

Addendum:
Troglofauna
Assessment, Ularring
Haematite Project

Final Report

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Addendum: Troglofauna Assessment, Ularring Haematite Project

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Cover photo: *Trichorhina* sp. B09

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EXECUTIVE SUMMARY

This report is an addendum to Report 376.1/12/01 by Rockwater Pty Ltd “*Ularring Hematite Project, Results of Phase II Subterranean Fauna Investigation*”. Rockwater detailed the results of a troglifauna survey conducted across several deposits within Macarthur Minerals Limited’s tenement area to support the environmental impact assessment for their Ularring Hematite Project.

Within the Ularring Hematite Project (the Project Area), the only impact with significant potential to threaten troglifauna is pit excavation, which represents direct loss of troglifauna habitat. The impact areas resulting from pit excavation at Snark, Central and Banjo deposits are expected to be 125, 76 and 29 ha, respectively.

Rockwater collected seven troglifauna species from the Project Area. The animals collected consisted of two species of insect, and single species of spider, centipede, slater, pauropod and symphylan. At the time Rockwater reported, five of the species collected had not been recorded outside the proposed mine pits. These were the spider *Araneomorphae* sp. B19, the centipede *Cryptops* sp. B27, silverfish *Hemitrinemura* sp. B08 and the symphylan *Hanseniella* sp. B12, with the fifth species being the hemipteran species identified to family level (Meenoplidae sp.). Owing to the low level of taxonomic resolution, it was considered uncertain that Meenoplidae warranted further consideration as a potentially restricted species.

While a high proportion of the species collected in the Project Area appeared to be restricted to the proposed mine pits, Rockwater considered that the documented species ranges (based on known records of occurrence) were most likely under-estimates of the actual ranges. Use of existing species records alone is likely to over-estimate the conservation threat of mining in the Project Area.

To provide a more accurate assessment of risk to troglifauna, the following additional work was undertaken:

1. *Habitat characterisation.* The types of geologies in which troglifauna were found at Snark, Central and Banjo were documented, as was the wider occurrence of these habitats. The aim was to show that species were unlikely to be restricted to areas proposed to be impacted by mining.
2. *Taxonomic and biogeographic review of troglifauna species collected in the Project Area and wider Yilgarn.* The possible wider occurrence of species designated as apparently restricted to the Project Area was investigated and more information on the habitats occupied by these species, and their likely ranges, was collated.

Detailed investigation of geology and the extent of habitat connectivity showed:

- Assuming that ultramafic/mafic strata are unlikely to be prospective, drill-logs information showed that troglifauna occur in the target geology for mining, which is enriched hematite/goethite, and also frequently occur in unenriched Banded Iron Formation (BIF). Troglifauna species appear to select habitat on the basis of the physical structure of the rock, primarily the occurrence of vugs and other spaces generated by weathering, and do not distinguish between different rock chemistries. In the case of BIF in the Project Area, it is likely

that the enriched ore, which is more weathered and hence vuggier, has a greater abundance of troglifauna but unenriched BIF probably contains the same troglifauna community.

- Geological mapping suggests the regionally extensive BIF ridge occurs in a discontinuous manner. However, the mapping probably under-represents the extent of the BIF within the Project Area. Outcrops of hematite/goethite BIF have been the focus of most of the drilling to date and existing mapping, whereas detailed mapping of sub-crop and careful step out drilling have shown that the hematite/goethite mineralization can continue in areas of limited to no existing outcrop. This is also likely to be the case for the unenriched BIF. The troglifauna survey data offer support for this revised geological picture by suggesting more habitat connectivity than is shown by the mapped extent of the enriched hematite/goethite BIF outcropping.
- The occurrence of two troglifauna species at multiple deposits within the Project Area provides insight into the possible extent and connectivity of troglifauna habitat. *Trichorhina* sp. B09 occurs at Snark and Central with a linear range of 17 km and *Hanseniella* sp. B12 was collected from Central and Banjo with a linear range of 7 km. Assuming these species do not have the ability to use surface habitats during any stage of their lifecycles, it is likely that a stratum other than BIF is providing the habitat connectivity between locations. Review of diamond-drill cores from the Project Area suggests that the stratum is weathered volcanics (saprolite) near the surface.

Importantly, the extent of the enriched BIF outcropping does not represent the limit of troglifauna habitat in the Project Area and it is unlikely that individual troglifauna species are restricted to the proposed mine pits.

The direct loss of enriched BIF outcropping through pit excavation at Snark, Central and Banjo deposits is expected to total 42 ha of hematite/goethite or magnetite. It is estimated that approximately 509 ha of similar outcropping also occurs outside of the proposed pit boundaries and over therefore 92% of prime troglifauna habitat within the tenement area will be undisturbed by the Project. As has already been argued, there is connectivity between the in-pit BIF outcropping and the 92% of outcropping elsewhere.

Changes to the proposed mine plan since Rockwater's report was produced have reduced the likelihood of species being restricted to the proposed mine pits because two of the five species previously listed as restricted to the proposed impact area (*Cryptops* sp. B27 and *Hemitrinemura* sp. B08) now occur in the reference area outside of the proposed mine pits as a result of re-modelling of the pit boundaries.

Range information relevant to the three species known only from the proposed mine pit (*Araneomorphae* sp. B19, *Hanseniella* sp. B12, *Meenoplidae* sp.) is presented below:

- *Araneomorphae* sp. B19 is considered likely to be widespread and perhaps to have a surface dispersal phase.
- *Hanseniella* sp. B12 is considered likely to occur in the intervening area between the proposed pits at Central and Banjo deposits.
- *Meenoplidae* sp. is considered likely to have a surface dispersal phase and to be very widespread, as is the case for other known troglifaunal *Meenoplidae* species in Western Australia.

In conclusion, the outcomes of this additional work on habitat characterisation and taxonomic review suggest the Project will not significantly impact of the local troglafauna community of the Project Area or affect the conservation status of any known troglafauna species.

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1. BACKGROUND

This report is an addendum to Report 376.1/12/01 by Rockwater (2012) "*Ularring Hematite Project, Results of Phase II Subterranean Fauna Investigation*". Rockwater (2012) detailed the results of a troglifauna survey conducted across several deposits within the Macarthur Minerals Limited's tenements (Figure 1.1) as part of the environmental impact assessment for their Ularring Hematite Project. The lease area covers over 116,000 ha and comprises at least 11 deposits; however only 2,818 ha is designated as Ularring Hematite Project (the Project Area). The proposed mining will focus on the Snark, Central and Banjo deposits (Figure 1.2).

The only impact within the Project Area with significant potential to threaten troglifauna is pit excavation, which represents the direct loss of troglifauna habitat. The areas proposed for pit excavation at Snark, Central and Banjo deposits are small, being 125, 76 and 29 ha, respectively.

Rockwater (2012) collected seven troglifauna species from the Project Area. The species collected consisted of two insect, and single species of spider, centipede, slater, pauropod and symphylan. At the time Rockwater (2012) reported, four of the species collected were yet to be recorded outside the proposed mine pits: the spider *Araneomorphae* sp. B19, the centipede *Cryptops* sp. B27, silverfish *Hemitrinemura* sp. B08 and the symphylan *Hanseniella* sp. B12. Another species identified to family level (Meenoplidae sp.) was also recorded from inside a proposed mine pit and owing to the low level of taxonomic resolution the conservation significance of this species was considered uncertain.

While a high proportion of the species collected in the Project Area appeared to be restricted to the proposed mine pits, it was considered that the current ranges of troglifauna species were most likely under-estimated (Rockwater 2012). Such under-estimation of species ranges means that the risk to species from the proposed mining within the Project Area is likely to have been over-estimated. To provide a more accurate assessment of risk to subterranean fauna, the following additional work was undertaken:

1. *Habitat characterisation.* The types of geologies in which troglifauna were found at Snark, Central and Banjo, and their wider occurrences, were documented. The aim was to determine whether species were restricted to areas proposed to be impacted by the Project. The habitat characterisation work was based on:
 - a. Data from geological investigations carried out by Macarthur Minerals;
 - b. Discussions and communications with Macarthur Minerals geologists; and
 - c. Geological Survey of Western Australia mapping (DIR 2003);
2. *Taxonomic and biogeographic review of troglifauna species collected in the Project Area and wider Yilgarn.* The possible wider occurrence of species designated as apparently restricted to the Project Area (Rockwater 2012) was investigated and more information on the habitats occupied by these species, and their likely ranges, was collated.

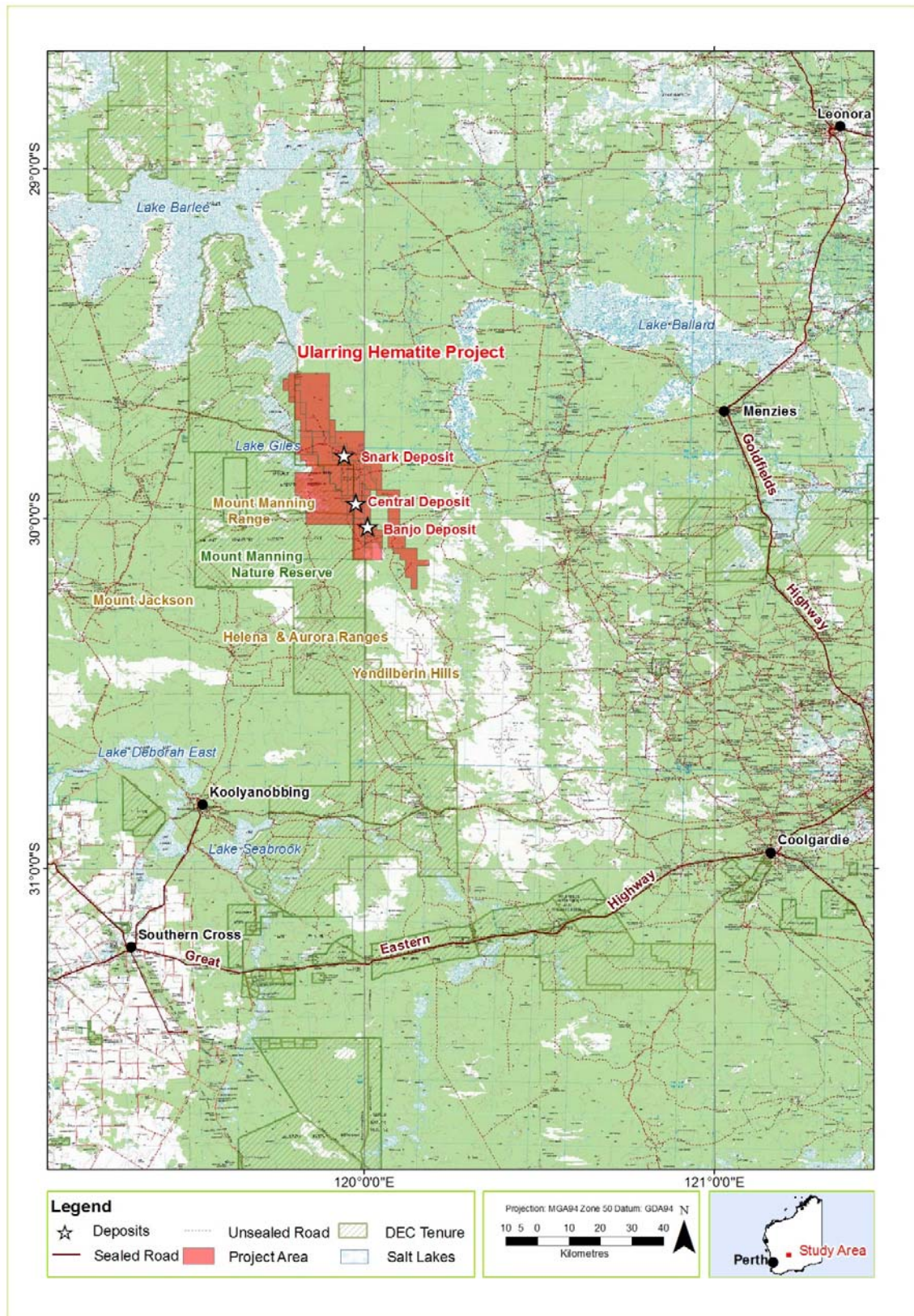


Figure 1.1. Location of the Ularring Hematite Project.

2. TROGLOFAUNA HABITAT CHARACTERISATION

2.1. Habitat Requirements for Troglifauna

Troglifauna presence is dependent on geology and, if no fissures or voids are present in the strata, no troglifauna will occur. If fissures, voids or vugs are present, the pattern of their occurrence will largely determine the abundance and distribution of troglifauna. Vertical connectivity to the surface is important for supplying nutrients to maintain populations of different species (plant roots are an important surface connection), while lateral connectivity of voids is crucial to underground dispersal.

In rock habitats, the occurrence of fissures, voids and vugs is primarily driven by broad rock type (rocks such as granite typically contain few spaces) and the degree of weathering (e.g. iron ore formations contain increasing quantities of internal spaces as they weather).

2.2. Geology and Occurrence of Troglifauna in the Project Area

Troglifauna habitat was characterised by identifying the lithologies in which troglifauna are known to occur at the Project Area. Lithologies that are unlikely to represent troglifauna habitat were also identified. The geology of the mineralization within the Project Area is described in some detail by Snowden (2011) and CSA Global (2012). These descriptions, in conjunction with reverse circulation drill-hole data and diamond-drill cores, have been used for the troglifauna habitat characterisation given below:

The Yilgarn Craton consists of multiple lenticular greenstone belts. Greenstone belts comprise of variably metamorphosed mafic to ultramafic volcanic sequences with associated sediments, including Banded Iron Formation (BIF). They are of Archaean to Proterozoic age and are commonly surrounded by granite and gneiss (Figure 2.1). The greenstone belts are highly deformed, faulted and folded.

The Project Area is comprised of low ridges associated with discontinuous outcropping BIF units, striking in a general northwest-southeast direction, that rise up between about 5-30 m above the surrounding sandy plains (Figure 2.2). The 30 km or so of outcropping BIF ridges within the Project Area comprise a combination of two main types of ironstone: magnetite and goethite-haematite (Figure 2.2). Primary magnetite mineralization is associated with un-oxidized BIF and ultramafic/mafic rocks, while goethite-hematite mineralization is associated with altered, enriched BIF and some secondary pisolite mineralization (Snowden 2011).

Mining will focus on enriched hematite/goethite BIF. The enriched BIF bands vary in thickness from 1 m to 30 m; however, most of the mineralization targeted for mining occurs at the surface or up to a maximum depth of approximately 50 m below ground. The rock type is generally friable, except for some caprock cover at the surface (CSA Global 2012). Weathering has resulted in the leaching of the majority of the silica from the target BIF, thus producing a rock rich in iron and low in silica. These rocks tend to be porous (CSA Global 2012) and are well known troglifauna habitat (Biota 2006; Bennelongia 2008a,b,c, 2009a). As the silica-rich magnetite BIF has not been subject to significant weathering, it exhibits fewer voids, fissures and cavities. However, this stratum still provides prospective troglifauna habitat, based on the review of 23 diamond-drill cores from the Project Area. This was confirmed by survey results (discussed below).

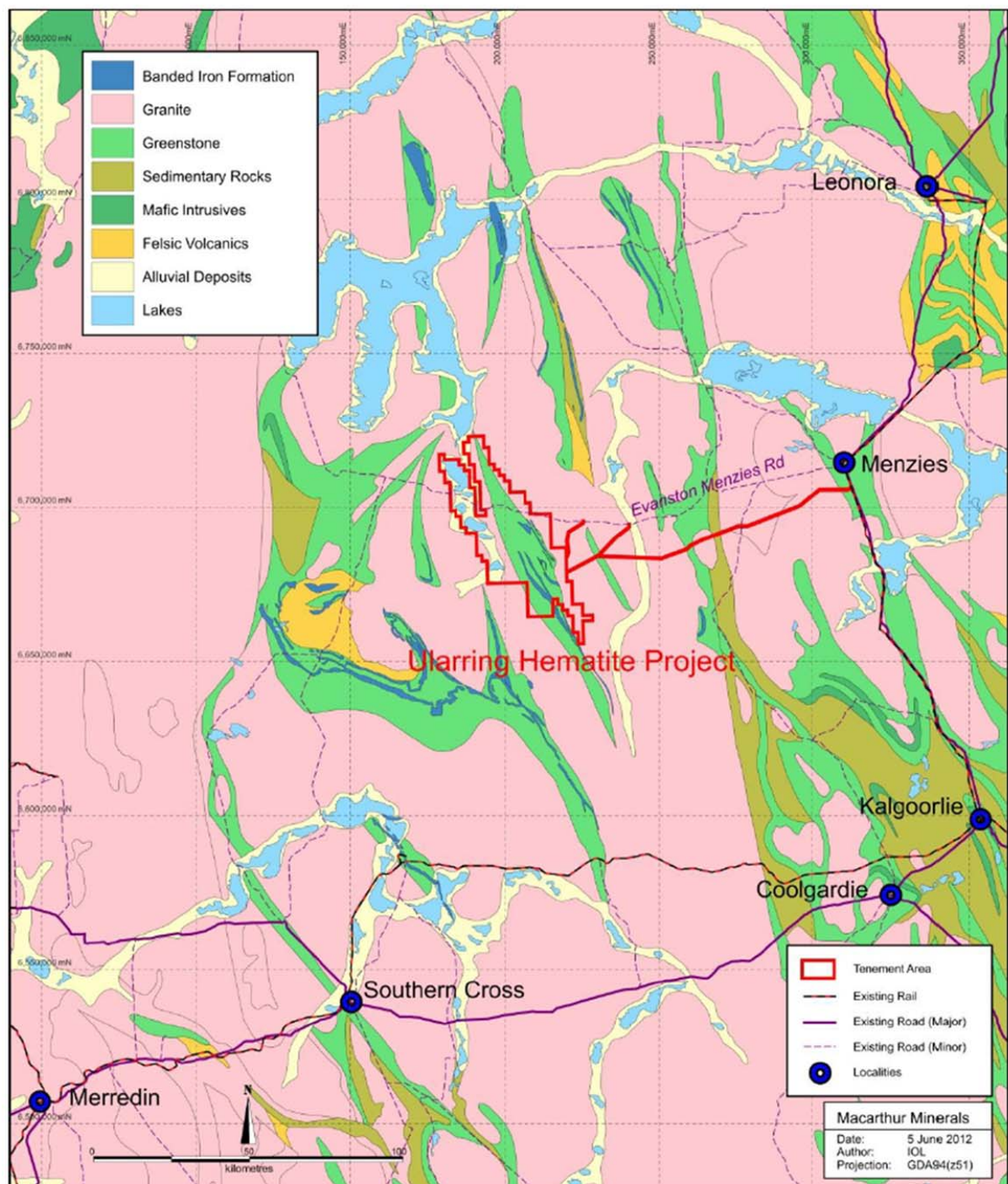


Figure 2.1. Project Area geology in context with the regional greenstone belts.

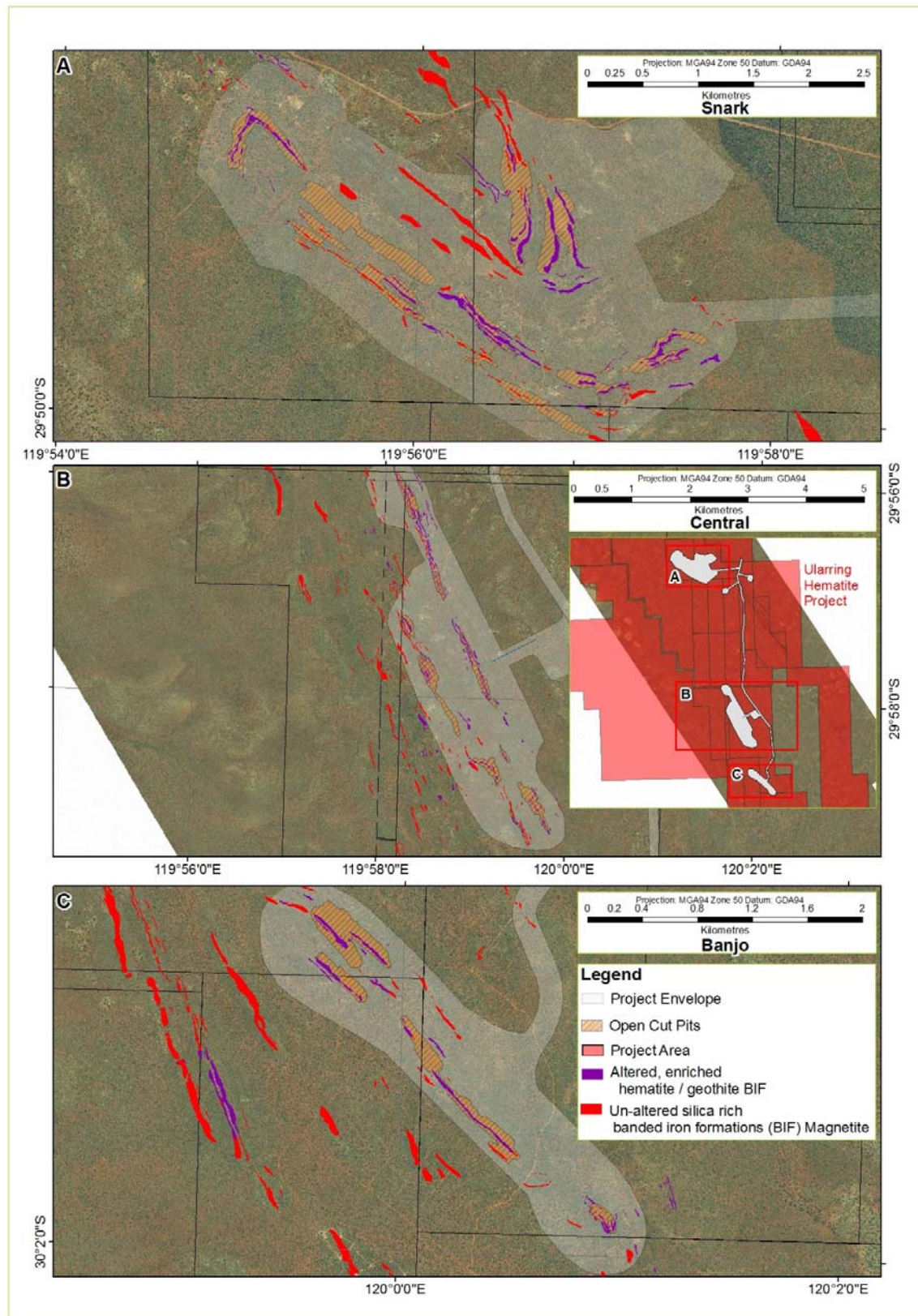


Figure 2.2. Banded Iron Formation in the vicinity of the Project.

The BIF lenses also include minor amount of shale, quartzite, chert and interbedded sandstone/siltstone. These rocks are not typically recognised as troglifauna habitat because they mostly lack voids but troglifauna have been collected from drill holes within these rocks when associated with BIF (Bennelongia 2009a; Bennelongia unpublished data) and the rock types may in some cases harbour troglifauna when weathered or fractured.

Review of diamond-drill cores from the tenement area indicates the volcanics of this area (dominated by ultramafics and mafics) do not appear to represent prospective troglifauna habitat, owing to a general lack of voids/weathering. This is typical of ultramafic/mafic volcanics, particularly at depth. However, near the surface, notable vugs were observed in saprolite (undifferentiated acid volcanics) 9-14 metres below ground in one diamond core and fine fractures were observed in some ultramafics and mafics at various depths.

Examination of reverse circulation drill logs provides some further insight to the occurrence of troglifauna in the Project Area (Appendix 1A). An account of the stratigraphy from each of the holes where troglifauna were collected is given below:

At Snark, three troglifauna animals were recorded, each from separate holes, all within the proposed mine pits. All of these holes contained unenriched BIF (<40% Fe) (moderately prospective habitat), one of the holes had undifferentiated ultramafic (not prospective), and two (LGRC_0359 and LGRC_0731) had sequences of enriched hematite (the most porous rock and most prospective habitat) (Appendix 1B). Notably, one bore where troglifauna were recorded (LGRC_0577) did not include any enriched hematite or goethite (Appendix 1B). This indicates that troglifauna at Snark are not restricted to the target geology for mining.

Troglifauna were collected from two holes in the reference area at Central; all were *Trichorhina* sp. B09 with four specimens collected at each hole. These holes (LGRC_0388 and LGRC_0389) were almost completely comprised of either clay (not prospective troglifauna habitat) or unenriched BIF, with undifferentiated ultramafic rock at depths of >70 m. It is almost certain that *Trichorhina* sp. B09 occurs in the unenriched BIF. A further three troglifauna species were collected from three holes within the proposed pit. Two of the holes contained enriched hematite near the surface, one also had unenriched BIF and the other also had undifferentiated ultramafic. The third hole, (LGRC_0903) did not have enriched hematite, but did contain unenriched BIF, undifferentiated ultramafic (not prospective) and chert (unlikely to be prospective) (Appendix 1C). These results indicate that troglifauna at Central are also not restricted to the Project's target geology.

Troglifauna were recorded from two bores at the Banjo deposit (LGRC_0241 impact; LGRC_0507 reference). Prospective habitat in the impact hole was represented by both unenriched BIF and enriched hematite. The reference hole, where 23 *Hemitrinemura* sp. B08 were collected, had a thin band of enriched hematite (7 to 9 m below ground) and undifferentiated ultramafic occurring below and above the hematite (Appendix 1D).

Assuming that ultramafic/mafic strata are unlikely to be prospective, it seems certain (based on the drill-logs) that troglifauna occur the enriched hematite/goethite that is in the target geology for mining and also in the unenriched BIF. Evidently, troglifauna species choose habitats with suitable physical structure, primarily vugs and other spaces within the rock generated by weathering rather than recognising specific chemical compositions.

2.3. Spatial Extent of Troglifauna Habitat

Many troglifauna species have small ranges and the factor limiting these ranges (geological or otherwise) are rarely obvious except in the case of ranges that coincide with isolated mesa formations. If two areas are connected by a continuous expression of the same geological formation, then connectivity of troglifauna habitat may be inferred if there are no obvious physical barriers or from the continuous extent of preferred troglifauna habitat between the areas of interest. However, this inference of connectivity is best viewed as a hypothesis that requires supporting evidence. The clearest evidence of connectivity is provided by sampling results when the same species is collected in both areas.

There are two geological entities that comprise preferred troglifauna habitat in the Project Area, the Yerilgee Greenstone and the BIF, that potentially define the ranges of troglifauna species in and around the Project Area. It should be noted, however, that just as individual species may recognise different barriers, they may also recognize different geologies as providing continuous and connected habitat.

The elongated lens shaped Yerilgee Greenstone belt is bounded by major north-northwest trending fault/shear zones (CSA Global 2012). The established paradigm suggests that such features are likely to represent habitat barriers. The Yerilgee Greenstone formation is mapped at least 10 km to the north of Snark and up to 30 km south of Banjo (Figure 2.1). The BIF outcrops within Yerilgee Greenstone formation in a discontinuous manner over a combined strike length of at least 80 km (CSA Global 2012). However, while outcrops of hematite/goethite BIF have been the focus of most of the drilling and mapping to date, recent detailed mapping of sub-crop and careful step out drilling have shown that the hematite/goethite mineralization can continue in areas of limited or no existing outcrop (CSA Global 2012). This is also likely to be the case for the unenriched BIF. This is supported by the troglifauna survey data, which indicates that habitat connectivity is more extensive than the mapped extent of the unenriched BIF and the enriched hematite/goethite BIF.

The occurrence of two troglifauna species at multiple deposits in the Project Area provides some insight into the possible extent of troglifauna habitat. *Trichorhina* sp. B09 occurred at Snark and Central with a linear range of 17 km, while *Hanseniella* sp. B12 was collected from Central and Banjo with a linear range of 7 km (Appendix 2). Assuming these species do not have the ability to use surface habitats during any stage of their lifecycles, it is likely that either unmapped BIF (hematite/goethite or unenriched BIF) or some other stratum is providing some habitat connectivity between these locations. Review of diamond-drill cores from the Project Area indicates that weathered volcanics (saprolite) near the surface may be the other stratum. The critical issue from the viewpoint of assessment is that the currently mapped the extent of the enriched BIF is unlikely to be the limit of troglifauna habitat in the Project Area. Therefore, it is unlikely that individual troglifauna species are restricted to the proposed mine pits.

3. RANGES OF TROGLOFAUNA SPECIES PREVIOUSLY LISTED AS RESTRICTED TO THE PROPOSED MINE PITS

Geology alone rarely enables the ranges of particular troglifauna species in an area to be predicted, unless one has information about the habitat requirements of those species. The ranges of related species are considered to be a reasonably good predictor of species range amongst short range taxa (see Harvey *et al.* 2002), although it is likely that dispersal capacity and to a lesser extent size, abundance and habitat characteristics are more important drivers of species range (Ponder and Cogan 2002; Webb and Gaston 2003).

Biological information that may be relevant to the likely distributions of the species presently only known from the proposed mine pits in the Project Area is provided below, together with some taxonomic information.

Araneomorphae sp. B19

Review of the taxonomy of this species indicates that *Araneomorphae* sp. B19 belongs to a family closely related to the Gnaphosidae. It is represented by a singleton from the Central deposit.

Drawing analogies between the Pilbara and Yilgarn should be done with some degree of caution; however, it is likely that spider species in the Yilgarn will have quite variable ranges as they do in the Pilbara. For example, species of the family Oonopidae have small ranges, typically under 10 km, while species of the family Gnaphosidae tend to have ranges in the tens of kilometres (Bennelongia unpublished data).

Bennelongia have collected three species of troglifaunal spider in the Yilgarn, all of different families. Only one species is represented by multiple records, *Araneomorphae* sp. B04 (nr Gnaphosidae), which was recorded near Mount Jackson and at Koolyanobbing Range. The 56 km range of *Araneomorphae* sp. B04 is not unlike the ranges of Gnaphosidae of the Pilbara; possibly the species is trogliphilic and has a surface dispersal phase in its lifecycle. *Araneomorphae* sp. B19 appears to belong to the same nr Gnaphosidae family as the *Araneomorphae* sp. B04, and it is considered likely it will also have a relatively wide distribution. Hence, it is considered unlikely to be restricted to the proposed mine pit at the Central deposit.

Cryptops sp. B27

This species was reported in Rockwater (2012) as restricted to the proposed pit at Banjo deposit (hole LGRC507); however, based on updated pit boundaries supplied to Bennelongia, the bore that this species was recorded from is now in the reference area and this species is not of conservation concern.

Hanseniella sp. B12

Little information is available about the ranges of troglifaunal species of *Hanseniella* and other symphylan genera. They are known to occur from a number of habitats, including BIF and have been recorded from a variety of rock types such as gossan, ferricrete, schist and phillite (Rockwater 2012). Species of *Hanseniella* are frequently found in surface soil/litter communities. Bennelongia has few records of *Hanseniella* in the Yilgarn and has multiple records from only one of these species, *Hanseniella* sp. B03 which has a linear range of 84 km (Bennelongia 2008a, b).

Two *Hanseniella* sp. B12 specimens were recorded at the Project Area from separate locations. One was recorded at the Banjo deposit, the other at Central deposit. The linear distance between these two occurrences is about 7 km. It is almost certain that this species occurs in the intervening landscape and is very unlikely to be restricted to the proposed mine pits.

Hemitrinemura sp. B08

As with *Cryptops* sp. B27, this species was reported in Rockwater (2012) as restricted to the proposed pit at Banjo deposit (hole LGRC507); however, based on updated pit boundaries supplied to Bennelongia, the drill hole that this species was recorded from is now in the reference area and this species is not of conservation concern.

Meenoplidae sp.

This species is represented by a single nymph collected at Snark. It was classified as troglifauna because it was eyeless and troglifaunal meenoplids occur in the Yilgarn (Bennelongia 2008a, 2009a, unpublished data). However, three non-troglifaunal meenoplids (sub-adult/adult) were collected in the reference area at the Central deposit and it is possible that the nymph listed at Snark is conspecific with these eyed specimens, which are likely to have a surface dispersal stage. To date there is little evidence that troglifaunal meenoplids have tightly restricted ranges either in the Pilbara or Yilgarn and the vast majority of the data suggests that these species are trogliphiles with some surface dispersal (Bennelongia 2008a, 2009a, b, 2010). It is considered most unlikely that Meenoplidae sp. collected at Snark is a species of conservation concern.

4. LOSS OF HABITAT

The direct loss of troglifauna habitat through pit excavation at Snark, Central and Banjo deposits is expected to total 230 ha, which comprises 42 ha of hematite/goethite or magnetite surface outcropping (Figure 2.2). Based on geological surface mapping of the entire tenement area, it is estimated that approximately 509 ha of similar outcropping also occurs outside of the proposed pit boundaries. This means that over 92% of prime troglifauna habitat within Macarthur Minerals' tenement area will remain undisturbed by the Project. This is also considered a conservative estimate based on the understanding that troglifauna habitat extends beyond the surface outcropping areas. As has already been argued, it is likely from the viewpoint of many troglifauna species that there is connectivity between the in-pit BIF outcropping and the 92% of outcropping elsewhere.

5. CONCLUSION

Detailed investigation of geology and the extent of habitat connectivity showed:

- Assuming that ultramafic/mafic strata are unlikely to be prospective, it seems certain (based on drill-logs) that troglifauna occur in the target geology for mining, which is enriched hematite/goethite, and also frequently occur in unenriched Banded Iron Formation (BIF). Evidently, troglifauna species do not distinguish between different rock chemistries when selecting habitat but choose on the basis of physical structure of the rock, primarily the vugs and other spaces within the rock generated by weathering. In the case of BIF in the Project Area, it is likely that the enriched ore, which is more weathered and hence vuggy, would logically have a greater abundance of troglifauna but unenriched BIF probably contains the same troglifauna community.
- Geological mapping suggests the regionally extensive BIF ridge occurs in a discontinuous manner. However, this is likely to under-represent the extent of the BIF within the Project Area. Outcrops of hematite/goethite BIF have been the focus of most of the drilling to date, whereas detailed mapping of sub-crop and careful step out drilling have shown that the hematite/goethite mineralization can continue in areas of limited to no existing outcrop. This is also likely to be the case for the unenriched BIF. The troglifauna survey data certainly suggests more habitat connectivity than is shown by the mapped extent of the enriched hematite/goethite BIF outcropping.
- The occurrence of two troglifauna species at multiple deposits within the Project Area provides insight into the possible extent and connectivity of troglifauna habitat. *Trichorhina* sp. B09

occurs at Snark and Central with a linear range of 17 km and *Hanseniella* sp. B12 was collected from Central and Banjo with a linear range of 7 km. Assuming these species do not have the ability to use surface habitats during any stage of their lifecycles, it is likely that a stratum other than BIF is providing some habitat connectivity between locations. Review of diamond-drill cores from the Project Area suggests that this connectivity may be provided by weathered volcanics (saprolite) near the surface.

Importantly, the extent of the enriched BIF outcropping does not represent the limit of troglifauna habitat in the Project Area and it is unlikely that individual troglifauna species are restricted to the proposed mine pits.

The direct loss of enriched BIF outcropping through pit excavation at Snark, Central and Banjo deposits is expected to total 42 ha of hematite/goethite or magnetite. It is estimated that approximately 509 ha of similar outcropping also occurs outside of the proposed pit boundaries and over therefore 92% of prime troglifauna habitat within the tenement area will be undisturbed by the Project.

Changes to the proposed mine plan since Rockwater's report was produced have reduced the likelihood of species being restricted to the proposed mine pits because two of the five species previously listed as restricted to the proposed impact area (*Cryptops* sp. B27 and *Hemitrinemura* sp. B08) now occur in the reference area outside of the proposed mine pits as a result of re-modelling of the pit boundaries.

Range information relevant to the three species known only from the proposed mine pit (*Araneomorphae* sp. B19, *Hanseniella* sp. B12, *Meenoplidae* sp.) is presented below:

- *Araneomorphae* sp. B19 is considered likely to be widespread and perhaps to have a surface dispersal phase.
- *Hanseniella* sp. B12 is considered likely to occur in the intervening area between the proposed pits at Central and Banjo deposits.
- *Meenoplidae* sp. is considered likely to have a surface dispersal phase and to be very widespread, as is the case for other known troglifaunal *Meenoplidae* species in Western Australia.

In conclusion, the outcomes of this additional work on habitat characterisation and taxonomic review suggest the Project will not significantly impact of the local troglifauna community of the Project Area or affect the conservation status of any known troglifauna species.

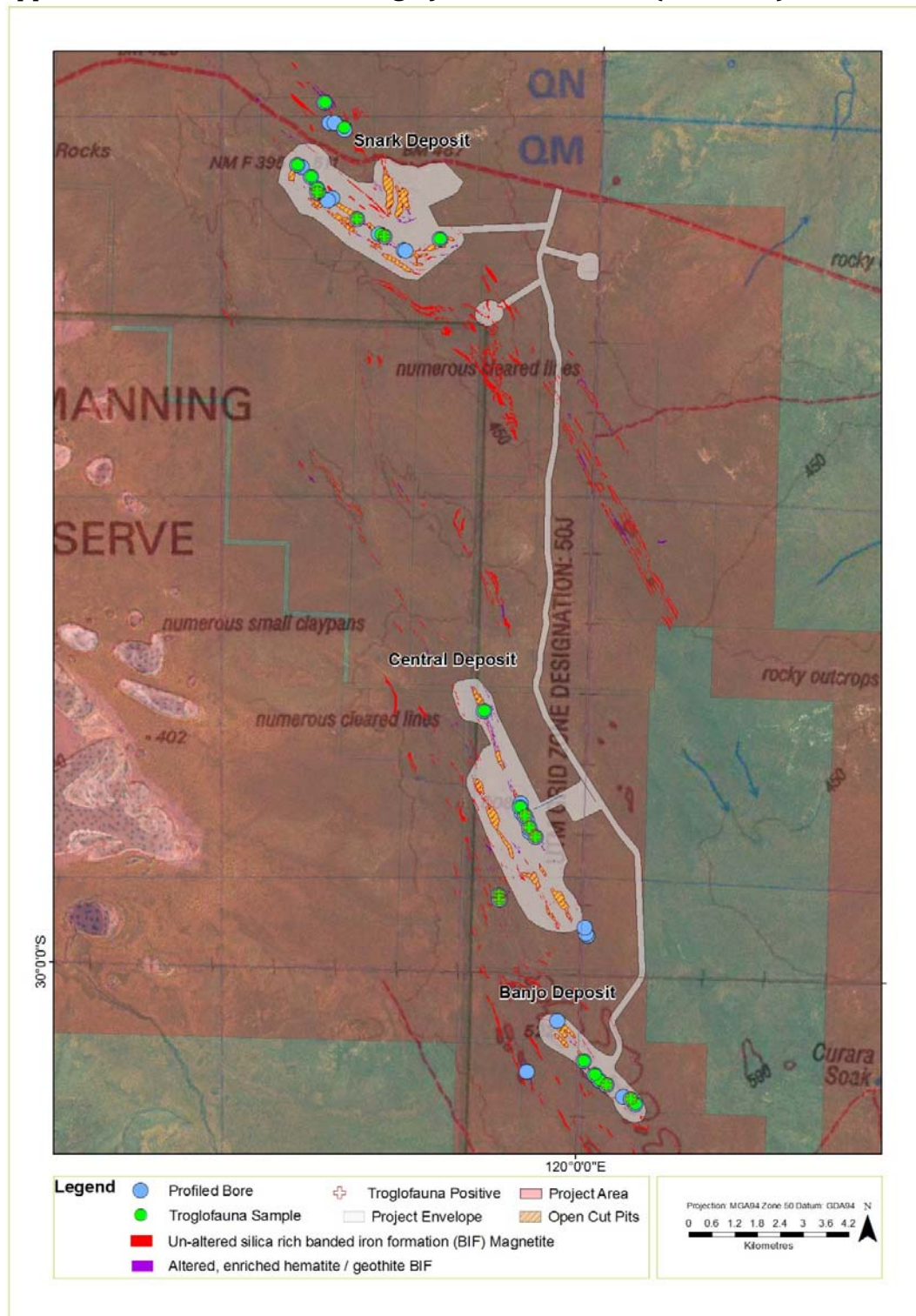
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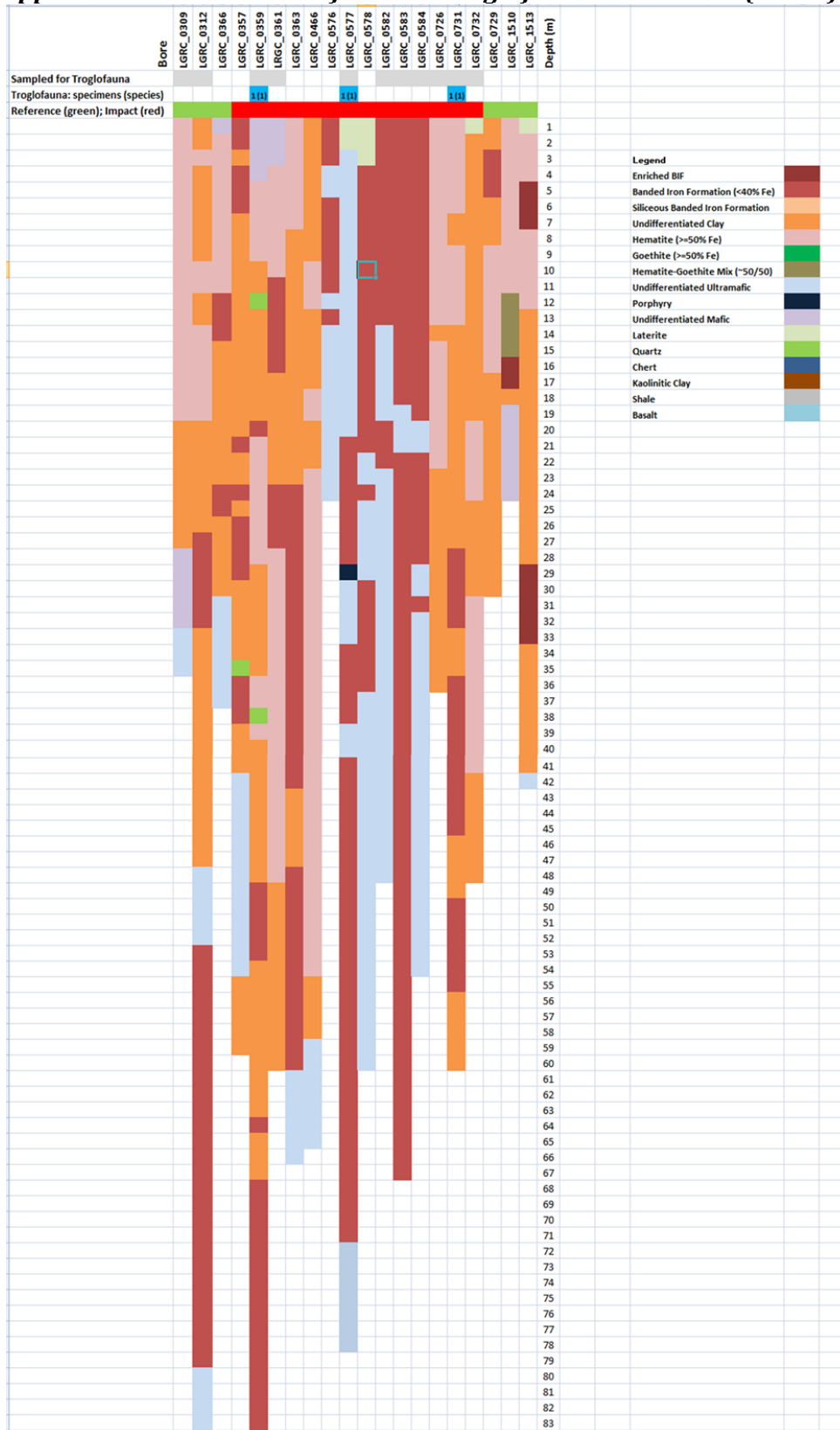
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7. APPENDICES

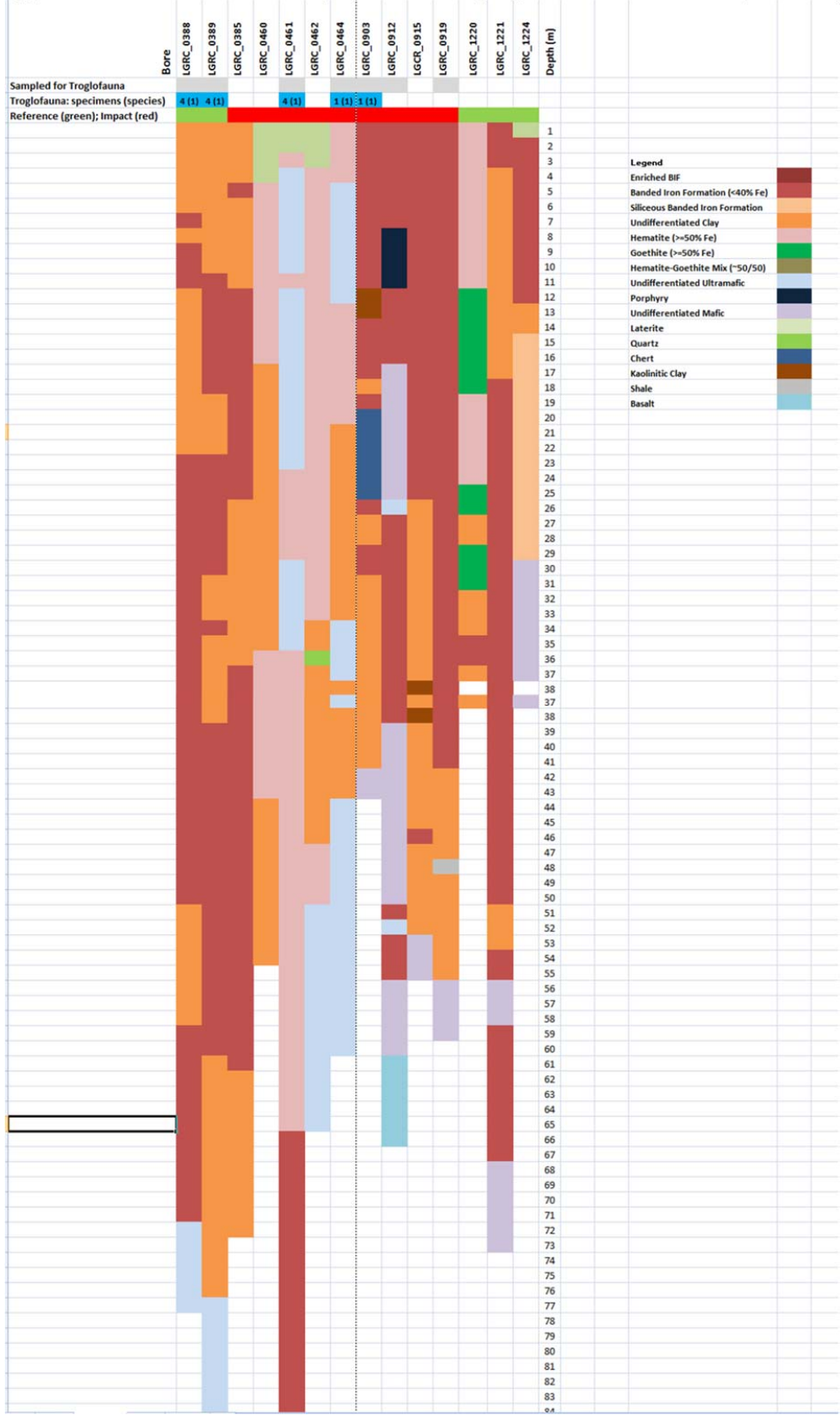
Appendix 1A. Drill-holes and Troglofauna Occurrence (Overview)



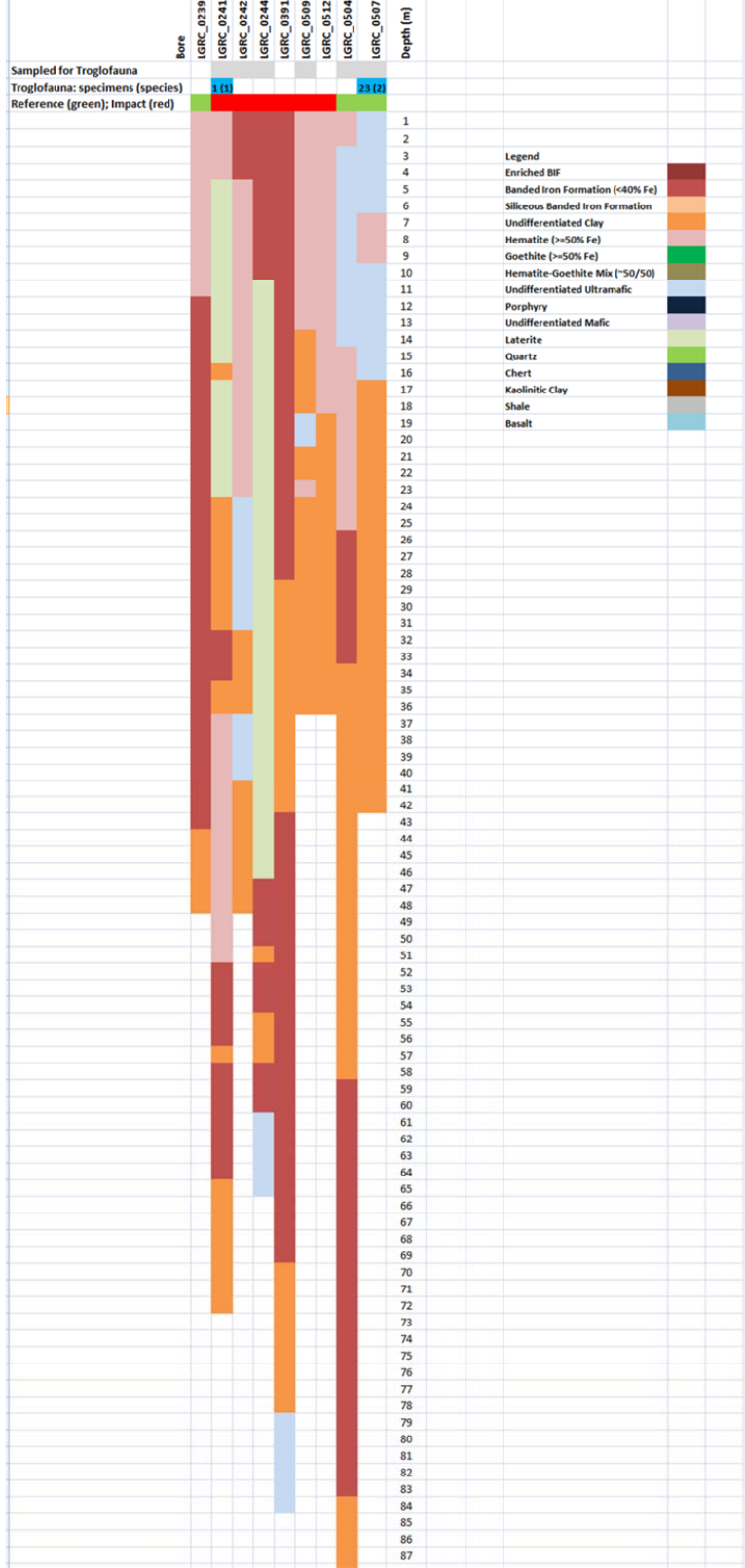
Appendix 1B. Drill-hole Profiles and Troglotauna Occurrence (Snark)



Appendix 1C. Drill-hole Profiles and Troglofauna Occurrence (Central)



Appendix 1D. Drill-hole Profiles and Troglotauna Occurrence (Banjo)



Appendix 2. Records of *Hanseniella* sp. B12 and *Trichorhina* sp. B09

