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## British Hill Mine: Subterranean Fauna Review

Prepared for:  
Blue Cap Mining Pty Ltd

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Final Report

Short-Range Endemics | Subterranean Fauna

Waterbirds | Wetlands





# British Hill Mine: subterranean fauna review

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## EXECUTIVE SUMMARY

The British Hill Gold Mine is a brownfields deposit that was discovered in the 1980s and mined by Eclipse Ridge Pty Ltd. The tenement is held by IMD Gold Mines Ltd, which plans to re-develop a gold mine at the site managed by Blue Cap Mining. The site is 40 km south of Marvel Loch in the Goldfields of Western Australia. This report on potential threats of mining on subterranean fauna is being provided in the early stages of mine planning.

The Project consists of three tenements (M 77/1256, L 77/221 and L 77/223) and the proposed developments include an amalgamated open pit, a waste rock dump and a hardstand area. The total area of these components is approximately 27.65 ha in extent but whether it will extend below the water table is unknown. It is also yet to be determined whether ore-processing will occur on-site or elsewhere. At this stage of planning it is not intended for the mine pit to extend below the water table. Existing drilling has encountered very little groundwater

The mine site lies within the Southern Cross Greenstone Belt, which has complex geology. In summary, the mine will be in granite/pelite and schist, within a broader mafic/ultramafic rock setting. Dolerite dykes are present.

The term subterranean fauna refers to aquatic (stygo fauna) and terrestrial (troglifauna) species that spend all or most of their lives below ground and have dependency on subterranean habitats for completion of their life cycles. Stygo fauna and troglifauna species tend to have much smaller ranges than their surface counterparts and, therefore, can be more readily threatened by projects that involve extensive ground and water table disturbance.

The objectives of this report are to provide an assessment of the likelihood of subterranean fauna occurring at the British Hill Project, of any listed subterranean fauna species occurring, and an evaluation of the threats possibly posed to subterranean fauna values by proposed development.

Two species of stygo fauna and 21 species of troglifauna have been recorded in a two-degree square around British Hill. Thirty species of troglifauna have been recorded from the ranges at Koolyanobbing, approximately 100 km north of British Hill in the Southern Cross Greenstone Belt. However, it appears that as the greenstone belt becomes more topographically subdued in the south it supports fewer troglifauna. There are no listed subterranean species or communities in the vicinity of British Hill.

The threat to stygo fauna at the mine site is likely to be low. Whether there may be a threat from groundwater abstraction to provide processing water is unknown, but it is currently the proponent's intention to not mine below the water table or to undertake processing of significance on the site. Any bore field is likely to support, at most, only moderate numbers of species. Thus, there is unlikely to be any threat of stygo fauna from abstraction of processing water (although this conclusion might be altered if processing water is required).

The British Hill mine site is likely to support a small number of troglifauna species but the potential for these species to be significantly impacted by mine pit excavation is low because of the small size of the proposed mine pit.

There are no subterranean fauna species listed under conservation legislation as requiring special protection in the vicinity of the British Hill Project.

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## 1. INTRODUCTION

The British Hill Gold Mine is located 40 km south of Marvel Loch in the Goldfields of Western Australia (Figure 1). The tenement is held by IMD Gold Mines Ltd, which plans to re-develop a gold mine at the site. Gold was first discovered there in the 1980s and Eclipse Ridge Pty Ltd mined 160,000 tonnes of ore from a shallow laterite deposit.

This report provides:

- An assessment of the likelihood of subterranean fauna (stygo fauna and troglifauna) occurring in the vicinity of the mine;
- An evaluation of obvious conservation values of any subterranean fauna communities (and the constituent species) in the vicinity of the mine (such as listing under conservation legislation); and
- An assessment of the threats posed to these values by the proposed developments.

## 2. PROJECT DESCRIPTION

The Project consists of three tenements (M 77/1256, L 77/221 and L 77/223) and the proposed developments include an amalgamated open pit, a waste rock dump and a hardstand area (Figure 2). The total area of these components is approximately 27.65 ha. The annual tonnage of ore to be processed is unknown and it has not been determined whether this will occur on-site or elsewhere. Consequently, processing water requirements have not been defined.

At this stage of planning it is not intended for the mine pit to extend below the water table. Existing drilling has encountered very little groundwater and there may not be any aquifers present in the hydrological-yield sense.

## 3. GEOLOGY

The geology of the Southern Cross Greenstone Belt is complex. The British Hill mine lies in an area of granite/pelite and schist (Figure 3), within a broader mafic/ultramafic rock setting. Dolerite dykes may be present. Gold mineralisation occurs in multiple lenses associated with transverse faults and in steep dipping shear zones.

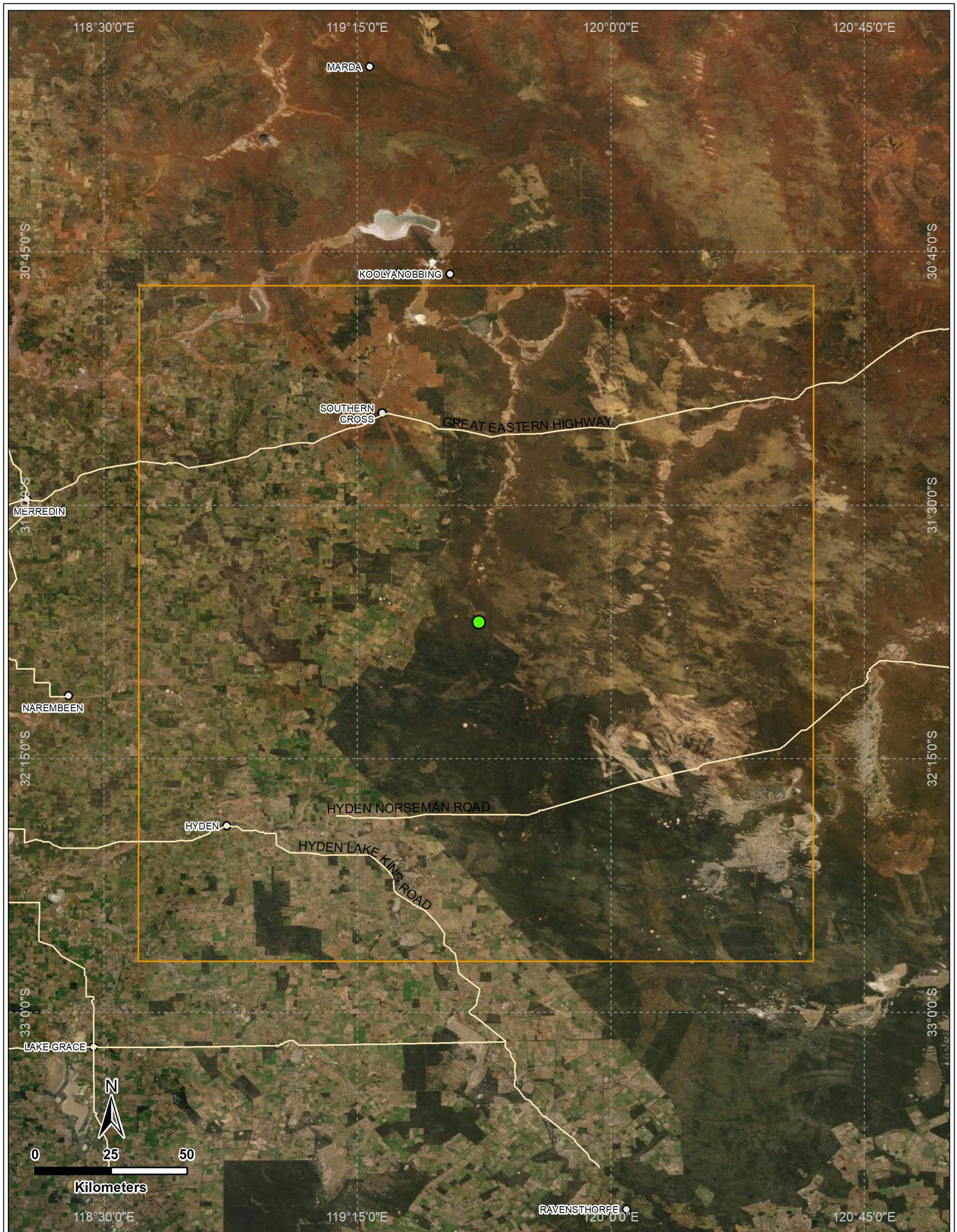
Historical data indicates that groundwater in the Dulcie borefield (several kilometres north of the planned mine at the southern end of a lake chain) occurs at approximately 26 m below ground level (bgl) and is saline (25,000–40,000 mg/L total dissolved salts [TDS]).

## 4. SUBTERRANEAN FAUNA

Western Australia contains a rich subterranean fauna, principally in the Pilbara and Yilgarn regions. On a global scale, the scientific significance of these subterranean fauna communities is as great as that of the plant communities that make south-western Australia a bio-diversity hotspot (Halse 2018).

Two types of subterranean fauna occur: aquatic stygo fauna and air-breathing troglifauna. Both groups typically lack eyes and are poorly pigmented due to lack of light. With the exception of a few species of fish and snakes, all subterranean fauna in Western Australia are invertebrates.

Subterranean fauna have mostly been studied in caves but occur across much of the landscape in microcaverns, fissures and interstitial spaces. Stygo fauna are strongly associated with the groundwater in river valleys and floodplains but have wider occurrence, while troglifauna in Western Australia have been found.



**Legend**

- British Hill
- Desktop search area
- Major road

**Figure 1. Location of the British Hill Project and extent of the desktop search area**





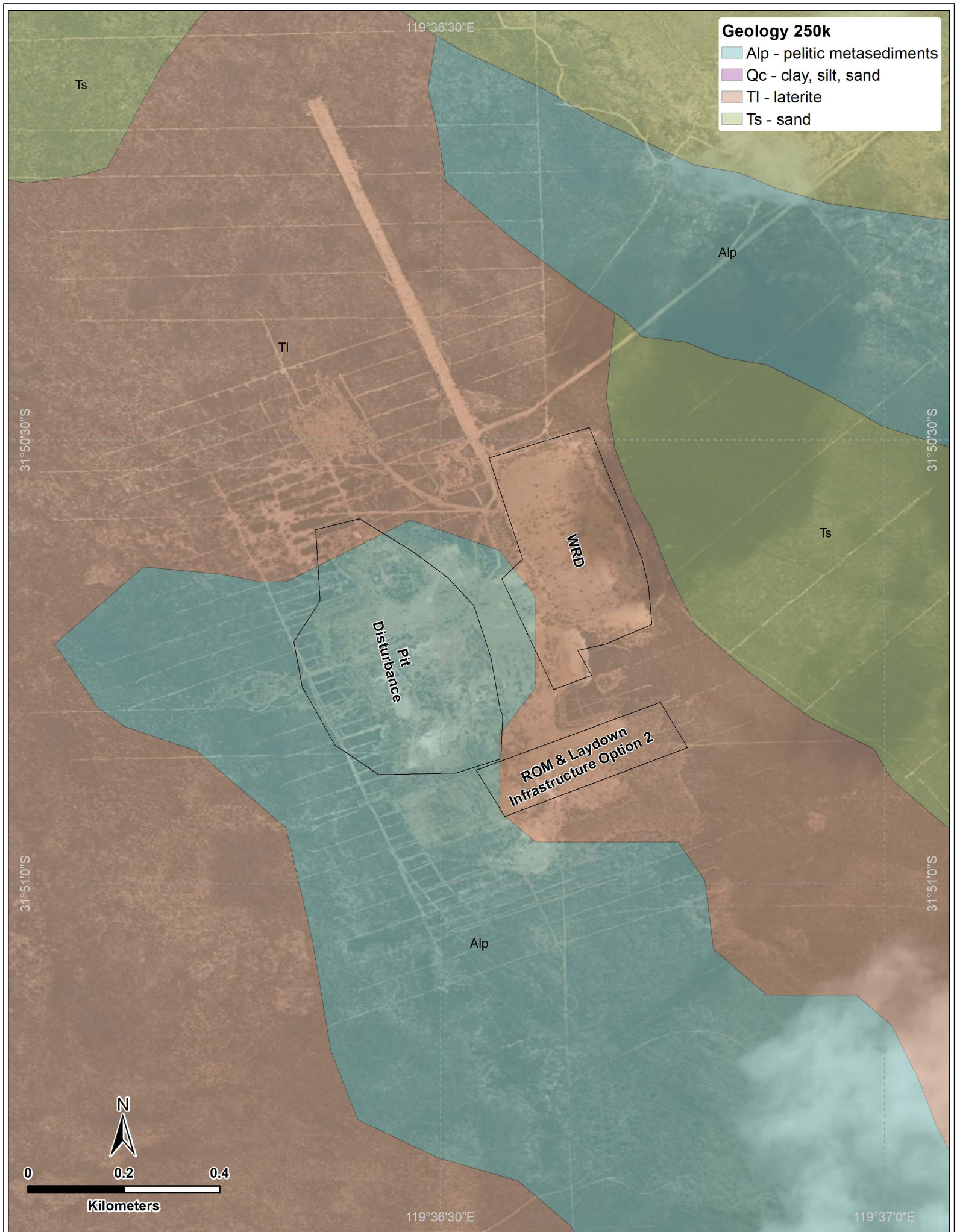
GCS GDA 1994  
 Author: amittra  
 Date: 16/07/2020



**Legend**

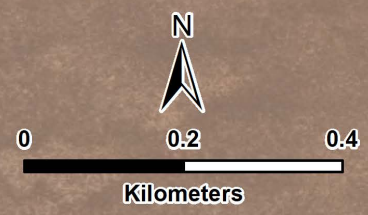
Site\_Layout\_20200504\_Option2

**Figure 2. Proposed layout of the British Hill Project**



**Geology 250k**

- Alp - pelitic metasediments
- Qc - clay, silt, sand
- TI - laterite
- Ts - sand



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Date: 16/07/2020



**Legend**

- Site\_Layout\_20200504\_Option2

**Figure 3. Geology of the British Hill Project and surrounds**

most abundantly in mineralised or weathered iron formations and areas of karstic calcrete (Mokany et al. 2018, Halse 2018), Lithology appears to be more important than geology in determining the richness and distribution of subterranean fauna (because the availability of spaces is more important than chemistry) but at the broadscale biogeographic factors may be most influential, while at the local scale factors such as depth to groundwater and salinity are important.

The richness of stygofauna (and to a lesser extent troglifauna) in areas of calcrete or iron deposit in the Yilgarn and Pilbara has led to a few areas being listed by the Minister for the Environment as Threatened Ecological Communities and many areas being listed by the Department of Biodiversity, Conservation and Attractions (DBCA) as Priority Ecological Communities on the basis of the stygofauna conservation values and the potential for these to be threatened (usually by mining). Owing to the difficulty of dispersal in subterranean fauna habitats there is a very high incidence of short-range endemism amongst stygofauna and, particularly, troglifauna (Halse 2018). Consequently, the Environmental Protection Authority (EPA) requires consideration of subterranean fauna as part of environmental impact assessment (EPA 2016a, c).

## 5. LEGISLATION

Two Western Australian acts of parliament are important to the assessment of impacts of development projects on subterranean fauna. First is the Environmental Protection (EP) Act 1986 and second is the Biodiversity Conservation (BC) Act 2016. The EP Act deals with assessment and the Environmental Protection Authority has provided guidance about the assessment of impacts on subterranean fauna under the EP Act (EPA 2016a,b,c). The guidance is followed in this report.

The BC Act provides an underlying conservation framework on which the EP Act and EPA guidance operate. All fauna species are protected by the BC Act unless specifically exempt from protection. However, some species and communities are specially protected. These are species and communities annually listed as 'threatened' by the Minister for the Environment under the BC Act and species and communities informally listed by the Department of Biodiversity, Conservation and Attractions as 'priorities' for protection.

The Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999 is also important for assessment and species protection. It also provides the basis for listing threatened species and communities but no subterranean species or communities in inland Western Australia have been listed under this act.

## 6. RESULTS

A search of the records of the Western Australian Museum for a two-degree square (-30.85, 118.6 to 32.85, 120.6), supplemented by some environmental impact assessment reports, showed two species of stygofauna and 21 species of troglifauna (Table 1).

The two stygofaunal harpacticoid species were collected about 80 km south of British Hill at the Cosmic Boy and Spotted Quoll nickel mines. The general geology of the three areas is similar; both harpacticoids were collected from greenstone metasediments outside palaeodrainage valleys in groundwater of very approximately 30,000 mg/L TDS (Karanovic et al. 2013).

Some of the troglifauna species in Table 1 were collected from the Parker Range about 35 km north of British Hill and just south of Marvel Loch, while others were collected from the periphery of the search areas in mines at Koolyanobbing, about 100 km north of British Hill. No troglifauna were recorded from Spotted Quoll, despite sampling occurring and some stygofauna being collected.

Altogether, 12 species of troglifauna have been collected at Parker Range (Rockwater 2010). Not all species are represented in WAM collections. Thirty species have been recorded from the ranges at Koolyanobbing (Bennelongia 2008, 2009), with most species being outside the search area and so not

recorded in the search of WAM databases. The occurrence of a rich troglofauna community at Koolyanobbing is likely to be the result of pronounced local topography (i.e. a range) because analysis of troglofauna occurrence in the Pilbara showed local elevation was the best predictor of species richness (Mokany et al. 2019). Extensive weathering and mineralisation to create voids is also likely to have contributed to richness (see Halse 2018). The landscape becomes more subdued to the south at Parker Range, where fewer species of troglofauna were collected and is even more subdued at British Hill.

**Table 1.** Species of subterranean fauna known from the two degree (100 km by 100 km) search area.

<b>Stygofauna</b>					
Order	Family	Species	Location	Source	
Harpacticoida	Ameiridae	<i>Antistygonytocyrella pardalotos</i>	Spotted Quoll	WAM	
Harpacticoida	Ameiridae	<i>Megastygonytocyrella embe</i>	Cosmic Boy	WAM	
<b>Troglofauna</b>					
Order	Family	Species	Location	Source	
Geophilida	Schendylidae	<i>Australoschendyla</i> `sp. nov. Koolyanobbing`	Koolyanobbing	1	
Araneae	-	Araneomorphae sp. B16	Parker Range	2	
Pseudoscorpiones	Chthoniidae	<i>Austrochthonius</i> `PSE034`	Parker Range	1	
		<i>Tyrannochthonius</i> `PSE047`	Koolyanobbing	1	
		<i>Tyrannochthonius</i> `PSE048`	Parker Range	1	
		<i>Tyrannochthonius</i> `PSE049`	Parker Range	1	
Diplura	Japygidae	Japygidae `DPL006`	Koolyanobbing	1	
Isopoda	Armadillidae	<i>Buddelundia</i> sp. B01	Koolyanobbing	1	
		<i>Buddelundia</i> sp. B03	Parker Range	2	
		<i>Buddelundia</i> sp. B04	Parker Range	1	
		<i>Quatordillo caecus</i>	Koolyanobbing	1	
		<i>Troglarmadillo</i> sp. B01	Koolyanobbing	1	
		<i>Troglarmadillo</i> `sp. ISO003`	Koolyanobbing	1	
		<i>Troglarmadillo</i> `sp. ISO007`	Parker Range	1	
		Philosciidae	Philosciidae sp. B04	Koolyanobbing	1
		Philosciidae sp. B14	Parker Range	1	
		Trichorhinae	Trichorhinae sp. B02	Koolyanobbing	1
Trichorhinae sp. B06	Parker Range	1			
Symphyla	Scutigereillide	Hanseniella sp. B05	Parker Range	2	
Coleoptera	Curculionidae	Curculionidae Genus 3 sp. B06	Parker Range	2	
	Staphylinidae	Staphylinidae sp. B02	Parker Range	2	

1, WAM database; 2, Rockwater 2010

## 7. DISCUSSION

British Hill can be considered a brownfields site, given the previous excavation of 160,000 tonnes of ore. However, the spatial extent of the disturbance to any troglofauna habitat associated with 160,000 of ore would have been smaller than the proposed mine pit. Further, the previous mining is unlikely to have intercepted the watertable and stygofauna habitat would not have been disturbed. Thus, any subterranean fauna communities occurring at British Hill are likely to have remained largely intact during previous mining

### 7.1. Likelihood of Species Occurrence

In considering the potential impacts of the proposed future mining at British Hill on subterranean fauna, there is relatively little information on which to base an assessment of the likelihood of any subterranean fauna occurrence. There has been little sampling close to the proposed mine and the capacity of the

local geology to support subterranean fauna is not well understood. However, the following conclusions are tentatively drawn:

#### Stygofauna

- Groundwater quality is likely to be suitable for stygofauna.
- In general, the geology at the British Hill mine site would not be expected to be suitable for stygofauna, based on results from other gold mines, but sampling further south at Spotted Quoll and Cosmic Boy suggests a small number of stygofauna species may occur.
- If stygofauna do occur at the mine site, the number of species is likely to be low. However, species present may have small ranges because of the occurrence of dolerite dykes across the greenstone belt.
- Large calcrete bodies of the type that host rich stygofauna assemblages occur only at latitudes north of 29°S (see Humphreys 2001). Consequently, any planned borefield for processing water (although in transmissive geologies that increase the likelihood of stygofauna occurrence) is unlikely to be in an area of extreme stygofauna richness and should have moderate numbers of species at most.

#### Troglofauna

- The geology of British Hill is likely to be suitable for troglofauna.
- Based on sampling at other mine sites, there appears to be a gradient of troglofauna richness from north to south in the Southern Cross Greenstone Belt, which suggests a small number of troglofauna species may occur at British Hill.
- The occurrence of dolerite dykes may cause at least some, if not all, the species present to have small ranges.

## 7.2. Likelihood of Impacts on Species

Even when subterranean fauna are present at a mine site, there are unlikely to be significant impacts on the conservation values of the fauna unless species have small ranges relative to the area of mine-related disturbance. Troglofauna are potentially impacted by mine pit excavation, while stygofauna are potentially impacted by any excavation below the watertable and the associated cone of dewatering required to for dry-pit mining. In addition, groundwater abstraction for processing water in adjacent borefields may potentially impact stygofauna.

Assuming that some subterranean fauna species occur at British Hill, assessments of whether mine-related disturbances are likely to significantly impact the conservation values of the fauna are provided below:

#### Stygofauna

The potential for any stygofauna present to be significantly impacted by below watertable excavation, dewatering and groundwater abstraction for processing cannot be fully assessed at this stage because there is some uncertainty about whether the mine will extend below the watertable or whether there will be an on-site requirement for processing water. However, it is the proponent's current intention to not mine below the water table or undertake any significant processing onsite. This means the treat to stygofauna is low unless the proponent's intention changes.

#### Troglofauna

The potential for any troglofauna present to be significantly impacted by mine pit excavation is considered to be low based on the small size of the mine pit (approximately 20 ha, although size is still to be confirmed) in relation to known ranges of troglofauna species elsewhere. While dolerite dykes may constrain species ranges, and groups such as isopods may have relatively small ranges (estimated median range in Pilbara of at least 2.5 km<sup>2</sup>; see Halse and Pearson 2014), very few species could conceivably be restricted to a range of 0.2 km<sup>2</sup> (20 ha) or less.

### 7.3. Listed Species

While many inland subterranean communities in Yilgarn calcretes have been listed as threatened, or priority, ecological communities there are no listed subterranean communities or species within the search area used in this report. The British Hill Project is unlikely to affect the status of any recognised high conservation-value species.

### 7.4. Conclusions

In summary, it is likely that few stygofauna species will occur at the mine site. The threat to them appears to be low, although mine planning is not complete. Whether processing water from a local source will be needed is also unclear, although it is the proponent's current intention not to undertake any significant processing onsite. Therefore, while the possible threat to stygofauna from groundwater abstraction for processing water remains uncertain, it is likely to be low. Any borefield is likely to support, at most, only a moderate number of species.

It is likely that a small number of troglofauna species occur at the British Hill mine site but the potential for these species to be significantly impacted is low because of the small size of the proposed mine pit.

There are no subterranean fauna species listed under conservation legislation as requiring special protection in the vicinity of the British Hill Project.

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## Appendix 1. Records from Western Australian Museum.

Reg. No.	Order	Family	Lowest identification	Latitude	Longitude	Collectors
<b>STYGOFAUNA</b>						
47223	Harpacticoida	Ameiridae	Antistygonytorella pardalotos	-32.4886	119.68	Rockwater Pty Ltd
47222	Harpacticoida	Ameiridae	Megastygonytorella embe	-32.5843	119.758	Rockwater Pty Ltd
<b>TROGLOFAUNA</b>						
100092	Geophilida	Schendyliidae	Australoschendyla `sp. nov. Koolyanobbing`	-30.8704	119.604	Scanlon, M.D.; Scanlon, B.J.
119419	Pseudoscorpiones	Chthoniidae	Austrochthonius `PSE034`	-31.615	119.555	Evelegh, N.C.P.; Scott, D.S.
119420	Pseudoscorpiones	Chthoniidae	Austrochthonius `PSE034`	-31.531	119.547	Evelegh, N.C.P.; Scott, D.S.
119421	Pseudoscorpiones	Chthoniidae	Austrochthonius `PSE034`	-31.53	119.548	Evelegh, N.C.P.; Scott, D.S.
100289	Pseudoscorpiones	Chthoniidae	Austrochthonius `PSE034`	-31.489	119.68	Rockwater Pty Ltd
119450	Pseudoscorpiones	Chthoniidae	Tyrannochthonius `PSE047`	-30.875	119.608	Cocking, J.S.; Cocking, P.S.
119451	Pseudoscorpiones	Chthoniidae	Tyrannochthonius `PSE047`	-30.875	119.606	Cocking, J.S.; Main, D.C.
119452	Pseudoscorpiones	Chthoniidae	Tyrannochthonius `PSE048`	-31.62	119.553	Evelegh, N.C.P.; Scott, D.S.
119454	Pseudoscorpiones	Chthoniidae	Tyrannochthonius `PSE049`	-31.648	119.548	Evelegh, N.C.P.; Scott, D.S.
119455	Pseudoscorpiones	Chthoniidae	Tyrannochthonius `PSE049`	-31.624	119.553	Evelegh, N.C.P.; Scott, D.S.
83165	Diplura	Japygidae	Japygidae `DPL006`	-30.8775	119.61435	Scanlon, M.D. & Trotter, A.J.
42928	Isopoda	Armadillidae	Buddelundia sp. B1	-30.8713	119.605	Scanlon, M.D. & Trotter, A.J.
45630	Isopoda	Armadillidae	Quatordillo caecus	-30.8733	119.608	Cocking, J.S. & Cocking, P.S.
45685	Isopoda	Armadillidae	Troglarmadillo sp. B01	-30.8738	119.608	Cocking, J.S. & Cocking, P.S.
51632	Isopoda	Armadillidae	Troglarmadillo `sp. ISO003`	-30.8752	119.609	Cocking, J.S.; Cocking, P.S.
51639	Isopoda	Armadillidae	Troglarmadillo `sp. ISO007`	-31.5184	119.537	Evelegh, N.P.; Scott, D.S.
70107	Isopoda	Philosciidae	Philosciidae sp. B04	-30.86	119.591	Trotter, A.J. & Scanlon, M.D.
42929	Isopoda	Philosciidae	Philosciidae sp. B04	-30.8601	119.591	Scanlon, M.D. & Scanlon B.J.
45627	Isopoda	Philosciidae	Philosciidae sp. B14	-31.6188	119.553	Scott, D.S. & Evelegh, N.C.P.
70115	Isopoda	Trichorhinae	Trichorhinae sp. B02	-30.8733	119.608	Main, D.C. & Cocking, J.S.
45676	Isopoda	Trichorhinae	Trichorhinae sp. B06	-31.6505	119.571	Scott, D.S. & Evelegh, N.C.P.