HASTINGS
Technology Metals Limited

APPENDIX 13

SUBJECT:	**Troglofauna habitat extent and distribution**
DATE:	17/04/2019
DOCUMENT NO. & REV:	Rev A
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BACKGROUND

This technical file note discusses troglofauna habitat in response to a request for further information from EPA Services (email dated 10 April 2019) as follows:

Scutigerella sp. B09 – noting that the precise collection depth cannot be attributed to the specimen, geological cross-sections for site BHRC006 should be provided (as has been done for other sites discussed in the RTS) that illustrate connectivity between any prospective habitats at site BHRC006 and those in adjacent non-impact areas. Figures 7-2 and 8-11 of the ERD do not contain specific data relevant to site BHRC006.

Chilenophilidae sp. (Yangibana North), *Chilenophilidae* sp. B09 (Frasers), *Schendylidae* sp. (Frasers) and *Schendylidae* sp. (Yangibana North) – the rationale provided regarding habitat is reasonable but is not sufficiently supported to give confidence that there is a low risk of significant impact. Provide:

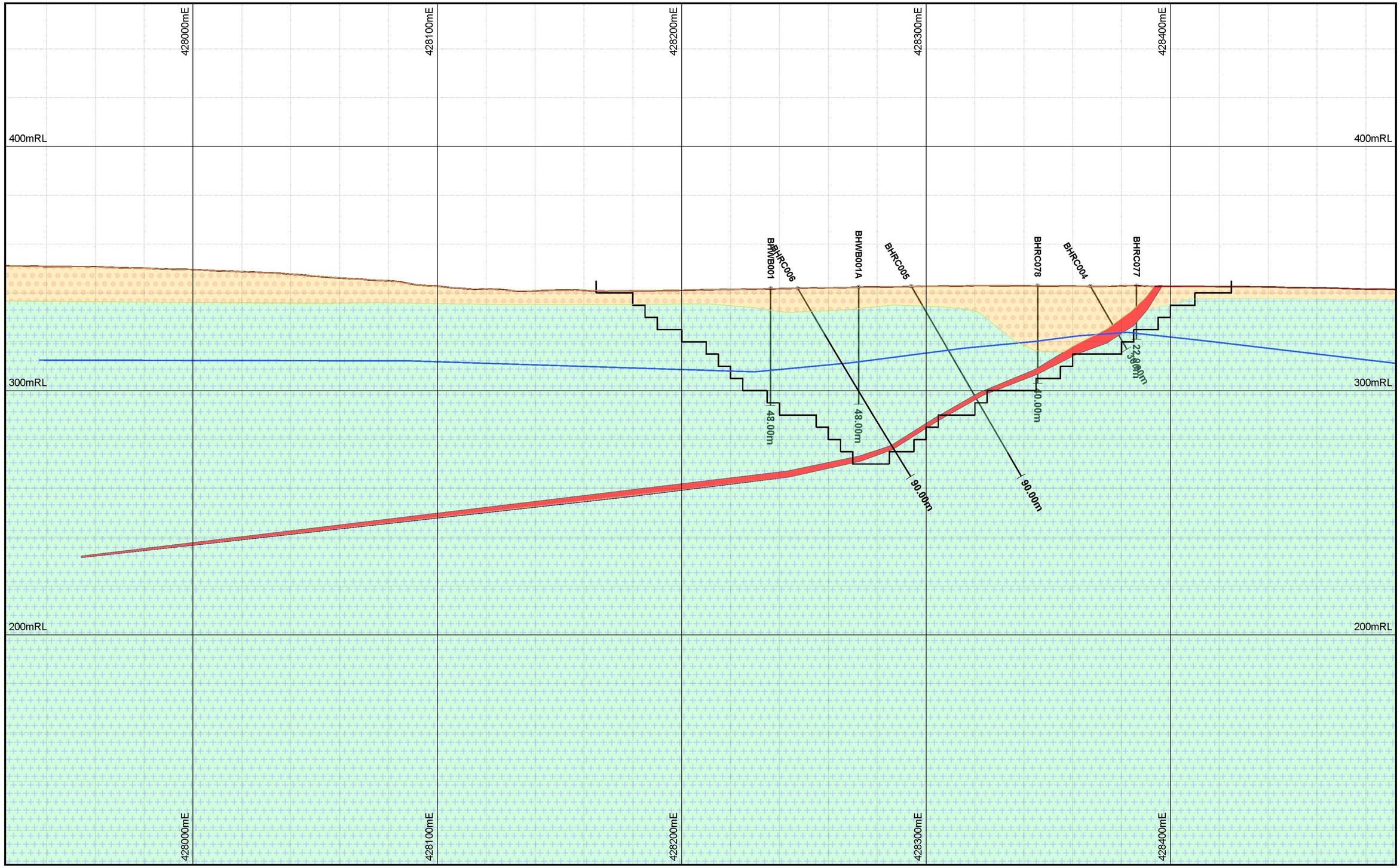
- core sample photographs and/or down hole camera images from sites YGRC066, FRRC100 and YGRC069 that demonstrate that the Pimbyana Granite is suitable troglofauna habitat and that the ironstone is unsuitable habitat; and/or
- evidence, such as geological cross-sections, that demonstrates that the ironstone geology at sites YGRC066, FRRC100 and YGRC069 is well-connected – above the water table – to equivalent geology in adjacent, non-impact areas.

HASTINGS RESPONSE

Figure 1 shows a cross section of the Bald Hill pit for BHRC006. Note the drill hole didn't intersect the ironstone unit until well below the water table, thus the troglofaunal habitat is in the upper zone of the hole above the water table. The presence of granites and fresh granites in the upper zone of the hole extends across the entire project area.

Weathered and fractured granite has been evidenced to be extensive across the Project area outside of the disturbance footprint and its presence is consistent with each pit footprint, which occur over distances of 12-13 km. Weathered granite has also been noted during geotechnical investigations within the TSF footprint, which also occurs on a granite geology. Thus Figure 7-2 of the ERD (Hastings 2018; Attachment 1) showing the distribution of granite geologies is likely representative of available habitat for troglofaunal communities.

It should also be noted that alluvium, colluvium and calcrete lithologies also provide suitable habitat for troglofaunal communities and these occur extensively outside of the pit footprints (shown in Figure 7-2 of the ERD; Attachment 1).



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- Ironstone
- Weathered Granite
- Pimbyana Granite
- Water Table
- Pit Outline

Figure 1

1:1500

Plot Date 16-Apr-2019

Sheet 1 of 1

Plot File: Vizex

20 0 20m

Bald Hill 7355875mN

Yangibana Project

Core sample photographs and/or down hole camera images from sites YGRC066, FRRC100 and YGRC069 are not available due to the drilling methodology (i.e. reverse circulation as suggested in the RC component of the hole identification code). However, diamond drilling (DD) has been employed in each of the pit areas. The distance to the nearest hole prepared using DD is:

- YGRC066 is 180 m to YGDD074
- FRRC100 is 50 m to FRDD065
- YGRC069 is 380 m to YGDD074

Tables 1 and 2 show the diamond drilling core between the surface and the water table of FRDD065 and YGDD074, respectively. As can be seen in these photos fresh granite does not provide suitable habitat for troglofaunal taxa (i.e. no interstitial spaces observed), however weathered granite and ironstone (and sometimes saprolite) do provide suitable habitat. The presence of troglofauna is not determined by specific lithologies but rather the availability of suitable interstitial spaces and humidity. The drilling logs have noted vugginess in several lithology types, which suggests potential habitat as well.

An assessment of the main geology lithologies show suitable habitat in all types except fresh granite. The coloration of the drill core shows a variety of lithologies associated with the geological profile. However, suitable habitat for troglofauna is demonstrated by the presence of interstitial spaces (highlighted in yellow in Tables 1 and 2) in all lithologies due to the weathering processes that have acted in the vicinity of structures such as faults on the fresh and weathered granites and ironstones over long periods of time creating porous zones.

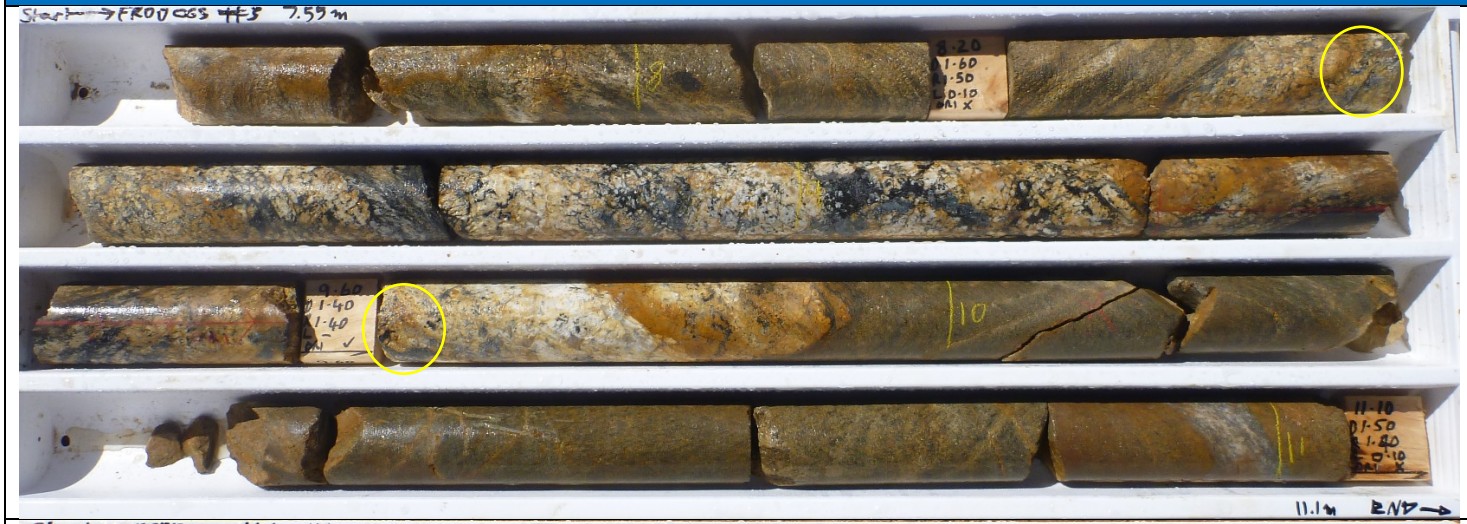
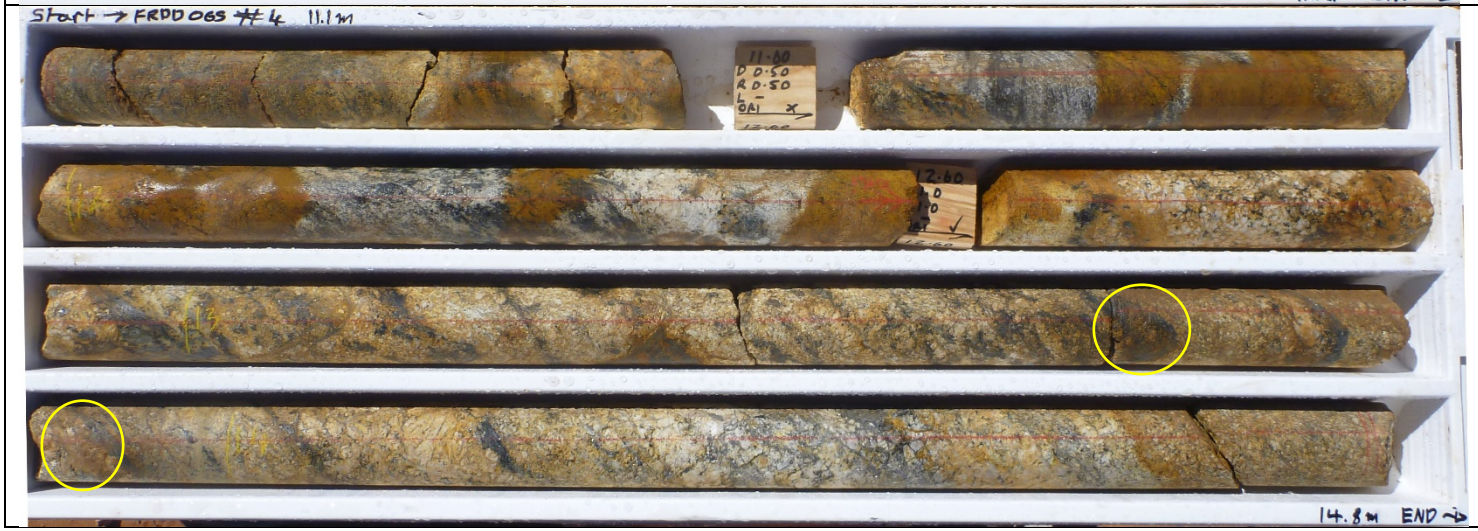
There are limitations associated with an assessment of the DD core photo's:

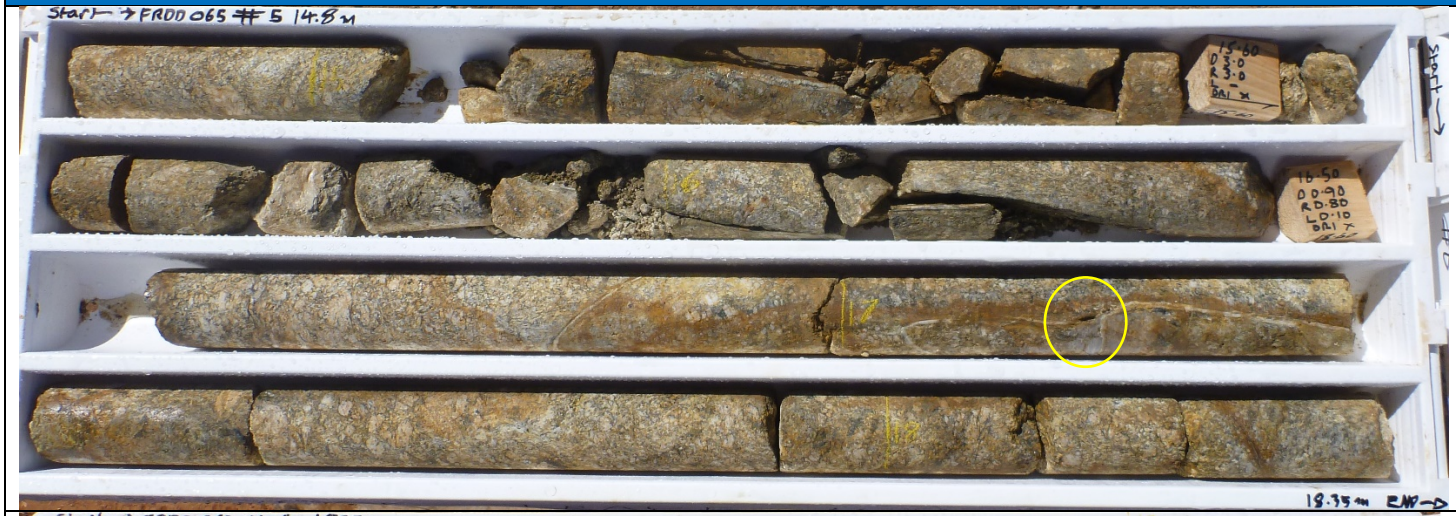
1. It is not the drill holes from which the troglofauna species were found; and
2. It is difficult to determine whether interstitial spaces are caused by the drilling methodology or occur naturally although the friable, porous zones adjacent to fractures in the granite cannot be attributed to drilling methodology nor the obvious spaces in the ironstone.

Thus, an assessment of potential habitat (in the absence of an extensive drilling campaign outside of the pit areas) should also consider other factors, such as records of vugginess and fractures.

Table 1: Diamond core from a drill hole (FRDD065) at Yangibana North in close proximity to troglofauna collected in a drill hole (FRRC100).

Drill core	Depth and descriptor
	**0-3.8m** **Saprolite** **Slightly Weathered pegmatite (i.e. a coarsely crystalline granite)** **Slightly Weathered pegmatite** **Slightly Weathered pegmatite**
	**3.8-7.55** **Moderately Weathered granite** **Moderately Weathered granite** **Moderately weathered granite** **Moderately Weathered granite**

Drill core	Depth and descriptor
	**7.55-11.1 m** **Moderately Weathered granite** **Moderately Weathered Pegmatite** **Moderately Weathered granite** **Moderately Weathered granite**
	**11.1-14.8 m** **Moderately Weathered granite** **Moderately Weathered granite** **Moderately Weathered granite** **Moderately Weathered granite**

Drill core	Depth and descriptor
	**14.8 – 18.35 m** **Moderately Weathered and Faulted granite** **Moderately Weathered and Faulted granite** **Moderately Weathered granite** **Moderately Weathered granite**
	**18.35 – 21.6 m** **Extremely weathered granite** **Extremely weathered granite** **Strongly weathered granite** **Extremely weathered granite**

Drill core	Depth and descriptor
	**21.6 – 25.55 m** **Extremely weathered granite** **Extremely weathered granite** **Extremely weathered granite** **Vuggy, extremely weathered mineralised zone**
	**25.55 – 28.7 m** **Vuggy, extremely weathered mineralised zone** **Vuggy, extremely weathered mineralised zone** **Vuggy, extremely weathered mineralised zone** **Vuggy, extremely weathered mineralised zone**

Drill core	Depth and descriptor
	**28.7 – 32.15 m** **Vuggy, extremely weathered mineralised zone** **Internal waste extremely weathered granite, quartz veined** **Internal waste extremely weathered granite, quartz veined** **Vuggy, extremely weathered mineralised zone**
	**32.15 – 35.5 m** **Vuggy, extremely weathered mineralised zone** **Vuggy, extremely weathered mineralised zone** **Vuggy, extremely weathered mineralised zone** **Vuggy, extremely weathered mineralised zone**

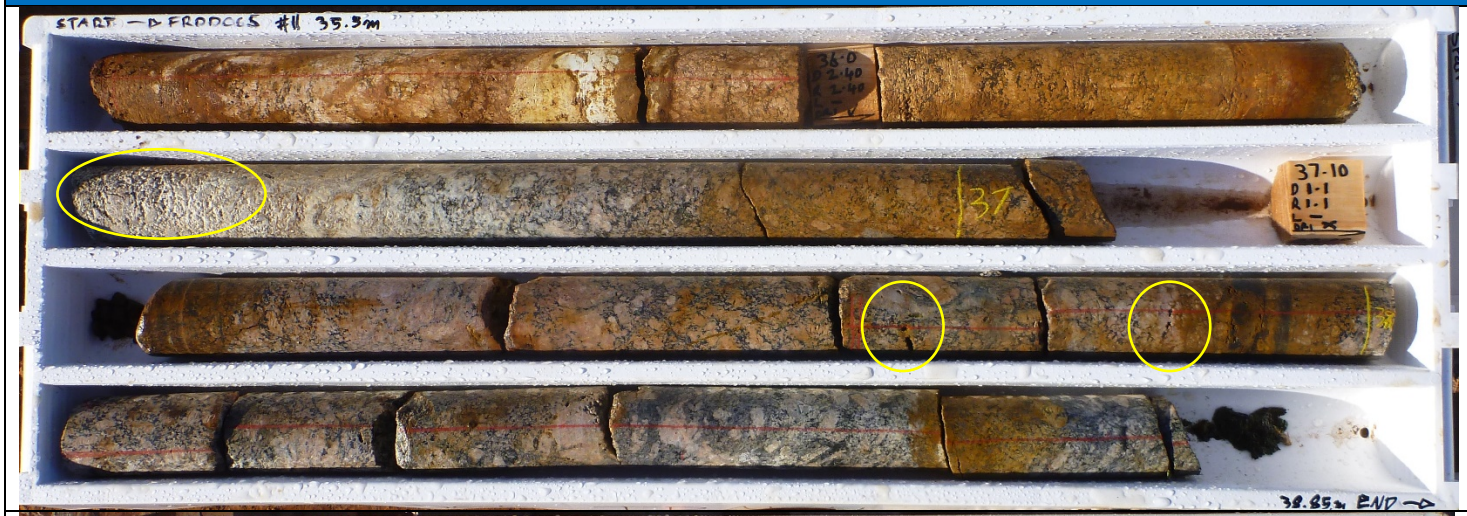
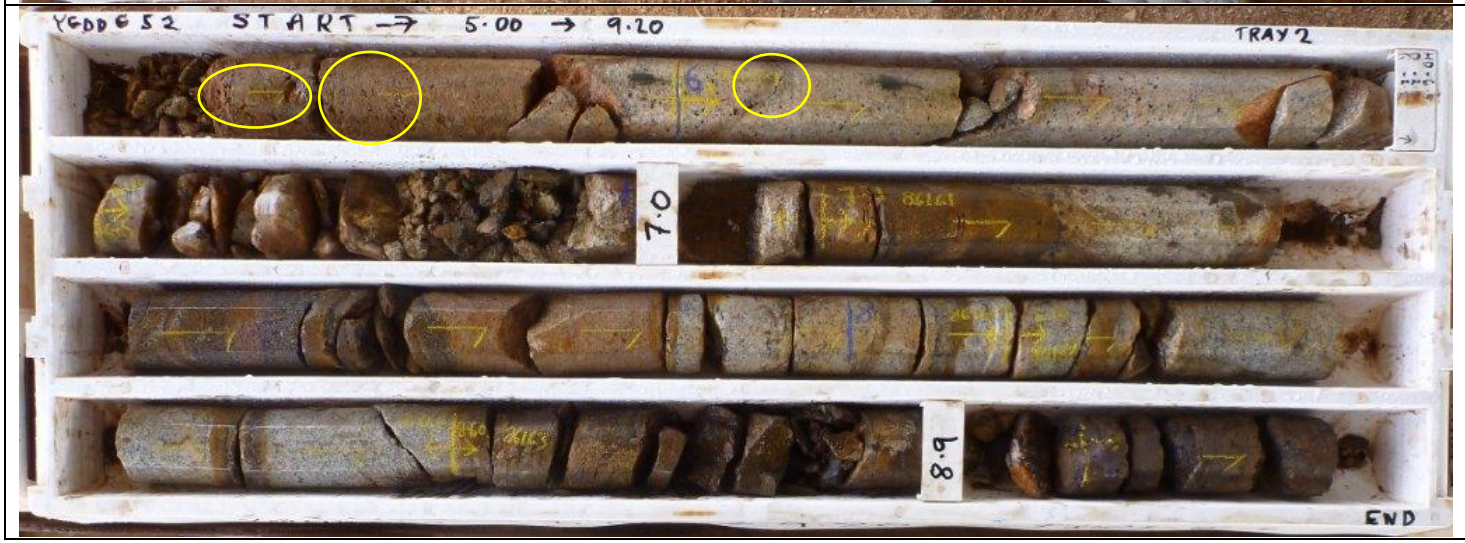
Drill core	Depth and descriptor
	**35.5 – 38.85 m** **Extremely weathered FW granite** **Slightly weathered granite** **Fresh granite, slightly porous** **Fresh granite**
	**38.85 – 39.4 m** **Fresh granite**

Table 2: Diamond core from a drill hole (YGDD052) at Yangibana North in close proximity to troglofauna collected in drill holes (YGRC066 and YGRC069).

Drill core	Depth and descriptor
	**0 - 5.0 m** **Slightly weathered aplite (i.e. similar to granite but more finely grained)** **Slightly weathered aplite** **Slightly weathered aplite** **Slightly weathered aplite**
	**5.0 - 9.20 m** **Slightly weathered aplite** **Slightly weathered aplite** **Slightly weathered aplite** **Slightly weathered aplite**

	**9.20 - 12.9 m** **Moderately weathered mineralisation** **Moderately weathered mineralisation** **Moderately weathered mineralisation** **Moderately weathered mineralisation**
	**12.90 – 16.35 m** **Moderately weathered mineralisation** **Moderately weathered mineralisation and quartz vein** **Moderately weathered low grade ironstone/granite** **Moderately Weathered granite**

	**16.35 – 20.0 m** **Moderately weathered granite** **Moderately weathered granite** **Moderately weathered granite** **Moderately weathered/fresh granite**
	**20.0 – 21.9 m** **Fresh granite** **Fresh granite**

SUMMARY

A variety of mineralisation occurs within the pits at the Yangibana Rare Earths Project. The mineralisation has been broadly characterised as ironstone with its saprolitic equivalent, hosted by weathered granite, fresh granite and, locally, metamorphics. The geological profile has a number of faults and fractures; and has weathered over long periods of time with different degrees of weathering evident in the lithological profile. The mineralisation occurs within the Pimbyana and Yangibana granites, and their extent is shown in Figure 7-2 (ERD 2018; Attachment 1) of the Environmental Review Document. The granites, and locally metamorphics, underlie the whole Project area. It should also be noted that other suitable geological profiles occur outside of the granite extent and include calcrete, alluvium and colluvium, which are also known to host troglofaunal communities.

Drilling programs focus on targeting the mineralisation, and thus it is often difficult to measure the extent of the troglofaunal community outside of the immediate disturbance footprint. However, strong evidence exists to suggest that they do occur outside of the disturbance footprint:

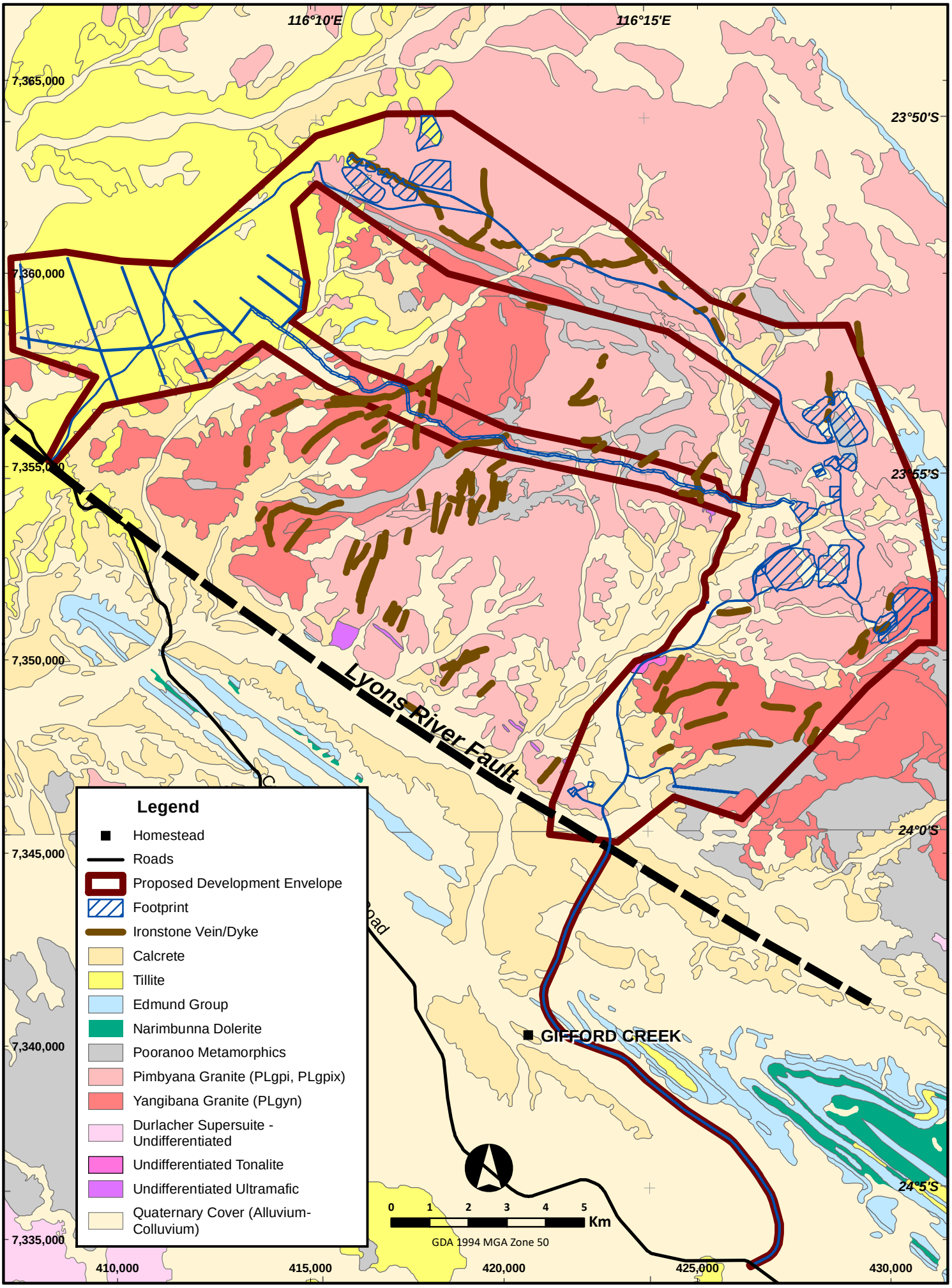
1. Suitable troglofauna habitat occurs in several lithologies (as shown in Tables 1 and 2; and noting vugginess and faulting is not limited to any one lithology) although it should be noted that Bennelongia (2018) found '*yields of troglofauna were low in terms of both abundance and species per sample, and it would appear that the Project area hosts a low-to-moderately diverse troglofaunal assemblage'.*
2. Suitable troglofauna habitat occurs spatially:
    a. Ironstones, weathered granites, and their saprolitic equivalents, calcrete, colluvium and alluvium (as shown in Figure 7-2 in the ERD (Hastings 2018; Attachment 1).
    b. Consistent habitat occurs across the landscape (as shown by the similar lithologies of pits that extend over a distance of 12-13 km apart; as demonstrated by the consistency of the respective lithology profiles in Figures 8-11 to 8-13 in the ERD (Hastings 2018); Attachment 2)
3. A pair of conspecific troglofauna specimens have been collected, each in different pits, for:
    a. *Chilenophilidae* sp. (Yangibana North and Fraser's)
    b. *Schendylidae* sp. (Yangibana North and Fraser's)
4. The evident presence of troglofauna in lithologies other than ironstone in locations where ironstone does not occur above the water table (as demonstrated in Figure 1).

REFERENCES

Bennelongia (2018) *Yangibana Rare Earths Project: Subterranean Fauna Assessment.* Unpublished report prepared for Hastings Technology Metals Limited.

Hastings (2018) *Yangibana Rare Earths Project Environmental Review Document*. Prepared by Hastings Technology Metals Limited (Hastings). Advertised 1 – 28 October 2018.

ATTACHMENT 1



YANGIBANA RARE EARTHS PROJECT

Regional Surface Geology

PER_FX-X_Geology.mxd
28 August 2018

HASTINGS Technology Metals Limited

Regional Geology source: © State of Western Australia (Department of Mines, Industry Regulation and Safety) 2017

ATTACHMENT 2

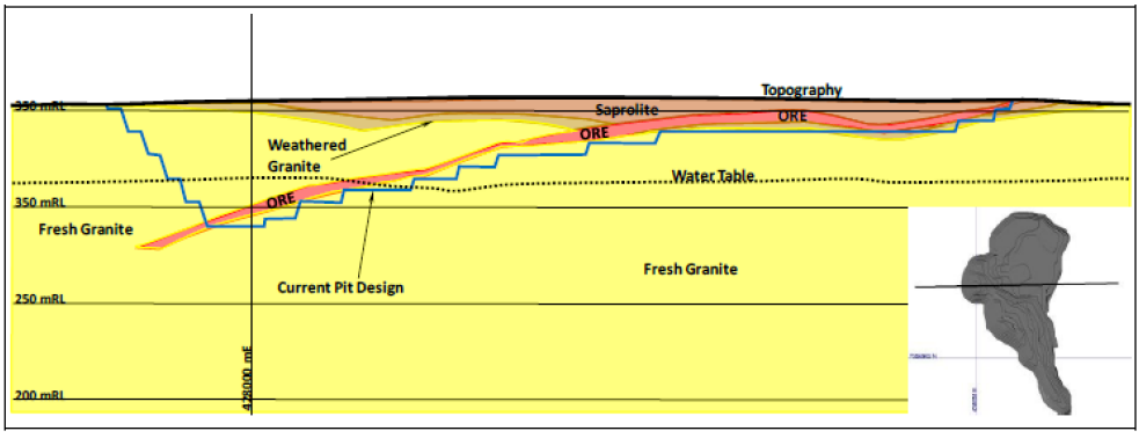


Figure 8-11 Cross-section of typical geology at Bald Hill pit (Snowden 2016)

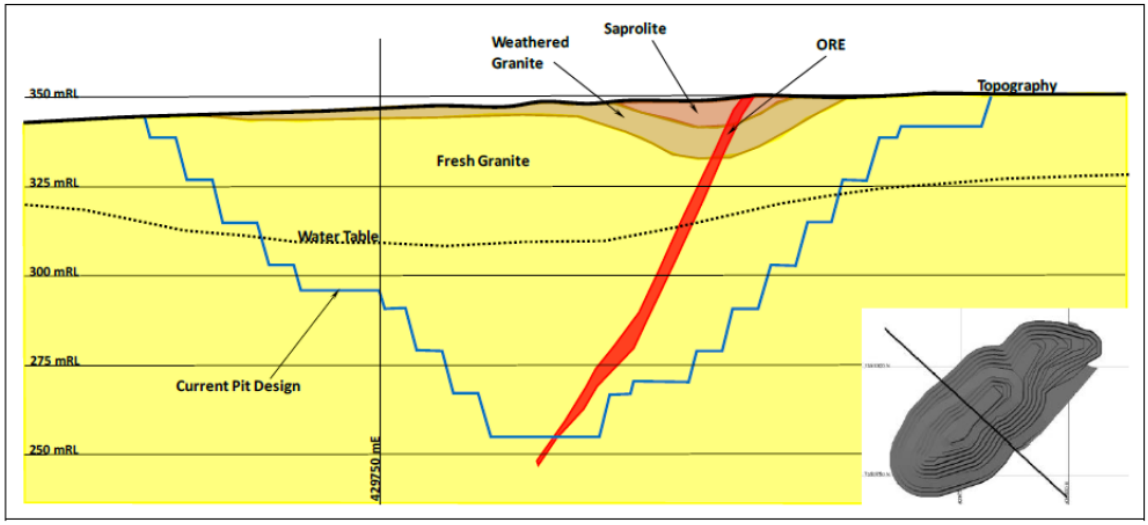


Figure 8-12 Cross-section of typical geology at Fraser's pit (Snowden 2016)

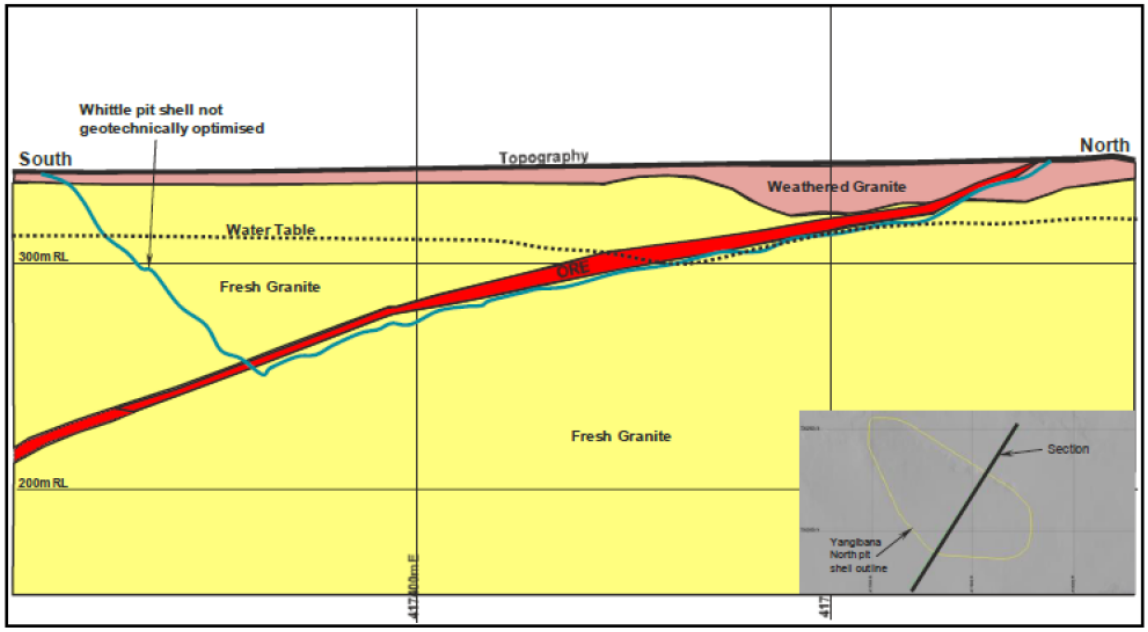


Figure 8-13 Cross-section of typical geology at Yangibana North pit (Snowden 2016)