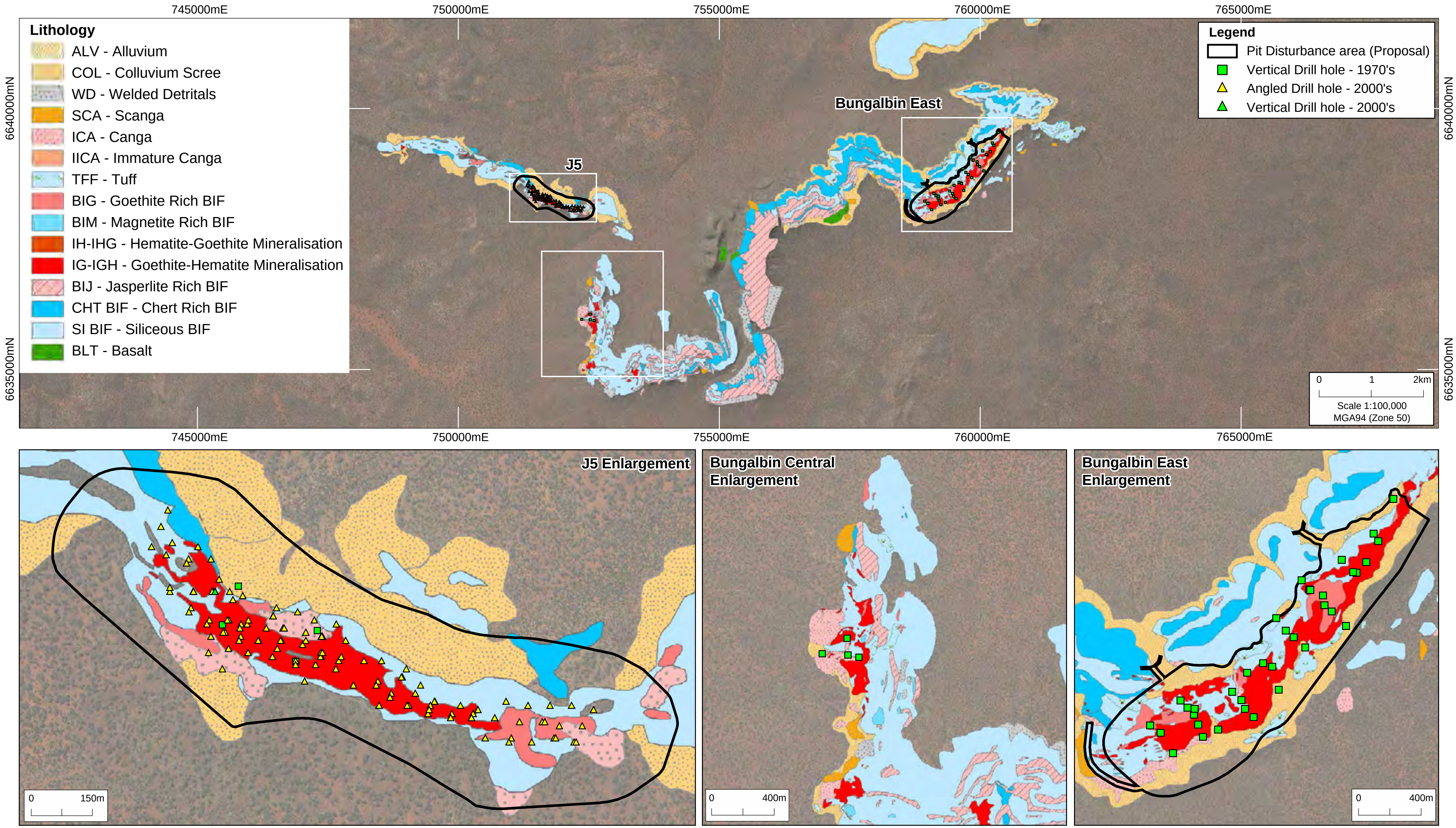
The proposed J5 and Bungalbin East pits and outcropping lithology

Figure: 1



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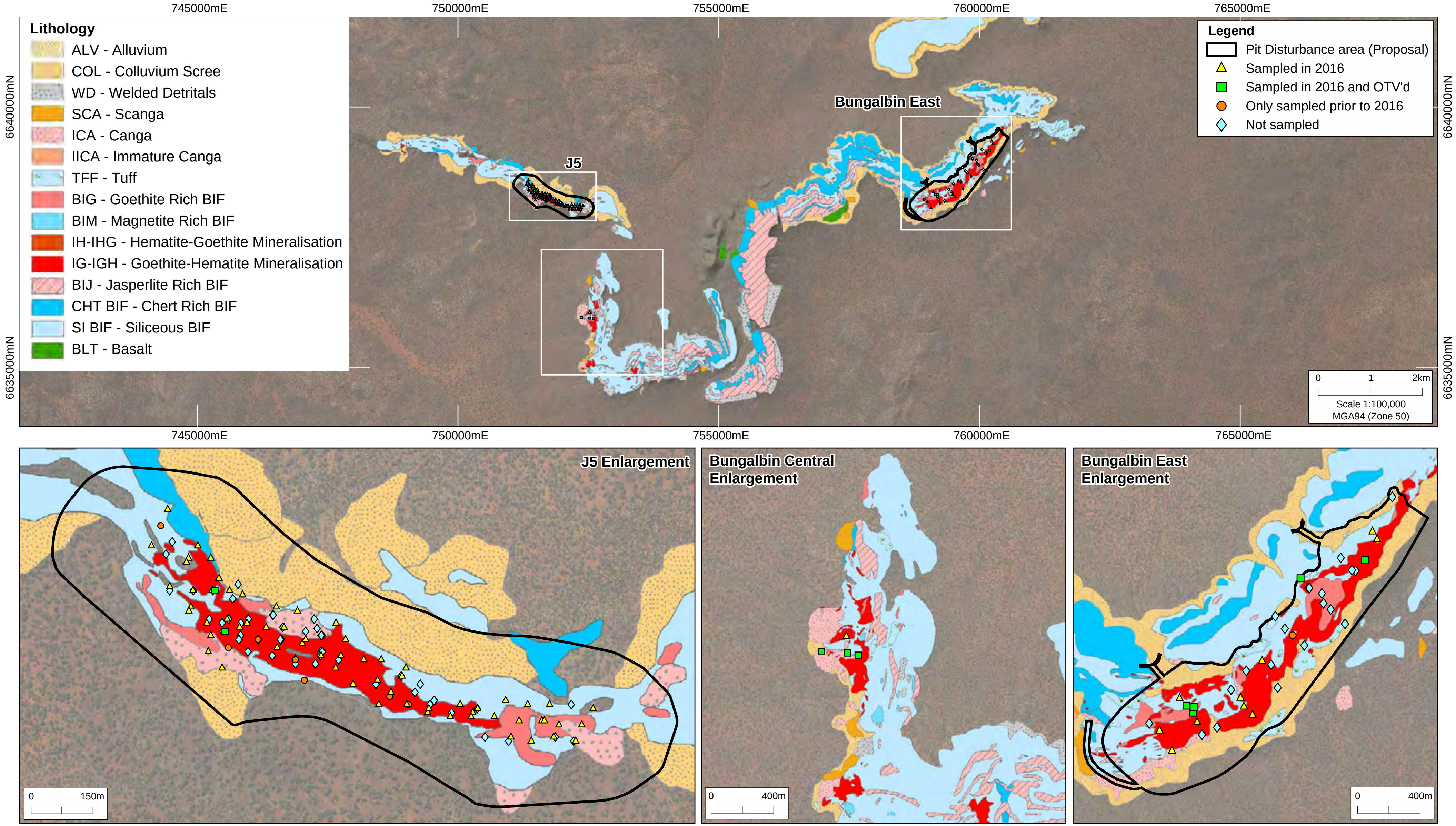
Drill holes in the Project area

Figure: 2



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Troglofauna sampling and OTV holes

Figure: **3**

Laboratory work was conducted at the University of Western Australia with DNA extracted using the Qiagen DNeasy Blood & Tissue Kit. The mitochondrial gene CO1 was targeted in all animals using two forward primers, LCO1490 and C1-J-1718, and two reverse primers, HCO2198 and HCOoutout (Folmer *et al.* 1994; Simon *et al.* 1994; Prendini *et al.* 2005). All PCRs were carried out using 25 µL reaction volumes (5.25 µL dH_2O, 1 µL forward primer [10 µM], 1 µL reverse primer [10 µM], 0.25 µL $MgCl_2$, 12.5 µL Promega Mastermix and 5 µL of isolated DNA). All PCR product was checked for successful amplification using gel electrophoresis and all products that produced bands were submitted for Sanger sequencing by the Australian Genome Research Facility (AGRF). The nuclear gene LysRS was targeted in the isopods using two sets of primers (see Javidkar *et al.* 2016) but they failed to amplify the gene fragment. Further attempts to amplify the gene could not be attempted in the short time frame available.

Table 2. Arachnids, myriapods and insects lodged at WAM that could not be located.

REGNO	Hole	Species	Lodgement date
100092	KFRC017	*Australoschendyla* sp. nov. Koolyanobbing	2009*
100093	J5RC040	nr Gnaphosidae sp. B04	2009
100094	J4RC038	Hanseniella sp. B03	2009
129631	CXRC0038	Pauropodidae sp. B18	2009
129648	LGRC461	Pauropodidae sp. B08	2009
140820	J5RC095	Prethopalpus sp. B31	4 May 2016
140822	BCUNK01	*Hanseniella* sp.	4 May 2016
Registered	J4RC015	*Hanseniella* sp. B03	2009
Registered	J5RC061	*Hanseniella* sp. B03	2009
BINSECT0030	CXRC0017	*Externanillus mcraeae*	5 November 2013
Registered	J5RC108	*Myrtonymus* sp. B05	4 May 2016
Registered	J5RC095	*Myrtonymus* sp. B05	4 May 2016
Registered	J5RC043	*Myrtonymus* sp. B05	4 May 2016
Registered	BG24	*Myrtonymus* sp. B06	4 May 2016
Registered	J5RC108	*Hemitrinemura* sp. B02	4 May 2016
Registered	KFRC239	*Hemitrinemura* sp. B02	2009
Registered	KFRC165	Meenoplidae sp.	2009
Registered	CA0047	*Trichorhina* \`ISO019\`	2009
Registered	CH0004	*Trichorhina* \`ISO019\`	2009
Registered	J1RC217	?*Haloniscus* sp. B04	2009
Registered	J4RC021	?*Buddelundia* sp. B02	2009
Registered	J5RC068	*Trichorhina* sp. B28	2009
Registered	J5RC080	?*Buddelundia* sp. B02	2009
Registered	KCRC010	?*Haloniscus* sp. B04	2009
Registered	KIRC021	?*Haloniscus* sp. B04	2009
Registered	KIRC021	?*Haloniscus* sp. B04	2009
45602	KCRC010	?*Haloniscus* sp. B04	2009
45608	J5RC116	?*Haloniscus* sp. B04	2009
45609	KCRC010	?*Haloniscus* sp. B04	2009
45660	J4RC030	*Trichorhina* sp. B02	2009
45661	J5RC040	*Trichorhina* sp. B28	2009
45667	PHJ1097	*Trichorhina* sp. B02	2009
1479;13:2034	BG9	Philosciidae \`bungalbin\`	Phoenix**
1479;13:2063 EE12:0884 (3579)	J4RC032	*Troglarmadillo* sp. indet.	Phoenix
1479;13:2069	J4RC032	Polyxenidae sp. indet.	Phoenix
EE12:0671 (3578)	J4RC018	*Trichorhina* sp. nov.	Phoenix
EE12:0882 (3580)	J4RC021	Armadillidae Unknown genus sp. nov.	Phoenix
EE12:0670 (3580)	J4RC032	Isopoda Unknown	Phoenix

* Dates in 2009 not readily accessible; ** animals identified by Phoenix Environmental Sciences but current location of specimens unclear.

2.3. Habitat characterisation

The potential of the subterranean habitat around 10 drill holes to support subterranean fauna was assessed by lowering a camera (OTV) down each drill hole and recording video footage of the walls of the hole. This work, which was undertaken by Water Bore Redevelopers, could only be done in vertical holes because of the potential for camera damage to occur in angled holes.

Footage was recorded from two holes at J5, where few vertical holes were available; five holes at Bungalbin East; and at three holes at Bungalbin Central (Table 3, Figure 2).

The suitability of habitat outside the hole for troglofauna was assessed on a scale of 1-10 (Figure 4), with 10 representing highly prospective troglofaunal habitat such as mesocaverns or areas with a dense occurrence of tree roots (Figure 4). Habitats scoring less than 4 are considered unlikely to contain troglofauna.

Depth at which video footage was collected was determined automatically by the OTV equipment. Notes were made of any animals visible in the footage.

Information on the lithology of the holes was derived from the drill logs for each hole (supplied by MRL). The lithological units used when recording the drill logs differed slightly from the terminology used in the geological mapping of the deposits (e.g. Figure 2) and was, in general, less detailed.

2.4. Personnel

Troglofauna field sampling was undertaken by Michael Curran and Jim Cocking. Samples were sorted by Mike Scanlon, Jim Cocking and Heather McLetchie and troglofaunal animals were identified morphologically by Jane McRae.

DNA laboratory work and analyses were undertaken by Michael Curran, with sequencing done by AGRF.

OTV fieldwork was done by Ben Wintergreene of Water Bore Redevelopers, with prospectivity of the drill hole surrounds assessed from video footage by Jim Cocking.

Mapping was done by Adam White of CAD Resources.

3. RESULTS

The results of animal identification are presented in two ways. In Section 3.1, results of troglofaunal sampling in October 2016 are presented, with reference to the results of earlier sampling as well, on the basis of morphological identifications. In later parts of Section 3.2, a combination of both genetics and morphology was used to assess the identification and occurrence of troglofauna at the Project and across seven nearby localitions.

The results of visual assessments of troglofauna habitat using OTV are presented in Section 3.3.

3.1. Additional sampling

Surveys at J5, Bungalbin East and Bungalbin Central prior to 2016 collected 64 troglofauna specimens that represented at least 16 species belonging to nine orders (Figure 5). An additional 74 animals were collected in October 2016, although 35 of these were nematodes collected from Bungalbin East (Table 3). These nematodes were probably in tree roots and are provisionally treated as troglofauna, although they may be deep soil fauna and are not assessed in the same scope as other species. The other 39 animals were all collected from J5 and, based on morphology, represented at least 14 species, five of which had not been recorded previously. No specimens were collected from Bungalbin Central.

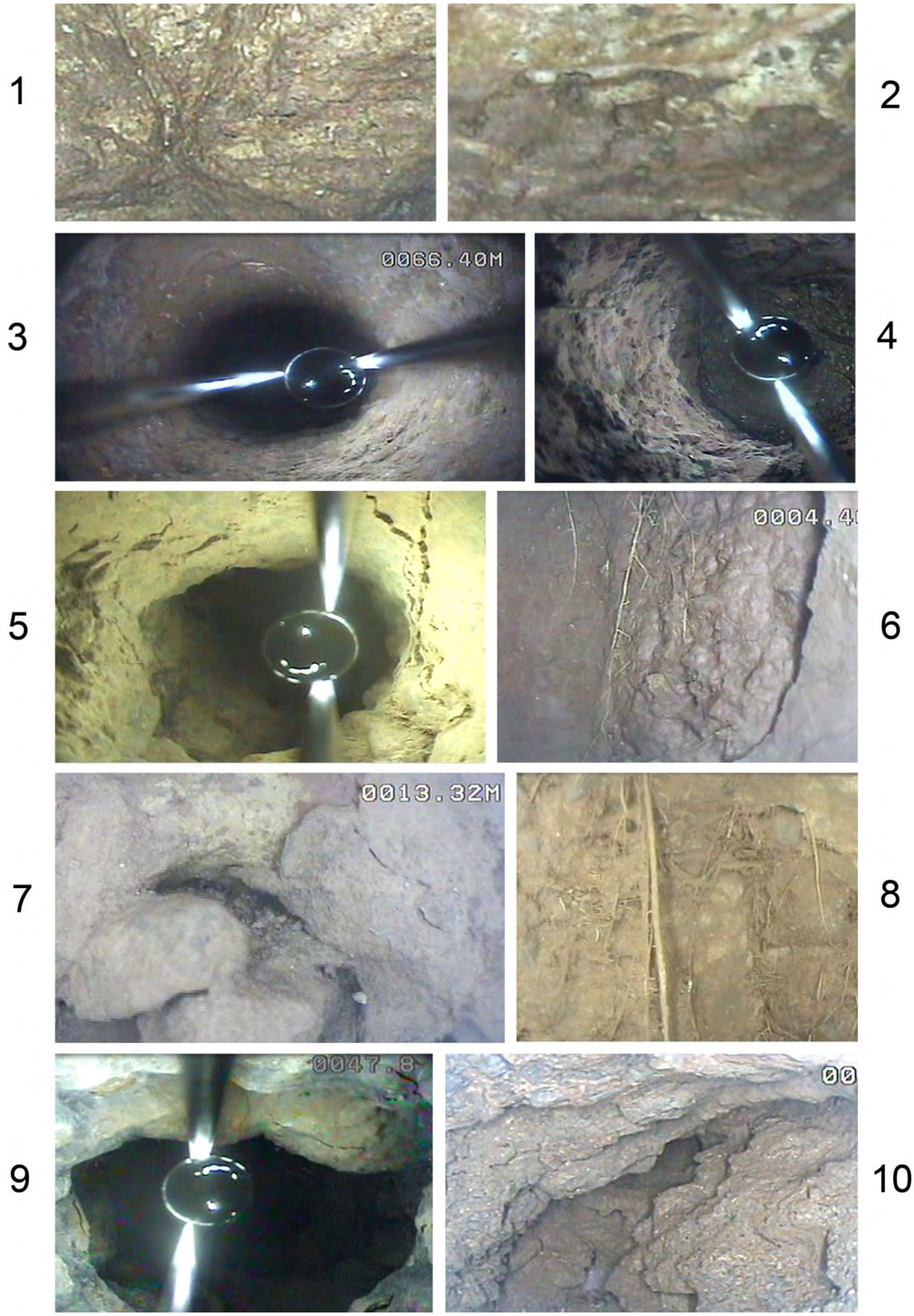
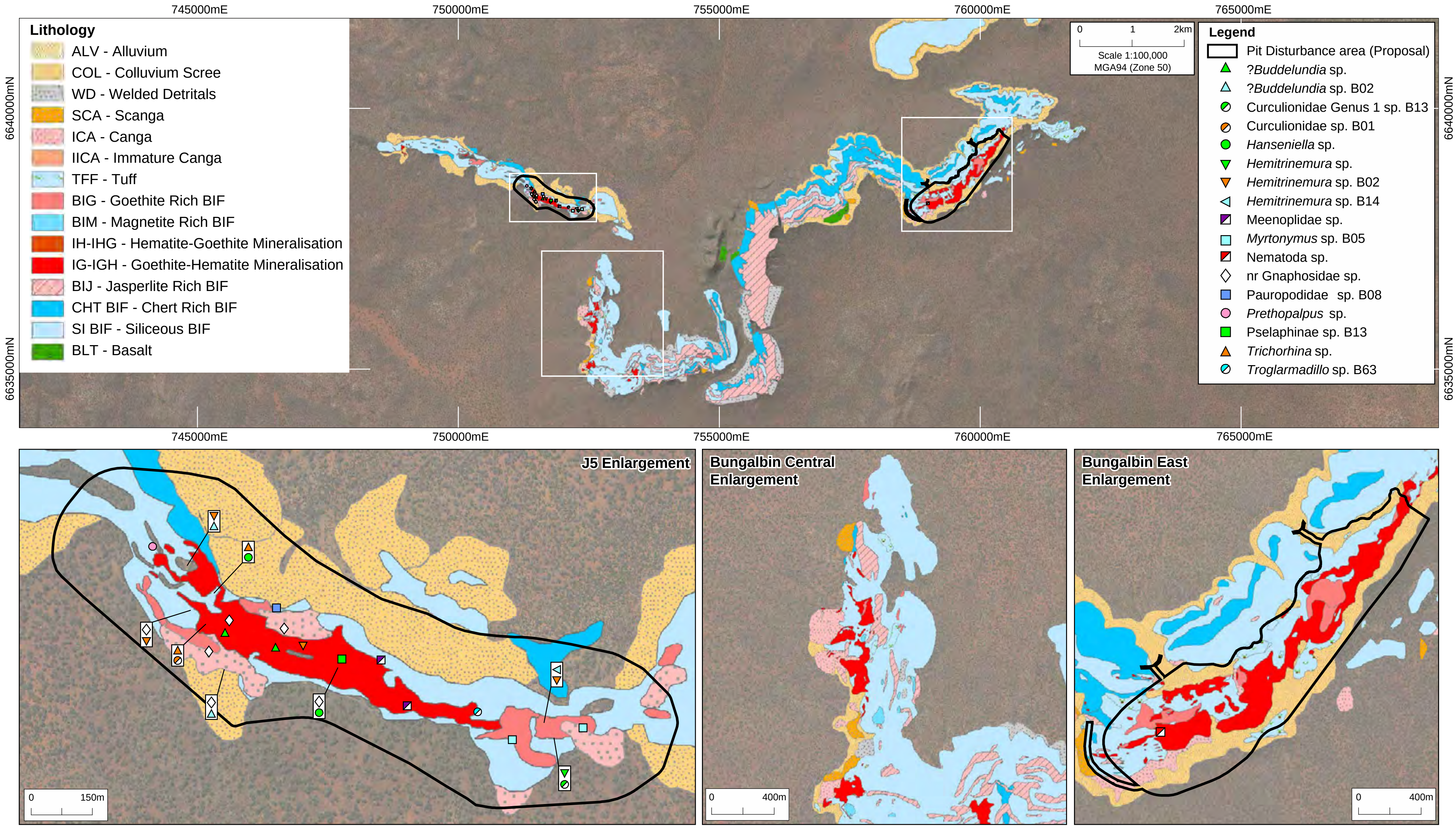


Figure 4. Examples of each habitat receiving scores from 1 to 10 are provided.

The additional sampling showed, based on morphological identifications, that at least 16 species of troglofauna to occur at J5 (Table 3, Figure 5). Of the species collected prior to 2016, only seven species were not re-collected during October 2016. They were the isopods ?*Haloniscus* sp. B04 and Philosciidae `bungalbin`, the centipedes Chilenophilidae sp. B01 and *Cryptops* (*Trigonocryptops*) sp. B03, the pauropod Pauropodidae sp. B36, the symphylan *Hanseniella* sp. B29 and the beetle *Myrtonymus* sp. B06. Note, however, that this list assumes that some of the animals collected in 2016 that were only able to be identified at higher taxonomic levels represent previously collected species. For example, it has been assumed the juvenile and female nr Gnaphosidae sp. collected in 2016 at J5 is in fact nr Gnaphosidae sp. B04 that was not collected at J5 in 2016. It should also be noted that further investigation showed one animal collected prior to 2016 (called Diplura sp. in Bennelongia 2016) was a silverfish of the genus *Hemitrinemura*. It was collected in 2015 from a trap set in 2008 and entered incorrectly into the identification database. It has been removed from the species list.

Table 3. Troglofauna species collected from J5 and Bungalbin East in October 2016.
Identifications in this table are based on morphology, using names provided in Bennelongia (2016). No species were collected from Bungalbin Central. Species highlighted in blue(*) collected for first time in Project Area in 2016, records in grey(+) are not to species level.

Taxonomy	Bungalbin East	J5 Deposit	Comments	Lithology
Nematoda				
Nematoda sp.	35			Goethite Mineralisation
Arachnida				
Araneae				
Prethopalpus sp.+		1	Juvenile. Probably *Prethopalpus* sp. B31	Siliceous BIF
nr Gnaphosidae sp.+		6	Females, juveniles. Probably nr Gnaphosidae sp. B04	Siliceous BIF, Canga, Colluvium & Goethite-Hematite Mineralisation
Pauropoda				
Tetramerocerata				
Pauropodidae sp. B08		1		Siliceous BIF
Symphyla				
Cephalostigmata				
Hanseniella sp.+		3	Probably *Hanseniella* sp. B03 or *Hanseniella* sp. B29	Siliceous BIF & Goethite-Hematite Mineralisation
Malacostraca				
Isopoda				
Troglarmadillo sp. B63*		4		Siliceous BIF
?*Buddelundia* sp. B02		2		Colluvium & Chert Rich BIF
?*Buddelundia* sp.+		5	Probably ?*Buddelundia* sp. B02	Siliceous BIF & Goethite-Hematite Mineralisation
Trichorhina sp.+		3	Juvenile. Probably *Trichorhina* sp. B28	Goethite-Hematite Mineralisation & Siliceous BIF
Insecta				
Thysanura				
Hemitrinemura sp. B02		4		Siliceous BIF, Goethite-Hematite Mineralisation & Goethite Rich BIF
Hemitrinemura sp. B14*		1		Goethite Rich BIF
Hemitrinemura sp.+		1	Missing diagnostic characters. *Hemitrinemura* sp. B02 or B14	Siliceous BIF
Hemiptera				
Meenoplidae sp.*		2	Juveniles	Siliceous BIF & Goethite-Hematite Mineralisation
Coleoptera				
Pselaphinae sp. B13*		1		Goethite-Hematite Mineralisation
Myrtonymus sp. B05		3		Goethite-Hematite Mineralisation, Siliceous BIF & Canga
Curculionidae sp. B01*		1		Goethite-Hematite Mineralisation
Curculionidae Genus 1 sp. B13*		1		Siliceous BIF



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Morphological identifications of troglofauna collected in 2016

Figure: 5

The October 2016 sampling at Bungalbin East added no species (other than nematodes) to the four species collected at that deposit prior to 2016. The yield of troglofauna at Bungalbin is very low but similar to results from most other BIF ranges in the Yilgarn and Gascoyne. A review of the sampling and collection data at Bungalbin East shows three records from scrape samples and two from trap samples. While these results are not especially depauperate, examination of the depths to which the net could be lowered while scraping, in conjunction with OTV video footage, suggests the old, cemented drilling fluid may have either prevented the net reaching the bottom of the hole or reduced the use of the hole by troglofauna and, therefore, the likelihood of troglofauna being collected. Scraping was the only collecting technique used in 2016.

3.2. DNA analyses

Sixty-nine of the 109 animals yielded CO1 sequences of between 344 and 856 base pairs (Table 4). The animals were collected between 2008 and 2016 and the success of DNA extraction and amplification was greater than 55% for each year except for the one animal collected in 2012 and a 30% success rate for 2008 material. 38 of the 45 animals from the Project yielded CO1 sequences. The primer combination C1-J-1718 and HCO was the most successful.

Table 4. CO1 sequencing results.

			CO1 Sequence returned	
Sub Phylum	**Class**	**Order**	**Yes**	**No**
Chelicerata	Arachnida	Araneae	10	3
Myriapoda	Chilopoda	Scolopendrida	4	1
	Diplopoda	Polyxenida		2
	Symphyla	Cephalostigmata	8	5
Crustacea	Malacostraca	Isopoda	28	24
Hexapoda	Insecta	Thysanura	10	4
		Hemiptera	6	
		Coleoptera	3	1
Total			**69**	**40**

CO1 analysis produced a number of taxonomic changes to the identifications of animals in the Project area and in surrounding localities. The conclusions are listed in Table 5. In total, 16 species were recognised at J5, five at Bungalbin East and one at Bungalbin Central. Detailed results and the final taxonomic position (based on morphology and genetics) of all troglofauna animals collected at the Project are shown in Appendix 5 and Figures 6 and 7. The most significant changes resulting from the DNA work was that *Trichorhina* sp. B28 may be restricted to J5, with a different species (*Trichorhina* sp. B30) at Bungalbin East. Bennelongia (2016) previously suggested a single species of *Trichorhina* occurred at both J5 and Bungalbin East. The juvenile *Prethopalpus* collected in this survey at J5 was successfully sequenced but could not be compared with *Prethopalpus* sp. B31 from the same deposit because Western Australian Museum staff could not locate that animal. However, it is considered likely the two animals belong to the same species, because of the proximity of their collecting locations. The two juvenile bugs from the family Meenoplidae collected at J5 were found to be part of a widespread, troglophilic lineage extending to Ularring and the Pilbara.

The CO1 gene suggests there is a high level of genetic differentiation (and speciation) in subterranean habitats in southern Yilgarn BIF ranges. Although some animals were too degraded to yield sequences, the results show a clear pattern in each group of lineages distinguished by their deposit or locality. Thus, the respective subterranean fauna communities of J5 and Bungalbin East appear to be distinct and to share very few species with other BIF ranges. Even when it is possible that a species occurs across multiple ranges, the can be some level of differentiation between populations. This is the case with two isopods, *Trichorhina* `ISO019` and *Trichorhina* sp. B02 from Lake Deborah and J4 Deposit (~50 km separation), that form a lineage with 8% divergence. For this reason they are currently treated as two species, although the work of Javidkar *et al.* (2016) indicates they could also be a single species.

Table 5. List of changes to taxonomy following DNA analysis.

Changes to taxonomy
Spiders
There is only lineage of nr Gnaphosidae sp. B04 at J5 (1.6% divergence). It is now called nr Gnaphosidae sp. B21-DNA. Other animals previously assigned to nr Gnaphosidae sp. B04 from J1 and Ularring are separate lineages
One juvenile *Prethopalpus* sp. animal was sequenced at J5. The *Prethopalpus* sp. B31 animal from J5 could not be found by WA museum staff and *Prethopalpus* sp. from Ularring failed to sequence. It is very likely that there is a single species of *Prethopalpus* at J5 (called *Prethopalpus* sp. B31) and a different species at Ularring (although this is unknown)
Myriapods
No changes to the four *Cryptops* centipede morphospecies from J5, Ularring, Lake Deborah and Parker Range
Distinct lineages of *Hanseniella* sp. B03 at J4 and at J5 (now called *Hanseniella* sp. B38-DNA). *Hanseniella* sp. at Bungalbin Central also different (called *Hanseniella* sp. B29)
Isopods
One species of ?*Buddelundia* at J5
?*Haloniscus* sp. B04 has been split genetically into three lineages from Koolyanobbing deposits C, D and F. Although it did not yield a sequence, ?*Haloniscus* sp. B04 from J5 is certain to be a different species (now called ?*Haloniscus* sp. B07)
Trichorhina \`ISO019\` from Lake Deborah aligned with a *Trichorhina* sp. B02 from J4 Deposit to represent a widespread species, although they should probably be treated as different ESUs (see text)
Six *Trichorhina* sp. B28 and juveniles from J5 and one *Trichorhina* sp. B28 from Bungalbin East form a single morphospecies but should be treated as two ESUs (9.9% divergence)
Insects
Hemitrinemura sp. B02 and B14 at J5 represent one species (now called *Hemitrinemura* sp. B14). It is distinct from *Hemitrinemura* sp. B02 at Koolyanobbing.
Meenoplidae sp. at J5 is widespread and shown to be the same genetically as animals from Ularring and the Pilbara. It is now called Meenoplidae sp. B14-DNA. Two new species of Meenoplidae were recognised from Koolyanobbing deposits C and F

3.2.1. Lithologies yielding specimens

It should be noted that the following information about the lithology of troglofauna is based on outcropping and not the down-hole lithology. There is substantial difficulty in providing a standardised assessment of which down-hole lithology hosts troglofauna, partially because animals collected in scrapes could originate from anywhere in the drill hole and the process of drilling also allows animals to traverse the column.

The 2016 sampling at Bungalbin East and Bungalbin Central did not collect any troglofauna, with the exception of nematodes (notionally treated as troglofauna). As all five species from these two deposits are only known from single locations, no additional habitat information to that contained in Bennelongia (2016) is provided here.

The combination of 2016 sampling and molecular work provided additional specimens and a number of changes to the taxonomy and distribution of species at J5. The resultant 16 species comprise six known from single drill holes, of which five species were collected as one animal and the sixth being represented by four animals. The remaining ten species were recorded from multiple locations at J5, although there were no changes to the taxonomy or distribution of the centipede *Cryptops (Trigonocryptops)* sp. B03:

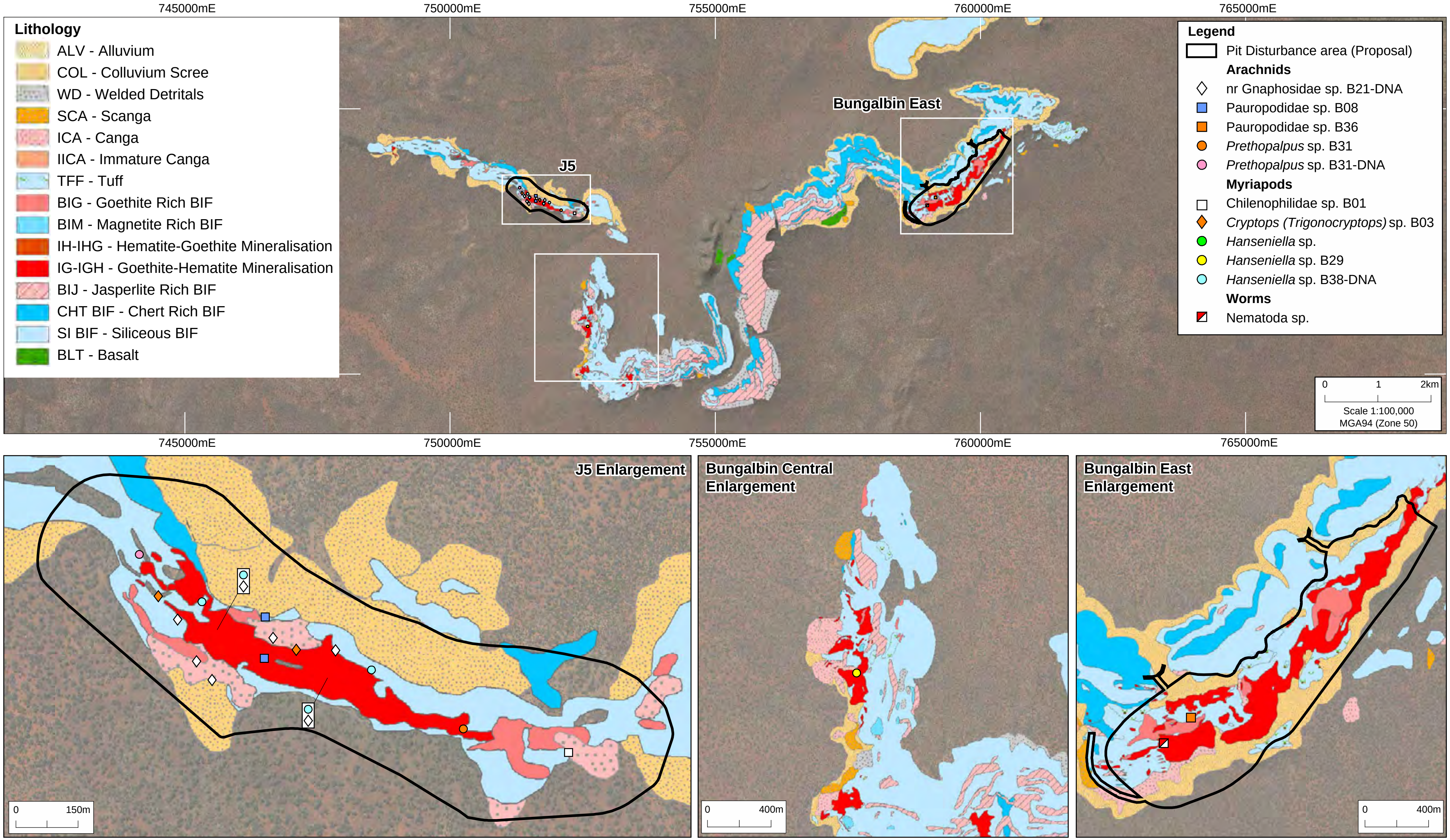
- One is known from two drill holes near to each other (Pauropodidae sp. B08);
- Four occur across approximately half the deposit each (nr Gnaphosidae sp. B21-DNA, *Cryptops (Trigonocryptops)* sp. B03, *Hanseniella* sp. B38-DNA, ?*Buddelundia* sp. B03);

- Four have ranges across the entire deposit (*Trichorhina* sp. B28, *Hemitrinemura* sp. B14, *Myrtonymus* sp. B05, *Prethopalpus* sp. B31/B31-DNA); and
- One species is known from Ularring and the Pilbara (the bug Meenoplidae sp. B14-DNA, represents the first collection of this group at the Project).

Apart from the centipede and cosmopolitan bug, the outcropping lithology of the eight other wider ranging J5 species has changed substantially compared to Bennelongia (2016). Six were recorded in the same outcropping geologies as previous years and the remaining two species, Pauropodidae sp. B08 and *Prethopalpus* sp. B31/B31-DNA, were recorded in siliceous BIF compared with goethite ore in 2015. In total, these ten species have been collected from two to six different lithologies and these units are present far beyond the pit boundary of J5 (see Figures 1, 2 and 3). A summary of outcropping lithology for these ten species is presented below in Table 6. Of the six single-hole species, four are known from drill holes that also yielded one or two of the species that occur across the entire deposit.

Table 6. Lithology of troglofauna at J5 excluding species only known from single locations.

Taxonomy	Collected in [1]2008/[2]2015	Collected in 2016
Arachnida		
Araneae		
nr Gnaphosidae sp. B21 (ex B04)	[1]Siliceous BIF	Banded Iron Goethite, Colluvium, Canga, Goethite-Ore and Siliceous BIF
Prethopalpus sp. B31/B31-DNA	[2]Goethite Ore	Siliceous BIF
Chilopoda		
Scolopendrida		
Cryptops (Trigonocryptops) sp. B03	[1]Canga, Goethite Ore and Siliceous BIF	
Pauropoda		
Tetramerocerata		
Pauropodidae sp. B08	[1]Goethite Ore	Siliceous BIF
Symphyla		
Cephalostigmata		
Hanseniella sp. B38-DNA (ex B03)	[1]Goethite Ore	Goethite Ore and Siliceous BIF
Malacostraca		
Isopoda		
?*Buddelundia* sp. B03 (ex B02)	[12]Goethite Ore and Canga	Colluvium, Canga, Goethite Ore and Siliceous BIF
Trichorhina sp. B28	[12]Goethite Ore and Siliceous BIF	Banded Iron Goethite, Chert Rich BIF, Colluvium, Canga, Goethite Ore and Siliceous BIF
Insecta		
Thysanura		
Hemitrinemura sp. B14 (ex B02)	[12]Goethite Ore and Siliceous BIF	Banded Iron Goethite, Canga, Goethite Ore and Siliceous BIF
Coleoptera		
Myrtonymus sp. B05	[12]Goethite Ore and Siliceous BIF	Banded Iron Goethite, Colluvium, Canga, Goethite Ore and Siliceous BIF
Hemiptera		
Meenoplidae sp. B14-DNA		Goethite Ore and Siliceous BIF



Source: Infrastructure supplied by Mineral Resources (July 2016)
Lithology supplied by Mineral Resources (Mar 2016)
Imagery: Landgate (2012)

CAD Ref: g2378_J5_BE_Ben_Trog_02_F05
Date: Feb 2017 | Rev: A | A4

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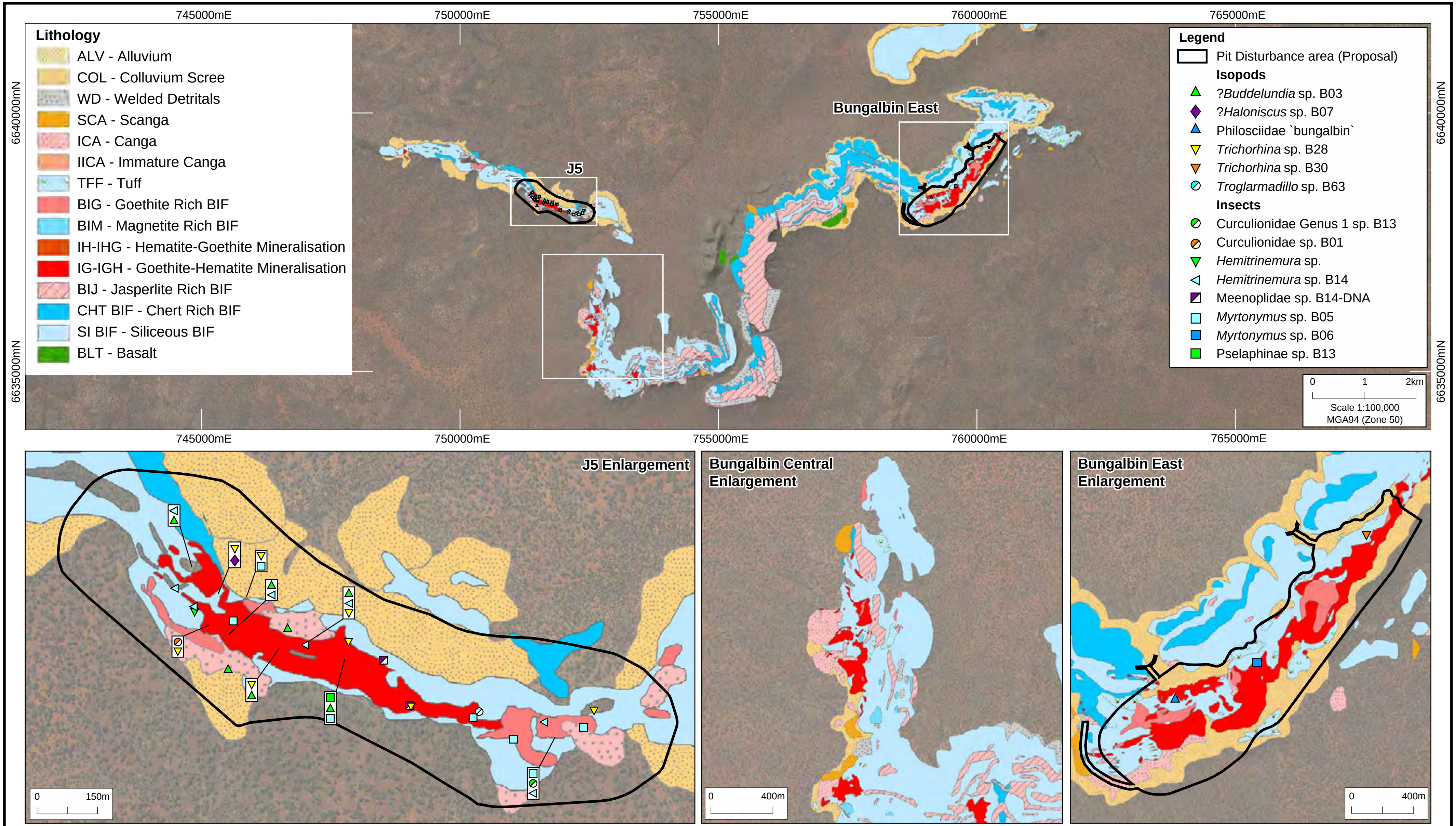
Troglofauna species - arachnids, myriapods and a nematode

Figure: 6



Source: Infrastructure supplied by Mineral Resources (July 2016)
Lithology supplied by Mineral Resources (Mar 2016)
Imagery: Landgate (2012)

CAD Ref: g2378_J5_BE_Ben_Trog_02_F06
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Troglofauna species - isopods and insects

Figure: **7**

3.3. Habitat characterisation

Logistical issues, principally the lack of vertical holes at J5, but also the difficulty to getting a vehicle to Bungalbin sites, reduced the intended program of OTV work. These logistical issues resulted in the prospectivity of subterranean habitat for troglofauna being studied in only 10 drill holes.

In overview, although only two holes at J5 were examined, OTV results showed subterranean habitat is prospective for troglofauna at J5 (Figures 8 and 9). This is confirmed by sampling results (Appendix 6 – J5 figure). Habitat appeared to have marginal prospectivity at three of the five holes examined at Bungalbin East and to be prospective at the other two holes (Table 7). Sampling yields were lower at Bungalbin East than might have been expected from the habitat available (see also the final paragraph of this section; Appendix 6 – Bungalbin East figure). Analysis of the limited sampling pre-2016 shows the majority of troglofauna animals were collected in traps at this deposit and OTV suggested that physical constraints (cementing, large caverns/vugs) may have impeded scrape sampling. The subterranean habitat at Bungalbin Central appeared to be more prospective than at the other two deposits, although the limited sampling undertaken did not support this interpretation (Appendix 6 – Bungalbin Central figure). However, this may mostly reflect that success rates of troglofauna sampling are always low and variable, so that trends cannot be reliably established from small numbers of samples.

Table 7. Habitat assessment by drill hole showing scores and overall assessment.

Deposit	Hole	Prospectivity		
		Mean ± SE	**Maximum**	**Overall rating**
Bungalbin Central	BC1	6.0 ± 0.9	10	Prospective
	BC2	3.9 ± 1.0	9	Prospective
	BC4	4.3 ± 0.8	10	Prospective
Bungalbin East	BG3	6.2 ± 0.9	10	Prospective
	BG10	3.5 ± 0.5	7	Low prospectivity
	BG11	3.3 ± 1.9	7	Low prospectivity
	BG25	4.0, 6.0	6	Low prospectivity
	BG36	6.3 ± 0.8	9	Prospective
J5	J5DD001	5.8 ± 0.6	10	Prospective
	J5RC116	4.2 ± 0.5	8	Moderate prospectivity

The geological record in the drill logs was altered slightly in Figures 8 and 9 to better reflect the terminology used in the mapping of surface lithology, with jasperlite taken to be siliceous BIF, limonite to be goethite mineralisation and laterite to be hematite and goethite mineralisation. Analysis of drill holes then suggested that the most prospective lithologies are hematite and goethite mineralisation and BIF (the latter at J5, where there appears to have been no differentiation among types of BIF). Goethite mineralistion and silicecous BIF mostly have low prospectivity. Rather unexpectedly, claystone looks to be prospective at Bungalbin Central, although it is suggested that this may be an artefact of the clays drying out in the drill hole.

While OTV showed there is some variability in degree of weathering at the three deposits, it mostly extended to about 60 m below ground. Plotting the frequency of habitat scores shown in Figures 8 and 9 against depth showed an inverse relationship between depth from the surface and suitability of habitat for troglofauna that is significant to depths of 40 m (Figure 10). No habitat scores greater than 4 occurred below 60m. The OTV work was undertaken in holes containing a range of weathered BIF lithologies that extend well beyond the proposed pits (Figures 1, 2 and 3).

The habitat assessment by lithology is shown in Table 8. This table shows that when all depths are considered, unmineralised BIFs have less prospective habitat than mineralised lithologies (goethite and hematite). When only weathered depths (<40m) are considered, the habitat suitability of mineralised and unmineralised lithologies for troglofauna appears to be the same. Unmineralised BIFs that are weathered within 40m of the surface occur along the entire length of the range in the vicinity of J5 and Bungalbin. Thus, prospective troglofauna habitat is expected to occur along the whole range. This view is further supported by the pattern of occurrence of troglofauana in relation to lithology (Appendix 4). Four species were only collected in mineralised lithologies, four were only collected in unmineralised (weathered) BIF lithologies and 12 were collected from both mineralised and unmineralised lithologies.

Table 8. Habitat assessment by lithology showing scores and overall assessment.
SE, standard error.

Lithology	Count	Mean	SE	Count <40 m	Mean <40 m	SE <40 m	Maximum	Rating
Goethite	22	5.27	0.61	18	5.44	0.72	10	Prospective
Hematite	25	5.24	0.63	20	5.35	0.73	10	Prospective
Goe & Hem	47	5.26	0.43	38	5.39	0.51	10	Prospective
Claystone	7	4.43	1.13	7	4.43	1.13	10	Prospective
No Recovery	7	4.43	0.95	7	4.43	0.95	9	Prospective
BIF	31	3.97	0.41	14	5.07	0.70	10	Prospective <40m

Four troglofaunal animals were visible in OTV footage. A species of symphylan was observed in drill hole J5RC116 and a species of curculionid beetle was seen in hole J5DD001 at J5. Sampling only collected an isopod at J5DD001 and a symphylan and an isopod at J5RC116 in October 2016 at the time the holes were filmed. In addition, a troglofaunal collembolan was observed in hole BG25 and some small, unidentified troglofauna were seen in BG11 at Bungalbin East (Appendix 2). Collembola are not included in impact assessments in Western Australia (EPA 2016) although it is very widely recognised that many collembolan orders are troglofaunal.

It is of interest that troglofauna were seen in two drill holes at Bungalbin East during OTV work, without any animals being collected during scraping. It provides some evidence to support predictions in Bennelongia (2016) that the troglofaunal community is likely to be richer than documented and suggests there may have been constraints that affected the efficiency of scrape sampling.

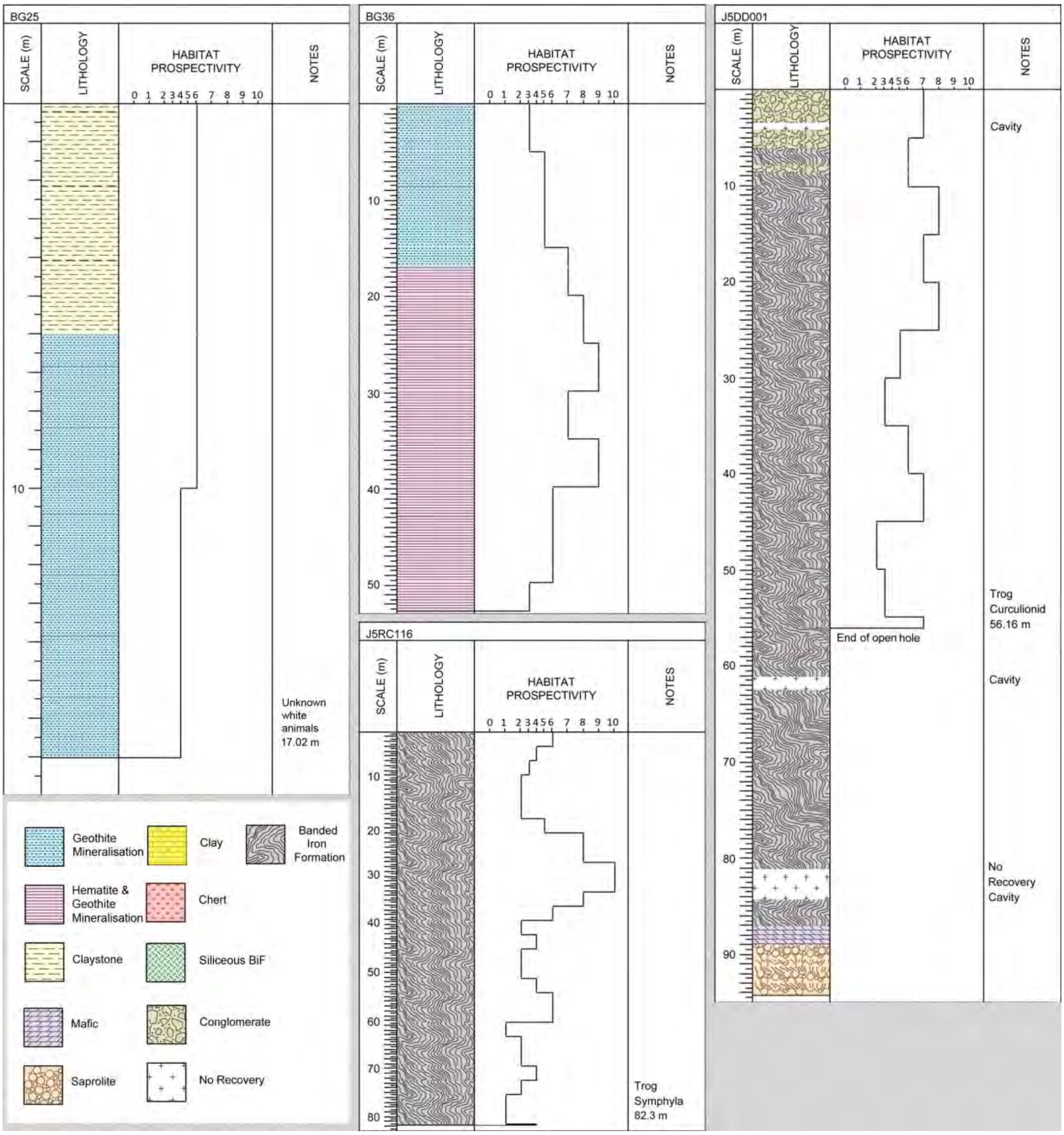

Figure 8. Lithology and habitat prospectivity of OTV holes.
BG25, BG36 (Bungalbin East); J5DD001 and J5RC116 (J5).

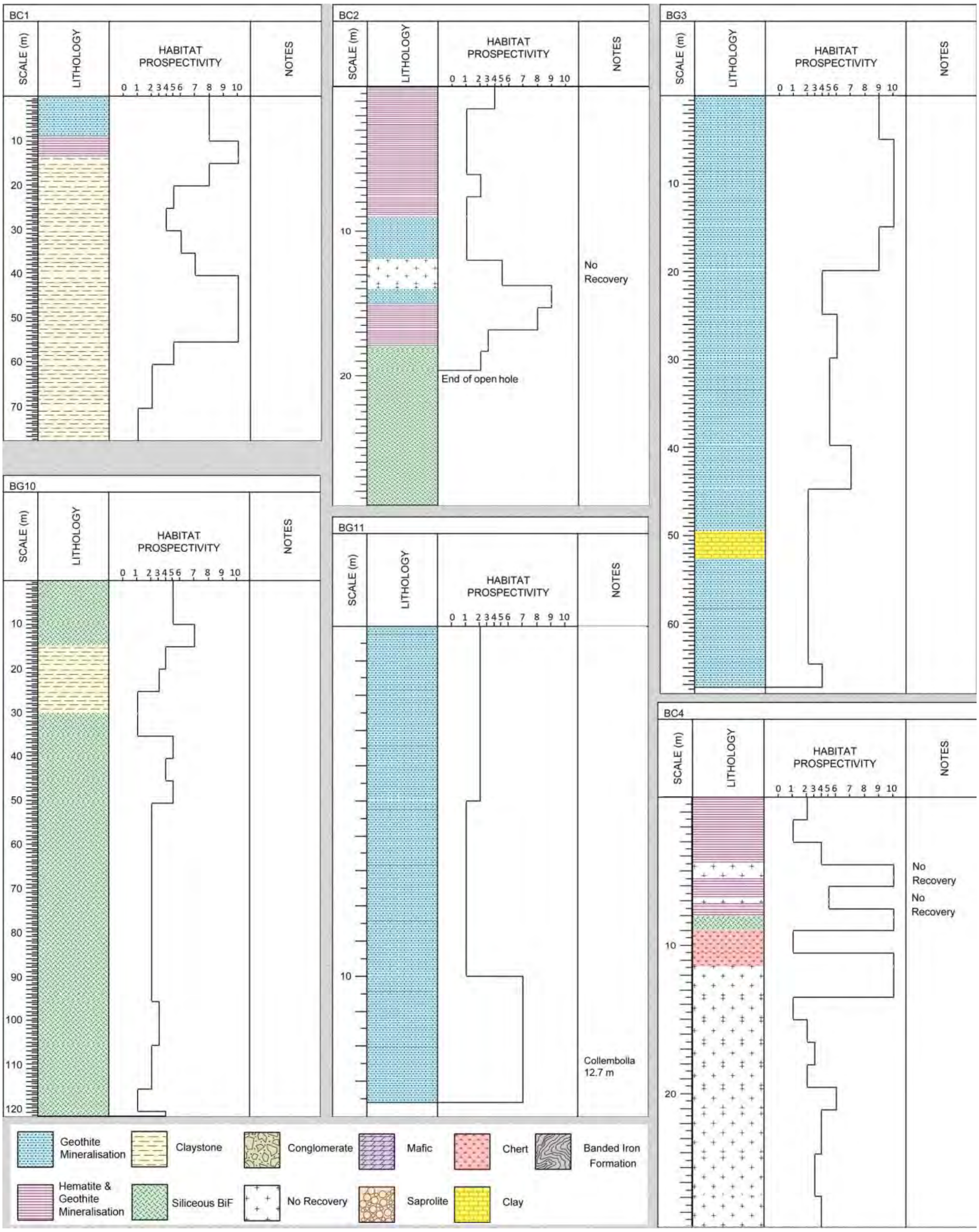

Figure 9. Lithology and habitat prospectivity of OTV holes.
BC1, BC2 and BC4 (Bungalbin Central); BG3, BG10, BG11 (Bungalbin East).

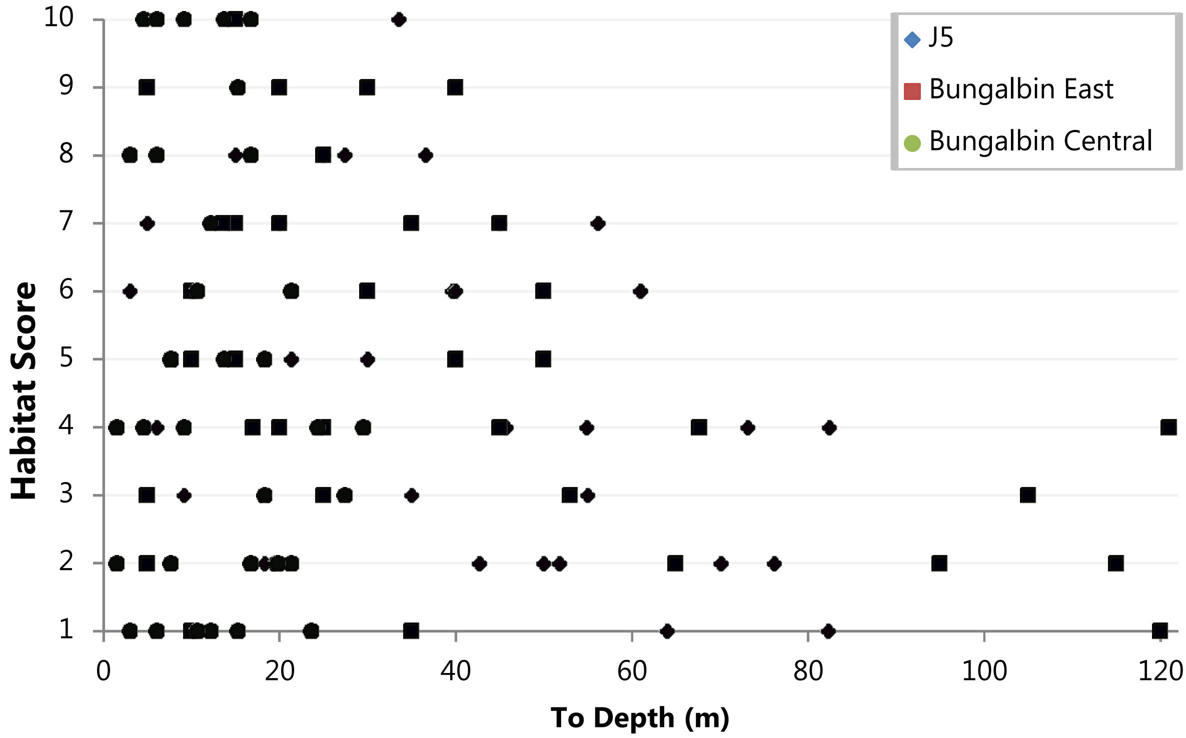

Figure 10. Frequency of habitat scores by depth and deposit.

4. DISCUSSION

Appendix 4 provides a list of the troglofaunal species known from the Project area, with up to date nomenclature. Some of these names differ from those used in Bennelongia (2016) as the relationships between the species in deposits of the Project area and surrounding deposits have been determined using CO1 sequencing alongside morphology. The list highlights the difficulties of reporting multiple surveys of fauna with an incomplete and developing taxonomic framework, and also that for many groups of invertebrates, morphological or molecular techniques should be used together to inform taxonomy.

4.1. Additional sampling

Additional sampling in October 2016 increased the number of troglofaunal morphospecies known from J5 reported by Bennelongia (2016) by five species (Section 3.1) and subsequent molecular work revised the total number of species to 16 (Section 3.2). Sampling effort at J5 has been relatively high, with 42 trap and 106 scrape samples collected since 2008. The collection of five additional species in 2016 during intensive scrape sampling, combined with the prediction in Bennelongia (2016), based on the ICE species richness algorithm, that 28 species may occur in total, suggests that it is likely that other species in the community remain to be documented. It is possible, however, that the ICE value is an overestimate and there is little doubt that a large proportion of the species in the community have been collected. It is considered that sufficient species have been collected to define the character of the community.

Sampling in 2016 failed to collect any additional animals other than nematodes at Bungalbin East and Bungalbin Central. Currently, four troglofauna species are known from Bungalbin East, plus nematodes that have doubtful status as troglofauna. Sampling effort has been moderate, with 30 trap and 36 scrape samples collected since 2012. While it is likely that extra species remain to be collected from Bungalbin East, the failure to collect additional animals by scraping all available drill holes in 2016 suggests that Bungalbin East supports a depauperate (and low abundance) troglofaunal community. Thus, it is possible that fewer species remain to be collected than the six or more additional species suggested by the ICE species richness algorithm in Bennelongia (2016). However, OTV results at Bungalbin East showed the presence of some troglofauna that were not collected by scraping and previous trap sampling appeared to be slightly more effective than scraping, which was the only sampling method employed in 2016. An alternative explanation for failure to collect more species in 2016 is that the efficiency of scrape sampling may have been constrained by the way holes were drilled or that some rehabilitated holes are not ideal to sample (rocks and debris sometimes fall down during excavation).

Only one troglofaunal species is known from Bungalbin Central, despite its relatively high habitat prospectivity. This may also be the result of the efficiency of scrape sampling being constrained or may be an artefact of the very limited sampling effort and the low and variable yields of troglofaunal sampling in general.

4.2. DNA analyses

In general, CO1 analyses supported the conclusion of Bennelongia (2016) that J5 and Bungalbin East support different troglofaunal communities. It is possible that the isopod *Trichorhina* sp. B28, which Bennelongia (2016) treated as one species, occurs at both deposits, because Javidkar *et al*. (2016) proposed that the threshold for separate species of stygofaunal isopods in the Yilgarn is 12% sequence divergence. There was 9.9% divergence between the J5 and Bungalbin East populations the variation within the J5 deposit was 6%. However, this within-J5 variation was nearly all attributable to one animal and the two populations are regarded as either evolutionarily significant units or separate species, which is how they are treated in Appendix 4.

There was no firm evidence for any species at J5 or Bungalbin East, other than the bug Meenoplidae sp. B14-DNA, occurring at deposits outside the Project area. The bug Meenoplidae sp. B14-DNA was collected at J5 and was shown genetically to also occur at Ularring and in the Pilbara.

4.3. Wide-ranging Species

As a result of revisions to the Proposal since referral and advertising of the PER, the proposed impact of the J5 mine pit covers 61 ha and constitutes only 2.2% of the landforms of the Helena-Aurora Range, while the proposed pit area at Bungalbin East covers 111 ha and constitutes 3.2% of the landforms of the Helena Aurora Range. Most importantly, the J5 and Bungalbin East pits have lengths of only 1.6 and 2.3 km, respectively, and it is highly unlikely that any species has a range of less than this. For example, schizomids, although not present in the Yilgarn, represent a group of troglofauna that tend to have small ranges and usually well-documented distribution associated with a geological feature. One such species is *Draculoides mesozeirus* from Middle Robe in the Pilbara that has been documented to have a range of 89 ha (Biota 2006; Harvey 2008).

The richness of troglofaunal assemblages at nearby mining areas varies greatly, with only three species known from Windarling, 13 from Lake Deborah and 27 from Koolyanobbing (Bennelongia 2010, 2009, 2014; richness potentially different to these reports due to sequencing), although many animals could not be sequenced and richness may potentially be higher. The more important issue is the minimum documented ranges of species, which is measured by the distance between the furthest two points of a species and therefore represents the most conservative, but unlikely, range of a species. At Koolyanobbing, nine species with records from more than one hole had minimum ranges between 500 m and 8 km. Of the isopods successfully sequenced, three species had minimum ranges between 500 m and 2 km and one species with a minimum range of 6.9 km. A species of symphylan confirmed by sequencing, *Hanseniella* sp. B40, had a minimum linear range of 5.4 km. Limited success of molecular work at Lake Deborah leaves the ranges of most species there somewhat ambiguous. Windarling is a very small deposit at which little sampling has occurred and from which few troglofauna species are known. Of the three species collected there, the single isopod species has a minimum range of 280 m, a higher order bug was collected across 450 m and the third species is the almost certainly the cosmopolitan polyxenid *Lophoturus madecassus*.

4.4. Habitat characterisation

Despite sequence results suggesting there is isolation between deposits, habitat characterisation demonstrated that several lithologies in each part of the Helena Aurora Range either support or are prospective for troglofauna. Habitats at Bungalbin Central and J5 appear to be more prospective than habitats at Bungalbin East, but results suggest prospectivity at J5 and Bungalbin East is likely to be similar in lithologies inside and outside the proposed mine pits. It is noted that only holes inside the proposed mine pits could be examined.

A very similar relationship to the one shown here between the degree of weathering of BIFs and suitablility of habitat for troglofauna, irrespective of the finer details of lithology, has also been recorded in the Pilbara and would be expected in most BIF ranges in the Yilgarn. Given the extent of weathered BIF outside the Project impact areas, there is a high probability that the species collected from prospective lithologies in the impact areas also occur outside the mine pit, in other weathered rocks.

Given the likely habitat connectivity between the mine pits and surrounding ranges, it is very unlikely that troglofauna species at J5 and Bungalbin East have ranges as small as the proposed mine pits. It is considered likely that the ranges of all species extend beyond the two deposits into the contiguous ranges.

4.5. Conclusions

The specific objectives of Bennelongia's assessment in 2016 of the subterranean fauna of the Project area were:

- To characterise the subterranean fauna communities present within the Project footprint and list their constituent species;
- To determine the likely ranges of the subterranean fauna species present based on survey information and geological mapping; and
- To assess the potential impacts on subterranean fauna from the developments associated with the Project.

This report provides further information about the troglofaunal communities in the proposed mine pits at J5 and Bungalbin East, including documenting a higher proportion of the community at J5, showing that troglofaunal species utilise a wide range of lithologies, and showing that habitat suitable for troglofauna is likely to be widespread in the Helena Aurora Range containing J5 and the Bungalbin East. The widespread occurrence of habitat suitable for troglofauna within the range means it is unlikely that mining in the Project area poses a significant conservation threat to troglofauna at J5 and Bungalbin East.

5. REFERENCES

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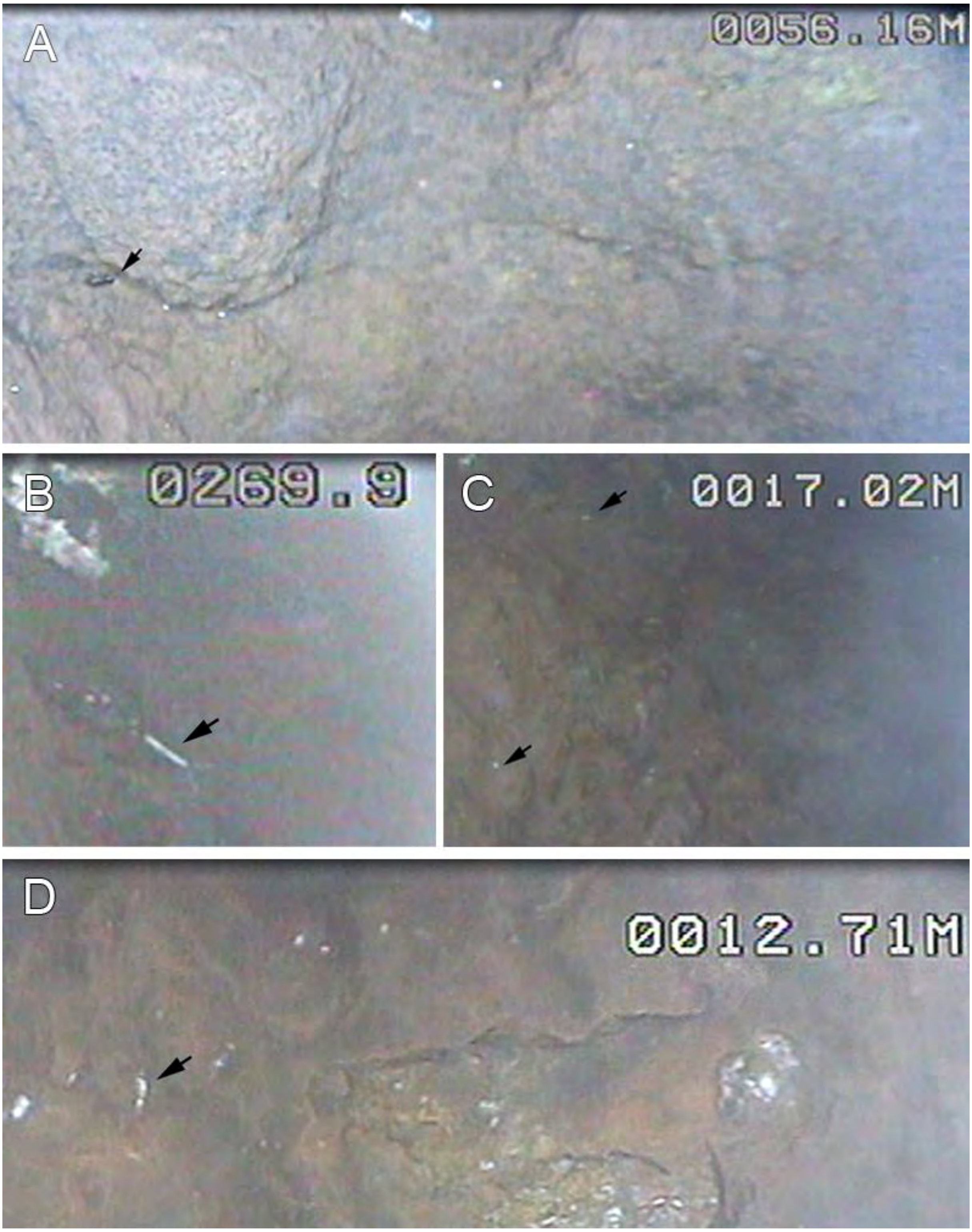
Appendix 1 – List of drill holes scraped in October 2016.

All coordinates are provided in Geocentric Datum of Australia 1994.

Orebody	Drill hole	Site Type	Sample Date	Latitude	Longitude	Sample Depth	OTV
Bungalbin Central	BC1	Control	27/10/2016	-30.382294686	119.626923694	20 m	Yes
Bungalbin Central	BC2	Control	26/10/2016	-30.382715142	119.629357886	17 m	Yes
Bungalbin Central	BC3	Control	26/10/2016	-30.381551018	119.628671706	25 m	
Bungalbin Central	BC4	Control	26/10/2016	-30.382510278	119.628666389	25 m	Yes
Bungalbin East	BG3	Impact	25/10/2016	-30.351359779	119.706833942	64 m	Yes
Bungalbin East	BG9	Impact	25/10/2016	-30.358829733	119.695828226	22 m	
Bungalbin East	BG10	Impact	25/10/2016	-30.359199758	119.696254399	121 m	Yes
Bungalbin East	BG11	Impact	25/10/2016	-30.359561196	119.696659501	13 m	Yes
Bungalbin East	BG12	Impact	25/10/2016	-30.360092496	119.696940558	24 m	
Bungalbin East	BG13	Impact	25/10/2016	-30.360549279	119.694668935	47 m	
Bungalbin East	BG15	Impact	25/10/2016	-30.359613069	119.700259491	82 m	
Bungalbin East	BG16	Impact	25/10/2016	-30.359186649	119.699726783	55 m	
Bungalbin East	BG17	Impact	25/10/2016	-30.358735718	119.699507363	65 m	
Bungalbin East	BG24	Impact	25/10/2016	-30.356777517	119.700754753	105 m	
Bungalbin East	BG25	Impact	25/10/2016	-30.352386939	119.702962352	17 m	Yes
Bungalbin East	BG28	Impact	25/10/2016	-30.35024291	119.707529487	5 m	
Bungalbin East	BG29	Impact	25/10/2016	-30.34985414	119.707239571	3 m	
Bungalbin East	BG30	Impact	26/10/2016	-30.361597464	119.695446562	46 m	
Bungalbin East	BG36	Impact	25/10/2016	-30.359335438	119.696480897	48 m	Yes
J5 Deposit	J5DD001	Impact	26/10/2016	-30.3611	119.6166	51 m	Yes
J5 Deposit	J5DD002	Impact	27/10/2016	-30.3615637652	119.619073049	41 m	
J5 Deposit	J5DD003	Impact	27/10/2016	-30.362	119.6212	77 m	
J5 Deposit	J5RC001	Impact	28/10/2016	-30.3602	119.6167	4 m	
J5 Deposit	J5RC002	Impact	28/10/2016	-30.3592	119.6159	2 m	
J5 Deposit	J5RC003	Impact	28/10/2016	-30.3609	119.6172	40 m	
J5 Deposit	J5RC012	Impact	28/10/2016	-30.3616	119.6202	95 m	
J5 Deposit	J5RC014	Impact	27/10/2016	-30.3623	119.6209	11 m	
J5 Deposit	J5RC015	Impact	27/10/2016	-30.3628	119.6218	3 m	
J5 Deposit	J5RC018	Impact	27/10/2016	-30.3626	119.6227	4 m	
J5 Deposit	J5RC025	Impact	26/10/2016	-30.3605	119.6157	13 m	
J5 Deposit	J5RC026	Impact	27/10/2016	-30.360951703	119.618110255	12 m	
J5 Deposit	J5RC029	Impact	26/10/2016	-30.3615	119.6162	2 m	
J5 Deposit	J5RC030	Impact	26/10/2016	-30.3619	119.6166	7 m	
J5 Deposit	J5RC031	Impact	28/10/2016	-30.3622	119.6199	53 m	
J5 Deposit	J5RC033	Impact	28/10/2016	-30.3626	119.6206	79 m	
J5 Deposit	J5RC036	Impact	27/10/2016	-30.3627	119.6231	7 m	
J5 Deposit	J5RC039	Impact	27/10/2016	-30.3616	119.6206	17 m	
J5 Deposit	J5RC040	Impact	27/10/2016	-30.361190673	119.619687152	4 m	
J5 Deposit	J5RC043	Impact	28/10/2016	-30.360251777	119.617030723	31 m	
J5 Deposit	J5RC045	Impact	26/10/2016	-30.3584	119.6151	7 m	
J5 Deposit	J5RC048	Impact	26/10/2016	-30.3592	119.6147	15 m	
J5 Deposit	J5RC050	Impact	26/10/2016	-30.3595	119.6156	6 m	
J5 Deposit	J5RC051	Impact	26/10/2016	-30.3596	119.6156	61 m	

Orebody	Drill hole	Site Type	Sample Date	Latitude	Longitude	Sample Depth	OTV
J5 Deposit	J5RC052	Impact	27/10/2016	-30.3602	119.6158	4 m	
J5 Deposit	J5RC053	Impact	26/10/2016	-30.3602	119.6158	53 m	
J5 Deposit	J5RC054	Impact	26/10/2016	-30.3601	119.6152	15 m	
J5 Deposit	J5RC056	Impact	27/10/2016	-30.3602	119.6158	75 m	
J5 Deposit	J5RC057	Impact	28/10/2016	-30.3594566982	119.616198289	7 m	
J5 Deposit	J5RC058	Impact	28/10/2016	-30.3599	119.6164	24 m	
J5 Deposit	J5RC061	Impact	28/10/2016	-30.3608	119.6167	2 m	
J5 Deposit	J5RC062	Impact	26/10/2016	-30.3612	119.6162	65 m	
J5 Deposit	J5RC064	Impact	26/10/2016	-30.361	119.617	9 m	
J5 Deposit	J5RC067	Impact	28/10/2016	-30.361	119.6177	3 m	
J5 Deposit	J5RC068	Impact	27/10/2016	-30.3614	119.6179	10 m	
J5 Deposit	J5RC069	Impact	28/10/2016	-30.3605	119.6179	17 m	
J5 Deposit	J5RC070	Impact	28/10/2016	-30.3606	119.6184	15 m	
J5 Deposit	J5RC072	Impact	27/10/2016	-30.3613	119.6186	8 m	
J5 Deposit	J5RC073	Impact	27/10/2016	-30.3612	119.6187	7 m	
J5 Deposit	J5RC074	Impact	27/10/2016	-30.3608	119.6194	6 m	
J5 Deposit	J5RC076	Impact	27/10/2016	-30.3618	119.6195	6 m	
J5 Deposit	J5RC080	Impact	27/10/2016	-30.3616	119.6196	28 m	
J5 Deposit	J5RC081	Impact	27/10/2016	-30.3621	119.6205	6 m	
J5 Deposit	J5RC083	Impact	27/10/2016	-30.3618	119.6213	7 m	
J5 Deposit	J5RC086	Impact	27/10/2016	-30.3626015241	119.62129533	6 m	
J5 Deposit	J5RC088	Impact	27/10/2016	-30.3627	119.6219	4 m	
J5 Deposit	J5RC090	Impact	26/10/2016	-30.3609	119.6161	3 m	
J5 Deposit	J5RC091	Impact	26/10/2016	-30.3606	119.6157	7 m	
J5 Deposit	J5RC093	Impact	27/10/2016	-30.3628	119.6224	27 m	
J5 Deposit	J5RC094	Impact	27/10/2016	-30.3627	119.623	7 m	
J5 Deposit	J5RC095	Impact	27/10/2016	-30.3628389914	119.622945027	45 m	
J5 Deposit	J5RC096	Impact	28/10/2016	-30.3628	119.6235	7 m	
J5 Deposit	J5RC097	Impact	28/10/2016	-30.3625	119.6238	2 m	
J5 Deposit	J5RC098	Impact	28/10/2016	-30.3629	119.6242	3 m	
J5 Deposit	J5RC099	Impact	28/10/2016	-30.3625	119.6244	4 m	
J5 Deposit	J5RC100	Impact	28/10/2016	-30.3629	119.6248	4 m	
J5 Deposit	J5RC101	Impact	28/10/2016	-30.3633	119.6245	9 m	
J5 Deposit	J5RC102	Impact	28/10/2016	-30.3633	119.624	3 m	
J5 Deposit	J5RC105	Impact	28/10/2016	-30.3629741749	119.625195257	5 m	
J5 Deposit	J5RC106	Impact	28/10/2016	-30.3625	119.6249	15 m	
J5 Deposit	J5RC108	Impact	28/10/2016	-30.363247329	119.625067344	8 m	
J5 Deposit	J5RC110	Impact	28/10/2016	-30.363	119.6258	5 m	
J5 Deposit	J5RC111	Impact	28/10/2016	-30.3625960382	119.626058833	5 m	
J5 Deposit	J5RC113	Impact	28/10/2016	-30.3633	119.6256	3 m	
J5 Deposit	J5RC114	Impact	28/10/2016	-30.3629	119.6248	13 m	
J5 Deposit	J5RC116	Impact	27/10/2016	-30.3602	119.6163	75 m	Yes

Appendix 2 – Troglofaunal animals in OTV holes.



A, troglofaunal Curculionidae beetle in J5DD001; B, troglofaunal Symphylan in J5RC116 at 82.3 m (displayed units are in feet); C, troglofaunal Collembola in BG25; D, unknown animal in BG11.

Appendix 3 – Animals sequenced for mitochondrial gene CO1.

[1]-1 indicates a clean sequence of the target animal was obtained. LysRS was not successful.

Lab Ref	LowestID	Drill Hole	CO1 Result[1]	REGNO	Date Collected	Lab Notes
22_1	?*Haloniscus* sp. B04	KIRC018	0		8/10/2008	
22_2	*Trichorhina* sp. B02	KFRC204	0		7/10/2009	
22_3	*Trichorhina* sp.	J4RC018	0		15/10/2008	
22_4	*Troglarmadillo* \`ISO003\`	KFRC175	-1	49854	10/06/2009	
22_5	nr Gnaphosidae sp. B04	KFRC219	0		10/06/2009	
22_6	?*Haloniscus* sp. B04	PHF027	-1		5/08/2009	
22_7	Meenoplidae sp.	KFRC219	-1		10/06/2009	
22_8	Meenoplidae sp.	PHF003	-1		5/08/2009	
22_9	*Hemitrinemura* sp. B02	KJRC002	0		7/08/2008	
22_10	*Hanseniella* sp. B03	KFRCUNK10	0		7/10/2009	
22_11	*Lophoturus madecassus*	08RCMI014	0		26/11/2011	
22_12	*Cryptops* sp. B03	J5RC054	0		20/08/2008	
22_13	*Hanseniella* sp. B03	J4RC027	0		20/08/2008	
22_14	*Hemitrinemura* sp. B02	J5RC054	0		20/08/2008	
22_15	*Hanseniella* sp. B03	J5RC061	-1		8/08/2008	
22_16	*Trichorhina* sp. B02	J4RC018	0	45659	15/10/2008	
22_17	Meenoplidae sp.	08RCMI012	-1		26/11/2011	
22_18	*Hemitrinemura* sp.	J5RC091	0		20/08/2008	
22_19	*Hanseniella* sp. B03	J4RC038	-1	100094	15/10/2008	
22_20	nr Gnaphosidae sp. B04	J1RC236	-1		30/04/2008	
22_21	*Myrtonymus* sp. B05	J5RC061	-1		8/08/2008	
22_22	*Hanseniella* sp. B03	J1RC228	0		30/04/2008	
22_23	*Hemitrinemura* sp. B02	J5RC024	0		20/08/2008	
22_24	*Trichorhina* sp.	J5RC073	-1		31/05/2015	
22_25	*Cryptops* sp. B03	J5RC073	-1		31/05/2015	
22_26	*Hemitrinemura* sp.	J5RC073	-1		31/05/2015	
22_27	?*Buddelundia* sp.	J5RC073	-1		31/05/2015	
22_28	*Trichorhina* \`ISO019\`	CXRC0027	0	49884	21/12/2010	
22_29	*Cryptops* sp. B18	CXRC0020	-1		21/09/2010	
22_30	*Troglarmadillo* \`ISO004\`	CH0031	0	49856	10/09/2009	
22_31	*Hemitrinemura* sp. B08	LGRC507	-1		8/11/2011	
22_32	nr Gnaphosidae sp. B19	LGRC903	-1		9/11/2011	
22_33	*Lophoturus madecassus*	08RCMI007	0		26/11/2011	
22_34	*Prethopalpus* sp.	08RCMI007	0		26/11/2011	
22_35	*Trichorhina* \`ISO022\`	LGRC389	0		21/01/2012	

Lab Ref	LowestID	Drill Hole	CO1 Result[1]	REGNO	Date Collected	Lab Notes
22_36	*Hanseniella* sp. B12	LGRC464	-1		19/11/2010	
22_37	*Hanseniella* sp. B12	LGRC241	0		8/11/2011	
22_38	*Cryptops* sp. B27	LGRC507	-1		8/11/2011	
22_39	*Trichorhina* `ISO020`	W4RC054	0		22/09/2009	
22_40	*Cryptops* sp. B21	SB012	-1		18/01/2011	
22_41	Meenoplidae sp.	08RCMI007	-1		26/11/2011	
22_42	*Hanseniella* sp.	J5RC116	-1		27/10/2016	
22_43	Araneomorphae sp. B16	PKRC0044	0		23/04/2010	
22_44	*Hemitrinemura* sp. B03	SB012	-1		8/07/2010	
22_45	*Troglarmadillo* `ISO007`	SB017	0	49861	8/07/2010	
22_46	Araneomorphae sp. B13	PKRC0039	-1		17/02/2010	
22_47	*Hemitrinemura* sp. B03	SB031	-1		9/07/2010	
22_48	*Trichorhina* sp. B06	GVRC013	0		17/01/2011	
22_49	*Hanseniella* sp. B05	PATH05	-1		7/07/2010	
22_50	*Hanseniella* sp. B05	SB009	0		8/07/2010	
22_51	*Trichorhina* sp. B28	BG29	-1	60918	21/11/2015	
22_52	Philosciidae sp.	KFDD03	-1		5/08/2009	Small eye spot
22_53	?*Haloniscus* sp. B04	KCRC090	0	45603	29/04/2008	
22_54	*Trichorhina* sp. B02	KFRC242	-1		5/08/2009	Looks terrestrial
22_55	*Trichorhina* sp. B28	J5RC085	-1	68707	20/11/2015	
22_56	*Trichorhina* sp. B28	J5RC043	-1	68708	30/09/2015	
22_57	*Trichorhina* sp. B02	KFRCUNK05	-1	45665	5/08/2009	Looks terrestrial
22_58	nr Gnaphosidae sp.	J5RC029	-1		26/10/2016	
22_59	nr Gnaphosidae sp.	J5RC030	-1		26/10/2016	
22_60	nr Gnaphosidae sp.	J5RC091	-1		26/10/2016	
22_61	nr Gnaphosidae sp.	J5RC026	-1		27/10/2016	
22_62	nr Gnaphosidae sp.	J5RC076	-1		27/10/2016	
22_63	nr Gnaphosidae sp.	J5RC061	-1		28/10/2016	
22_64	*Prethopalpus* sp.	J5RC048	-1		26/10/2016	
22_65	?*Buddelundia* sp.	J5RC068	0		27/10/2016	
22_66	?*Buddelundia* sp.	J5DD001	-1		26/10/2016	
22_67	?*Buddelundia* sp. B02	J5RC030	-1		26/10/2016	
22_68	?*Buddelundia* sp. B02	J5RC051	-1		26/10/2016	
22_69	*Troglarmadillo* sp. B63	J5RC036	-1		27/10/2016	
22_70	*Trichorhina* sp.	J5RC116	-1		27/10/2016	
22_71	*Trichorhina* sp.	J5RC090	-1		26/10/2016	
22_72	*Trichorhina* sp. B28	J5RC111	-1	68709	20/11/2015	
22_73	*Trichorhina* sp. B28	BG16	-1	68710	21/11/2015	Terrestrial Philosciidae

Lab Ref	LowestID	Drill Hole	CO1 Result[1]	REGNO	Date Collected	Lab Notes
22_74	*Myrtonymus* sp. B05	J5RC110	-1		28/10/2016	
22_75	*Myrtonymus* sp. B05	J5RC102	0		28/10/2016	
22_76	*Myrtonymus* sp. B05	J5RC080	-1		27/10/2016	
22_77	?*Buddelundia* sp. B02	J5RC026	0	60894	30/09/2015	
22_78	Meenoplidae sp.	J5RC039	-1		27/10/2016	
22_79	Meenoplidae sp.	J5RC086	-1		27/10/2016	
22_80	*Hemitrinemura* sp.	J5RC108	-1		28/10/2016	
22_81	*Hemitrinemura* sp. B02	J5RC100	-1		28/10/2016	
22_82	*Hemitrinemura* sp. B02	J5RC072	-1		27/10/2016	
22_83	*Hemitrinemura* sp. B02	J5RC051	-1		26/10/2016	
22_84	*Hemitrinemura* sp. B02	J5RC025	-1		26/10/2016	
22_85	*Hemitrinemura* sp. B14	J5RC114	-1		28/10/2016	
22_86	*Hanseniella* sp.	J5RC076	-1		27/10/2016	
22_87	*Hanseniella* sp.	J5RC039	-1		27/10/2016	
23_10	*Hanseniella* sp. B29	BC4	-1	140821	21/11/2015	
23_11	?*Haloniscus* sp. B04	KCRC090	0	45603	29/04/2008	
23_12	?*Haloniscus* sp. B04	KDRC0001	-1	45605	8/10/2008	
23_13	?*Haloniscus* sp. B04	KCRC090	-1	45606	28/02/2008	
23_14	?*Haloniscus* sp. B04	KIRC021	0	45607	7/08/2008	
23_15	?*Haloniscus* sp. B04	KCDD003	-1	45610	6/08/2008	
23_16	Philosciidae sp.	KFRC188	0	45611	8/10/2008	
23_17	Philosciidae sp. B06	KCDD003	0	45614	29/04/2008	
23_18	Philosciidae sp. B08	CH0038	-1	45617	30/04/2009	
23_19	Philosciidae sp. B09	CH0038	-1	45618	23/06/2009	
23_20	nr *Andricophiloscia* sp. B14	PKRC0193	-1	45627	9/06/2010	
23_21	*Quatuordillo caecus*	KFRC165	0	45630	10/06/2009	
23_22	Isopoda sp.	KFRC225	0	45646	8/08/2008	Philosciidae
23_23	*Trichorhina* \`ISO019\`	CNRC0001	-1	45658	21/09/2010	
23_24	*Trichorhina* sp. B02	J4RC018	-1	45659	15/10/2008	
23_25	*Trichorhina* sp. B02	KFRC191	0	45663	7/08/2008	
23_26	*Trichorhina* sp. B02	KFRCUNK05	-1	45665	5/08/2009	Looks terrestrial
23_27	*Trichorhina* sp. B02	KIRC013	0	45666	7/08/2008	
23_28	*Trichorhina* \`ISO020\`	W4RC040	-1	45670	22/09/2009	
23_29	*Troglarmadillo* \`ISO003\`	KFRC152	0	45683	5/08/2009	
23_30	*Troglarmadillo* \`ISO003\`	KFRC189	0	45684	8/10/2008	
23_31	*Troglarmadillo* \`ISO003\`	KFRC200	0	45685	10/06/2009	

Appendix 4 – Troglofauna species recorded in the Project area.

Bungalbin East , BE; Bungalbin Central, BC.

Lithology codes: ALV, alluvium; BIG, banded iron goethite; CHT, chert; COL, Colluvium; ICA, canga; IG-IGH, goethite-hematite mineralisation; SI-BIF, siliceous BIF.

Taxonomy	LowestID	No. animals			Lithology (drill hole)	Drill Hole(s)	Linear Range	Notes on taxonomy
		J5	BE	BC				
Nematoda	Nematoda sp.		35		IG-IGH (BG13)	1	-	
Chelicerata								
Arachnida								
Araneae								
nr Gnaphosidae	nr Gnaphosidae sp. B21-DNA	7			ICA (J5RC026) ICA, BIG (J5RC029) COL, ICA (J5RC030) IG-IGH (J5RC040, J5RC061, J5RC076) SI-BIF (J5RC091)	7	389 m	Sequencing revealed high diversity in the previously common nr Gnaphosidae sp. B04 and split animals into species by their respective deposits. All nr Gnaphosids from J5 formed a unique genetic lineage and were given a new morphospecies code (includes juveniles and sp. B04 animals)
Oonopidae	*Prethopalpus* sp. B31/31-DNA	1			IG-IGH, SI-BIF (J5RC095) SI-BIF (J5RC048)	2	-	The juvenile collected in 2016 was successfully sequenced but the specimen of B31 collected in 2015 could not be located my museum staff. Given their proximity to each other they are very likely a single species
Myriapoda								
Chilopoda								
Geophilida								
Chilenophilidae	Chilenophilidae sp. B01	1			ICA (J5RC113)	1	-	Only record of this family and thus no sequencing attempted. No changes
Scolopendrida								
Cryptopidae	*Cryptops (Trigonocryptops)* sp. B03	2			SI-BIF (J5RC054) IG-IGH, ICA (J5RC073)	2	358 m	Genetics confirm this as a unique lineage compared to three morphospecies sequenced from three other ranges
Pauropoda								
Tetramerocerata								
Pauropodidae	Pauropodidae sp. B08	2			IG-IGH (J5RC068) SI-BIF, ICA, BIG (J5RC069)	2	100 m	Mounted on slide, not suitable for sequencing, no changes
	Pauropodidae sp. B36		1		SI-BIF (BG10)	1	-	Mounted on slide, not suitable for sequencing, no changes
Symphyla								
Cephalostigmata								
Scutigerellidae	*Hanseniella* sp. B29			2	ICA (BC4)	1	-	A genetically unique species from Bungalbin Central
	Hanseniella sp. B38-DNA	4			IG-IGH, SI-BIF (J5RC039) IG-IGH (J5RC061, J5RC076) SI-BIF (J5RC116)	4	441 m	A genetically unique species from J5
Crustacea								
Malacostraca								

Taxonomy	LowestID	No. animals			Lithology (drill hole)	Drill	Linear	Notes on taxonomy
Isopoda								
Armadillidae	?*Buddelundia* sp. B03	22			ICA (J5RC026) COL, ICA (J5RC030) SI-BIF (J5RC051) IG-IGH, ICA (J5RC073) IG-IGH (J5RC068, J5RC080, J5DD001)	7	445 m	Genetics indicate a single lineage at J5. Although the single animal from J4 could not be located by museum staff for sequencing, this moderately high intra-divergence of the J5 animals indicates they would be highly unlikely to be the same species as that at J4. As such, morphospecies B02 was split and the J5 lineage was given a new morphospecies code
	Troglarmadillo sp. B63	4			IG-IGH, SI-BIF (J5RC036)	1	-	Only record of this genus from the Project area, no changes
Philosciidae	Philosciidae `bungalbin`		1		SI-BIF (BG9)	1	-	Could not be located by Simon Judd or museum staff
Platyarthridae	*Trichorhina* sp. B28	22			IG-IGH (J5RC040) COL, BIG, SI-BIF, IG-IGH (J5RC043) IG-IGH (J5RC068) IG-IGH, ICA (J5RC073) IG-IGH, ICA (J5RC085) IG-IGH, poss. BIG & ICA (J5RC090) CHT, SI-BIF (J5RC111) SI-BIF (J5RC116)	8	976 m	Recognised as a separate ESU to an animal from Bungalbin East, although morphologically they are one species
	Trichorhina sp. B30		1		ALV (BG29)	1	-	See previous, given new species code
Scyphacidae	?*Haloniscus* sp. B07	1			SI-BIF (J5RC116)	1	-	High genetic divergences of animals in this genus from surrounding locations split the previously ubiquitous ?*Hanoniscus* sp. B04 into at least five species. Although this animal from J5 could not be located by Stefano Taiti or museum staff, it would most certainly be a separate species and was given a new species code
Hexapoda								
Insecta								
Thysanura								
Nicoletiidae	*Hemitrinemura* sp. B14	12			IG-IGH (J5RC024) IG-IGH, SI-BIF (J5RC025) SI-BIF (J5RC051, J5RC054) IG-IGH (J5RC072) IG-IGH, ICA (J5RC073) BIG, poss. SI-BIF (J5RC100) SI-BIF (J5RC108) BIG, poss. SI-BIF (J5RC114)	9	1011 m	A single genetic lineage occurs at J5, which comprises two morphospecies B02 and B14. However, morphospecies B02 was first collected at Koolyanobbing and as these are now distinct species the second species code was used for the J5 animals (B14)
Hemiptera								
Meenoplidae	Meenoplidae sp. B14-DNA	2			IG-IGH, SI-BIF (J5RC039) IG-IGH, SI-BIF (J5RC086)	2	129 m	Sequences of animals at J5 aligned an animal at Ularring and the ubiquitous troglophilic species found in the Pilbara
Coleoptera								
Curculionidae	Curculionidae Genus 1 sp. B13	1			SI-BIF (J5RC108)	1	-	Not sequenced, no changes as only record of this genus for a quite some distance
	Curculionidae sp. B01	1			IG-IGH, poss. BIG & ICA (J5RC090)	1	-	Not sequenced, no changes as only record of this genus for a quite

Taxonomy	LowestID	No. animals			Lithology (drill hole)	Drill	Linear	Notes on taxonomy
								some distance
	Myrtonymus sp. B05	11			COL, BIG, SI-BIF, IG-IGH (J5RC043) IG-IGH (J5RC061, J5RC080) IG-IGH, SI-BIF (J5RC095) SI-BIF, BIG (J5RC102) SI-BIF (J5RC108) ICA (J5RC110)	7	908 m	Sequencing confirmed the two distinct morphospecies of this genus at the Project
	Myrtonymus sp. B06		1		IG-IGH (BG24)	1	-	See previous
Staphylinidae	Pselaphinae sp. B13	1			IG-IGH (J5RC080)	1	-	Not sequenced, no changes as only record of this genus for a quite some distance

Higher Level Identifications

Taxonomy	LowestID	J5 Deposit	Bungalbin East	Bungalbin Central	Notes
Myriapoda					
Symphyla					
Cephalostigmata					
Scutigerellidae	*Hanseniella* sp.			1	This juvenile was recorded from the same hole at Bungalbin Central as *Hanseniella* sp. B29 and is very likely to be this species. However, this juvenile specimen could not be located by WA museum staff for sequencing
Hexapoda					
Insecta					
Thysanura					
Nicoletiidae	*Hemitrinemura* sp.	1			Very likely *Hemitrinemura* sp. B14 from J5 but sequencing failed (collected 2008)

Appendix 5 – DNA analyses.

Percentage divergence

Group by group

Animal	LowestID & Drill hole	Lineage	A	B	C	D	E	F	G	H	I	J
A	Hemitrinemura_sp_B02_J5RC025	1	-	3.6%	3.4%	3.7%	3.6%	3.6%	3.6%	10.4%	11.1%	12.6%
B	Hemitrinemura_sp_B02_J5RC051	1	3.6%	-	0.2%	0.5%	0.3%	0.3%	0.3%	12.0%	12.1%	13.5%
C	Hemitrinemura_sp_B02_J5RC072	1	3.4%	0.2%	-	0.3%	0.2%	0.2%	0.2%	11.8%	11.9%	13.3%
D	Hemitrinemura_sp_B02_J5RC100	1	3.7%	0.5%	0.3%	-	0.5%	0.2%	0.5%	12.2%	12.3%	13.7%
E	Hemitrinemura_sp_B14_J5RC114	1	3.6%	0.3%	0.2%	0.5%	-	0.3%	0.3%	11.8%	11.9%	13.3%
F	Hemitrinemura_sp_J5RC073	1	3.6%	0.3%	0.2%	0.2%	0.3%	-	0.3%	12.0%	12.1%	13.5%
G	Hemitrinemura_sp_J5RC108	1	3.6%	0.3%	0.2%	0.5%	0.3%	0.3%	-	12.0%	12.1%	13.1%
H	Hemitrinemura_sp_B03_SB012	2	10.4%	12.0%	11.8%	12.2%	11.8%	12.0%	12.0%	-	0.8%	14.0%
I	Hemitrinemura_sp_B03_SB031	2	11.1%	12.1%	11.9%	12.3%	11.9%	12.1%	12.1%	0.8%	-	14.4%
J	Hemitrinemura_sp_B08_LGRC507	3	12.6%	13.5%	13.3%	13.7%	13.3%	13.5%	13.1%	14.0%	14.4%	-

Animal	LowestID& Drill hole	Lineage	A	B	C
A	Myrtonymus_sp_B05_J5RC061	1	-	3.1%	2.9%
B	Myrtonymus_sp_B05_J5RC080	1	3.1%	-	0.4%
C	Myrtonymus_sp_B05_J5RC110	1	2.9%	0.4%	-

Animal	LowestID& Drill hole	Lineage	A	B	C	D	E	F
A	Meenoplidae_sp_08RCMI007	1	-	0.6%	0.4%	0.4%	9.8%	15.8%
B	Meenoplidae_sp_08RCMI012	1	0.6%	-	0.6%	0.6%	10.4%	16.5%
C	Meenoplidae_sp_J5RC039	1	0.4%	0.6%	-	0.1%	10.7%	16.9%
D	Meenoplidae_sp_J5RC086	1	0.4%	0.6%	0.1%	-	10.7%	17.1%
E	Meenoplidae_sp_KFRC219	2	9.8%	10.4%	10.7%	10.7%	-	17.1%
F	Meenoplidae_sp_PHF003	3	15.8%	16.5%	16.9%	17.1%	17.1%	-

Animal	LowestID& Drill hole	Lineage	A	B	C	D	E	F	G	H	I	J
A	Araneomorphae_sp_B13_PKRC0039	1	-	15.8%	12.3%	11.8%	12.2%	13.7%	11.8%	11.8%	14.5%	25.0%
B	nr_Gnaphosidae_sp_B19_LGRC903	2	15.8%	-	13.9%	13.7%	13.7%	14.4%	13.7%	13.7%	10.7%	26.8%
C	nr_Gnaphosidae_sp_J5RC061	3	12.3%	13.9%	-	0.9%	0.0%	0.4%	0.9%	0.7%	13.4%	26.5%
D	nr_Gnaphosidae_sp_J5RC026	3	11.8%	13.7%	0.9%	-	0.9%	1.4%	0.0%	0.1%	13.2%	25.5%
E	nr_Gnaphosidae_sp_J5RC076	3	12.2%	13.7%	0.0%	0.9%	-	0.4%	0.9%	0.7%	13.4%	26.3%
F	nr_Gnaphosidae_sp_J5RC091	3	13.7%	14.4%	0.4%	1.4%	0.4%	-	1.4%	1.4%	12.6%	26.6%
G	nr_Gnaphosidae_sp_J5RC030	3	11.8%	13.7%	0.9%	0.0%	0.9%	1.4%	-	0.1%	13.2%	25.5%
H	nr_Gnaphosidae_sp_J5RC029	3	11.8%	13.7%	0.7%	0.1%	0.7%	1.4%	0.1%	-	13.3%	25.5%
I	nr_Gnaphosidae_sp_B04_J1RC236	4	14.5%	10.7%	13.4%	13.2%	13.4%	12.6%	13.2%	13.3%	-	27.4%
J	Prethopalpus_sp_J5RC048	5	25.0%	26.8%	26.5%	25.5%	26.3%	26.6%	25.5%	25.5%	27.4%	-

Animal	LowestID& Drill hole	Lineage	A	B	C	D	E	F	G	H
A	Hanseniella_sp_B03_J4RC038	1	-	23.1%	21.4%	21.9%	21.7%	21.7%	14.1%	21.2%
B	Hanseniella_sp_B03_J5RC061	2	23.1%	-	1.4%	0.9%	1.6%	16.1%	16.5%	22.7%
C	Hanseniella_sp_J5RC076	2	21.4%	1.4%	-	0.6%	0.0%	16.7%	16.6%	23.4%
D	Hanseniella_sp_J5RC116 3	2	21.9%	0.9%	0.6%	-	0.8%	16.6%	16.9%	23.9%
E	Hanseniella_sp_J5RC039	2	21.7%	1.6%	0.0%	0.8%	-	16.9%	16.7%	23.4%
F	Hanseniella_sp_B05_PATH05	3	21.7%	16.1%	16.7%	16.6%	16.9%	-	18.1%	20.6%
G	Hanseniella_sp_B12_LGRC464	4	14.1%	16.5%	16.6%	16.9%	16.7%	18.1%	-	22.1%
H	Hanseniella_sp_B29	5	21.2%	22.7%	23.4%	23.9%	23.4%	20.6%	22.1%	-

Overview analyses

Isopods

				Drill		Inter divergences												
Locale	**LowestID**	**Lin**	**Seqs**	**Holes**	**Intra**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Koolyanobbing Deposit D	?Haloniscus sp. B04/Philosciidae sp.	1	3	3	**6.2%**	-												
Koolyanobbing Deposit C	?Haloniscus sp. B04	2	1	1	-	24.5%	-											
Lake Deborah	Philosciidae sp. B08/B09	3	2	1	**2.0%**	21.9%	23.2%	-										
Parker Range	nr Andricophiloscia sp. B14	4	1	1	**2.0%**	25.5%	28.8%	23.8%	-									
Lake Deborah & J4 Deposit	Trichorhina `ISO019`/Trichorhina sp. B02	5	2	2	**8.0%**	28.7%	27.5%	23.2%	24.8%	-								
Koolyanobbing Deposit F	Trichorhina sp. B02	6	3	2	**8.6%**	30.5%	30.8%	30.0%	26.6%	20.3%	-							
Windarling	Trichorhina `ISO020`	7	1	1	-	28.0%	29.1%	21.2%	26.1%	14.2%	21.3%	-						
Koolyanobbing Deposit F	Troglarmadillo `ISO003`	8	1	1	-	30.5%	26.4%	31.8%	28.5%	32.5%	32.6%	30.1%	-					
Koolyanobbing Deposit F	?Haloniscus sp. B04	9	1	1	-	24.1%	26.2%	13.3%	24.5%	25.6%	27.7%	26.1%	30.3%	-				
J5 Deposit	?Buddelundia sp. B02/?Buddelundia sp.	10	4	4	**7.3%**	31.0%	30.5%	31.4%	31.0%	30.8%	31.9%	29.2%	22.3%	31.0%	-			
J5 Deposit	Trichorhina sp. B28/Trichorhina sp.	11	6	6	**6.0%**	30.3%	29.6%	24.5%	30.6%	27.3%	17.1%	21.4%	16.6%	31.9%	27.3%	-		
Bungalbin East	Trichorhina sp. B28	12	1	1	-	30.2%	29.6%	25.2%	25.2%	16.7%	20.1%	16.0%	31.9%	27.3%	24.2%	**9.9%**		
J5 Deposit	Troglarmadillo sp. B36	13	1	1	-	29.8%	30.2%	32.2%	26.3%	29.5%	31.3%	27.5%	22.6%	28.2%	24.2%	29.2%	29.4%	-
Bungalbin East	Trichorhina sp. B28 (terr Philosciidae)	14	1	1	-	20.6%	22.5%	23.6%	24.0%	26.7%	32.2%	27.9%	28.5%	24.2%	29.8%	29.7%	28.5%	29.4%

Symphylans

				Drill		Inter			
Locale	**Species**	**Lineage**	**Seqs**	**Holes**	**Intra**	**1**	**2**	**3**	**4**
J4	Hanseniella sp. B03	1	1	1	-	-			
J5	Hanseniella sp./sp. B03	2	4	4	**1.6%**	23.1%	-		
Parker Range	Hanseniella sp. B05	3	1	1	-	21.7%	16.9%	-	
Ularring	Hanseniella sp. B12	4	1	1	-	14.1%	16.9%	18.1%	-
Bungalbin East	Hanseniella sp. B29	5	1	1	-	21.2%	23.9%	20.6%	22.1%

Thysanurans

				Drill		Inter	
Locale	**LowestID**	**Lineage**	**Seqs**	**Holes**	**Intra**	**1**	**2**
J5	Hemitrinemura sp. B02/sp. B14/sp.	1	7	7	**3.7%**	-	
Parker Range	Hemitrinemura sp. B03	2	2	2	**0.8%**	12.3%	-
Ularring	Hemitrinemura sp. B08	3	1	1	**-**	13.7%	14.4%

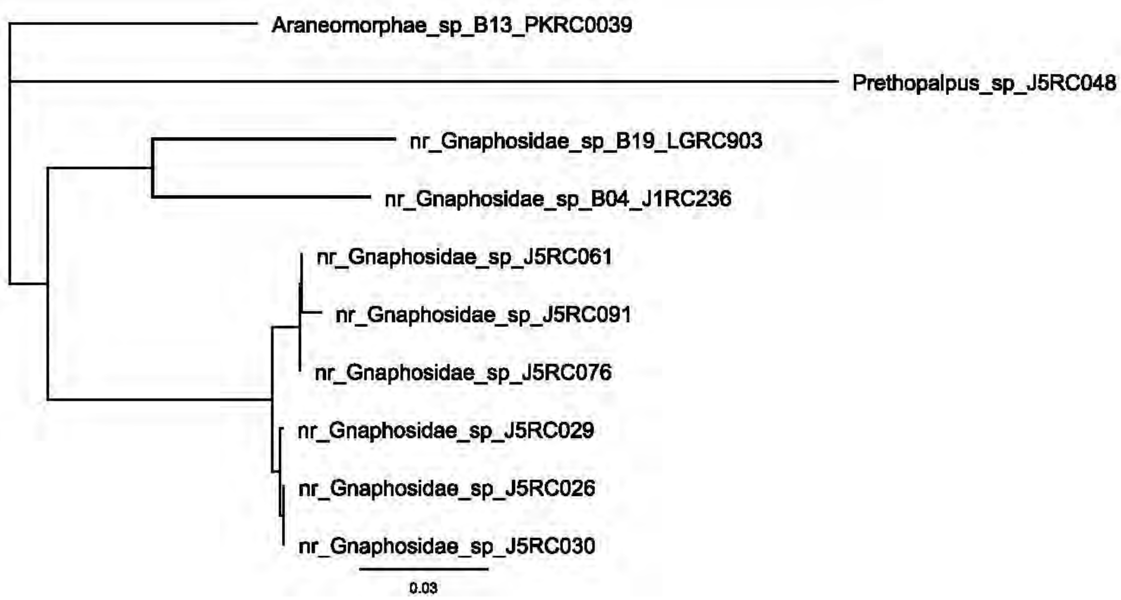
Spiders

				Drill		Inter			
Locale		**Lineage**	**Seqs**	**Holes**	**Intra**	**1**	**2**	**3**	**4**
Parker Range	Araneomorphae sp. B13	1	1	1	-	-			
Ularring	nr Gnaphosidae sp. B19	2	1	1	-	15.8%	-		
J5	nr Gnaphosidae sp.	3	6	6	**1.4%**	13.7%	14.4%	-	
J1	nr Gnaphosidae sp. B04	4	1	1	-	14.5%	10.7%	13.3%	-
J5	Prethopalpus sp.	5	1	1	-	25.0%	26.8%	25.5%	27.4%

Centipedes

				Inter		
		Lineage	**Seqs**	**1**	**2**	**3**
J5	Cryptops sp. B03	1	1	-		
Lake Deborah	Cryptops sp. B18	2	1	21.6%	-	
Parker Range	Cryptops sp. B21	3	1	23.7%	18.0%	-
Ularring	Cryptops sp. B27	4	1	23.1%	24.6%	23.9%

Following page
Examples of neighbour joining trees based on genetic distance/similarity in output from Geneious showing lineage relationships: Araneae, Symphyla, Thysanura.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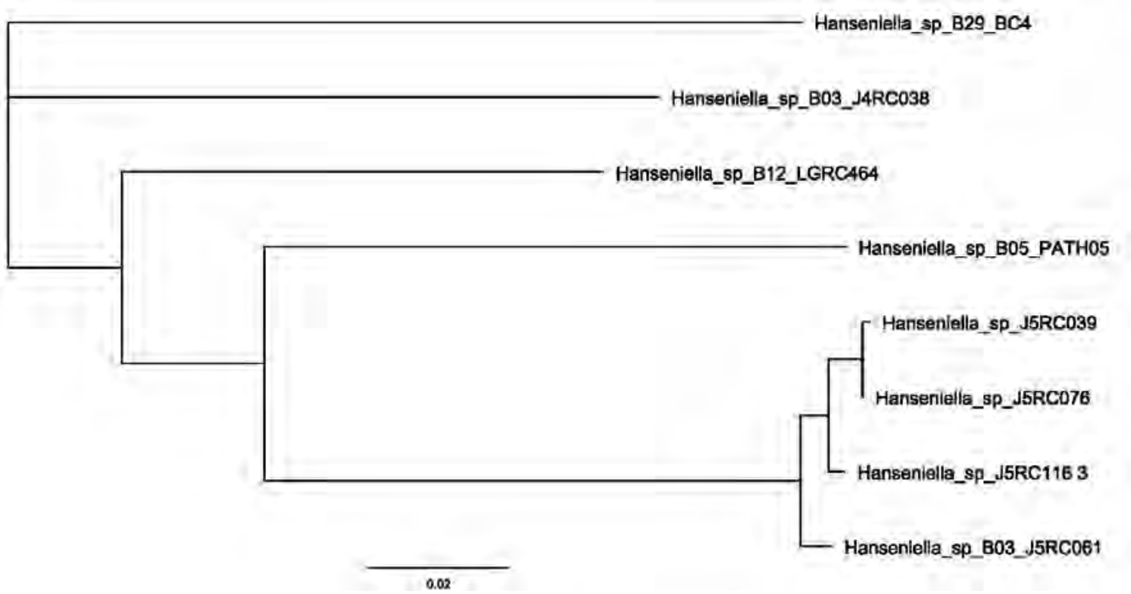
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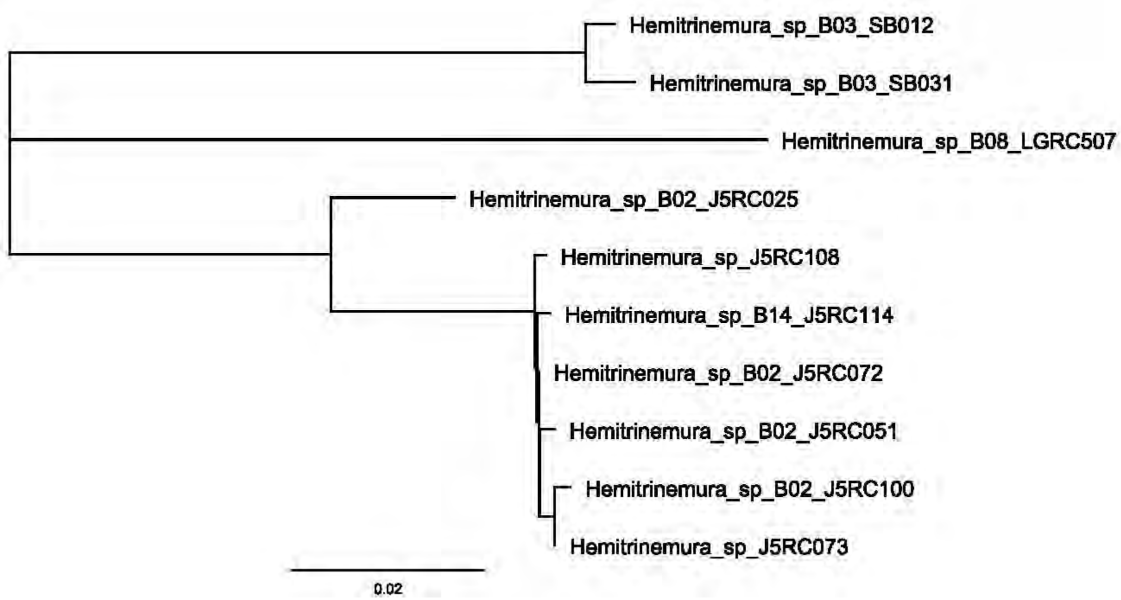
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Hemitrinemura_sp_J5RC108
Hemitrinemura_sp_B14_J5RC114
Hemitrinemura_sp_B02_J5RC072
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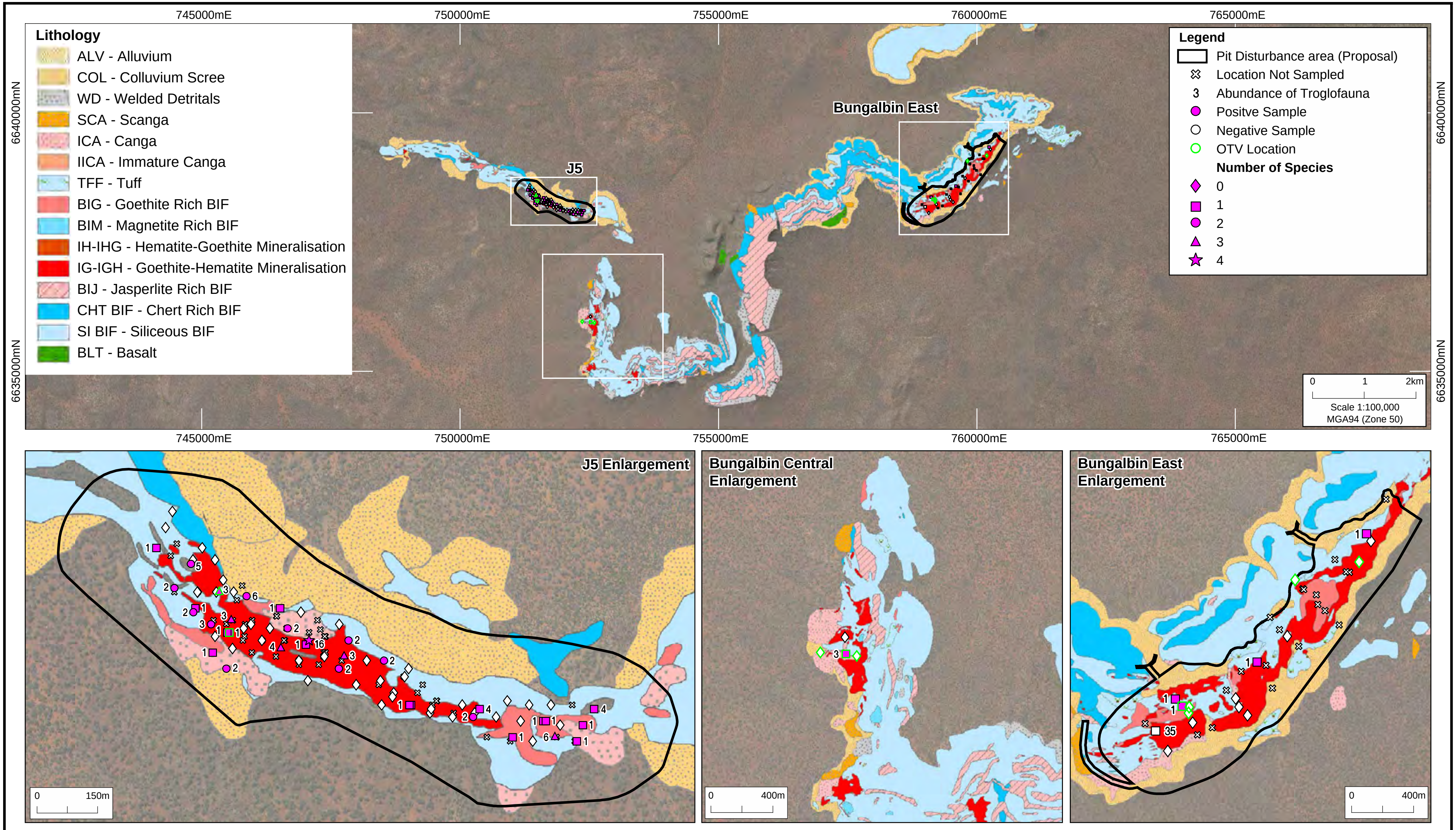

Source: Infrastructure supplied by Mineral Resources (July 2016)
Lithology supplied by Mineral Resources (Mar 2016)
Imagery: Landgate (2012)

N

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Bennelongia

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Troglofauna Yields

Appendix:
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