Graphinex – Esmeralda Graphite Project
Environmental Impact Statement

Appendix F – Stygofauna Assessment

GRAPHINEX



Esmeralda Graphite Project

Stygofauna Assessment

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Document Tracking

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1. Introduction

1.1. Background and project summary

The Esmeralda Project is a proposed open cut graphite mine located approximately 70 km south of Croydon in Queensland on land currently used for cattle grazing. The Esmeralda Granite unit consists of approximately 25 MT of graphite, which is considered a critical mineral, and is the third largest deposit in the world. The proposed project would mine up to 3.5 million tonnes of graphite ore per year over a mine life of approximately 65 years. Extracted graphite ore will be taken by truck to a mineral processing plant, where it will be stockpiled then concentrated using conventional floatation methods. Concentrate will then be sent by truck to Townsville for distribution.

An Initial Advice Statement (IAS) for The Project was prepared in early 2025 (AARC 2025), which indicated that an Environmental Impact Statement (EIS) would be required. The Esmeralda Project has been declared as a Coordinated Project under the State Development and Public Works Organisation Act 1971 (SDPWO Act). The Coordinated Project includes the mining and processing activities within the mining lease, the proposed transport corridor in the southern mining lease application areas, and the development and use of services and infrastructure associated with mining, including water supply, power, accommodation, and transport.

Terms of Reference have been issued by the Office of the Coordinator-General for the purposes of developing an EIS. This technical report will support Graphinex and AARC in preparing the EIS for the Project.

In recognition of the critical role this Project will play in the production and supply of graphite, the Project was declared a 'Prescribed Project' by the Queensland Government on the 13th of November 2025.

1.2. Project Scope

The ToR recognised the potential for the Project to use and alter groundwater resources in the area, and subsequently that there may be a resultant impact to groundwater dependent ecosystems (GDEs). An independent GDE assessment has been completed and found that there are no GDE's located in the project area. Database searches indicate that the nearest known spring was more than 30 km from the project, but there was no information available on whether stygofauna (groundwater invertebrates) occurred at or near the site.

The purpose of this stygofauna assessment is to determine, using a desktop review of available geological and groundwater information combined with field surveys, whether stygofauna are likely to occur at the site. If stygofauna are likely, then the assessment would determine what taxa are present and whether they are likely to receive significant impact from the Project.

2. Geology and hydrogeology

2.1. Groundwater environment

The project mining area consists of basement rocks overlain by Carpentaria Basin strata, unconsolidated Quaternary alluvium, and semi-consolidated Tertiary sediments. Weathering extends 15-30 m deep within the Carpentaria Basin strata, with no significant regional faults except a basement fault.

Quaternary alluvium forms floodplain deposits along Warrigal Creek and an unnamed tributary, and consists of clay, silt, sand and gravel deposits. The Tertiary aged Claraville beds are generally dry. These are a sedimentary layer about 10 m thick at the site, overlying the Cretaceous/Jurassic strata.

The Gilbert River Formation, a regional aquifer supports pastoral use and exhibits sub-artesian conditions locally, with artesian conditions likely further west. The Gilbert River Formation is characterised by sedimentary rocks of fluvial or shallow marine origin deposited in the Middle Jurassic to Early Cretaceous period (Raiber et al 2024). The formation consists of clay-rich sandstone and is dominated by interbedded calcareous siltstone, claystone, and conglomerate (Raiber et al 2024). The basement rocks, hosting the orebody, are expected to act as an aquiclude or aquitard, with localised permeability due to fracturing. Groundwater inflow is estimated at approximately 1.6 ML/day, primarily from the Gilbert River Formation, with minimal contribution from basement rocks.

2.2. Potential impacts to groundwater

Impacts of the Project potentially occur from surface construction activities, which may require groundwater as part of the water supply, and from direct impacts during mining. These latter impacts would include depressurisation and drawdown of aquifers caused by pit excavation.

The open-cut pit would be 250 m deep, intersecting the groundwater table and the Gilbert River Formation, which is the aquifer currently sourcing the 12 registered bores within 10 km of the project area. Groundwater inflow to the pit, and any dewatering, will result in a drawdown cone extending away from the pit.

3. Stygofauna ecology

Stygofauna are generally small aquatic invertebrates that live in groundwater systems. They are typically crustaceans, although there are a few insect taxa and other non-crustacean invertebrates in the communities of the Hunter Valley. Estimates suggest there could be as many as 2,680 species in the western half of the Australian continent, although only approximately 12% of these have been described (Guzik et al. 2011).

Stygofauna have special adaptations to survive in the relatively resource-poor aquifers, where there is no light, space is limited, and food is scarce (Humphreys 2008). Adaptations include blindness, slow metabolism, reduced body size, elongation, and low reproduction rates (Coineau 2000). As there is no photosynthesis below ground, subterranean environments rely on inputs of organic matter from the surface to provide the basis of the food web (Schneider et al. 2011). Alluvial aquifers often have gradients in species diversity associated with distance from recharge areas, where dissolved or fine particulate organic matter enters the aquifer (Datry et al. 2005). Tree roots are also important sources of organic matter for groundwater food webs, and where they intersect the water table can have support diverse communities (Hancock and Boulton 2008, Jasinska et al. 1996).

Many ecosystem functions provide essential services to humans, saving both money and resources (Tomlinson and Boulton 2008). Despite their small size, the cumulative effect of some key stygofauna processes are likely to cause significant changes to groundwater quality. These processes are evident in alluvial aquifers where water moving though sediment particles is cleaned during transit, in much the same way as water moving through slow sand filters or trickle filters during water and sewage treatment (Hancock et al. 2005). It is likely that through their movement and grazing of sediment-bound microbes, stygofauna also help prevent alluvial aquifer sediments from clogging (Hancock et al. 2005).

Unlike many surface aquatic species, stygofauna have no aerial life stages, and are limited in their ability to disperse. Consequently, movement through aquifers is relatively slow and often restricted to convoluted passages between sediment grains or along fractures in rock. Usually, greater porosity corresponds to higher connectivity between interstitial spaces, meaning that stygofauna can move around in the aquifer with greater ease. Conversely, areas of low porosity can restrict the transfer of genetic material. Aquifers that are hydrologically disconnected from each other often have different stygofaunal compositions, although they may share some species if the aquifers were connected in the past or become connected occasionally during periods of high water level. The more frequent the aquifers are connected, the more similar the stygofauna communities are likely to be. However, with prolonged genetic isolation between adjacent aquifers or isolated sections of the same aquifer, species may begin to evolve, resulting eventually in the development of new species (Watts et al. 2007). Aquifers that have been isolated for long periods often contain several unique species of stygofauna with very limited distributions.

Aquifers are relatively stable compared to surface aquatic environments with little or no daily fluctuations in parameters such as temperature, water level, and electrical conductivity (EC). As such, many stygofauna taxa are sensitive to rapidly changing conditions (Hancock et al. 2005). Activities such as water table draw-down, the removal of aquifer material for mining or quarrying, or rapid changes to water quality can all have detrimental effects to stygofauna communities and possibly cause extinctions (Humphreys 2008).

It is a combination of the features outlined above that have driven concerns for the potential loss of stygofauna biodiversity, particularly in areas subjected to rapid and extensive anthropogenic changes. The key attributes of stygofauna that may place them at risk are:

- The adaptation to relatively stable conditions and vulnerability to rapid or excessive changes in water level, temperature, and salinity
- Their slow rate of reproduction and slow growth rate
- The limited ability to disperse through aquifers, and intuitively recolonise following disturbance
- The high degree of endemism, with entire species restricted to only small geographic areas.

Concerns over the impact of mining and other large development projects, and concerns for State responsibility to maintain biodiversity, prompted the Queensland Government to develop guidelines for stygofauna assessments (DSITI 2015).

3.1. Background - Factors influencing biological distribution in aquifers

As with all fauna, stygofauna require favourable conditions to inhabit an aquifer, but with the large number of species occurring in aquifers, there is a broad range of variability in ecological requirements. Not all aquifers are naturally suitable for stygofauna and those that are suitable, may become unsuitable as a result of human activities or natural changes. The biological distribution of stygofauna in groundwater is influenced by historical, geological, hydrological, physico-chemical, and biological properties (Strayer 1994, Hancock et al. 2005). There is still a lot to learn about stygofauna ecology, particularly in the eastern states where there have been relatively few surveys when compared to Western Australia. Nevertheless, it is possible to briefly summarise what is already known about the aquifer conditions that are likely to influence the distribution of stygofauna.

3.1.1. Aquifer type

Stygofauna have been collected from many aquifer types, including fractured basalt, fractured sandstone, and pesolithic aquifers, but are most common in karstic and alluvial aquifers. Critical aquifer characteristics are the hydraulic conductivity, depth to water table, and porosity.

Generally, stygofauna occur more frequently in alluvial and karst aquifers than in other geological formations (Hancock et al. 2005, Humphreys 2008). Alluvial aquifers occur beneath floodplains, which often provide the following favourable conditions to stygofauna:

- Water table is shallow, so there is recharge of infiltrating rainwater and organic matter, and the water table is accessible to floodplain tree roots.
- There is often some degree of hydrological connectivity with surface rivers. This is particularly influential in regulated rivers where artificial flow releases from upstream dams may provide aquifer recharge of organic matter and oxygen in periods where natural surface flow would be absent.
- Compared to deeper aquifers, water in alluvial aquifers is young, has a rapid flux, and can have a lower salinity.

Where stygofauna occur in fractured basalt or sandstone aquifers, they are often adjacent to alluvium or karst.

3.1.2. Hydraulic conductivity

Hydraulic conductivity indicates how rapidly water flows through an aquifer. This is important to stygofauna communities because the flux of water through an aquifer often influences how rapidly organic matter and oxygen concentrations can be replenished.

3.1.3. Depth of water table

Depth to water table influences the amount of organic matter and oxygen that are available to aquifer food webs. With increasing depth below the land surface, the concentration of organic matter dissolved in infiltrating rainwater diminishes as it is absorbed in transit by soil bacteria and plant roots. Shallow water tables of less than 15 m have been found to favour high diversity in alluvial aquifers in the Hunter Valley and other parts of eastern Australia (Hancock and Boulton 2008).

Another source of organic matter to aquifer invertebrates is the presence of phreatophytic roots (Jasinska et al. 1996). Root density is likely to be higher in shallower aquifers, and the resultant increased availability of organic matter provides food to diverse stygofauna communities (Hancock and Boulton 2008).

3.1.4. Connectivity to recharge areas

A large proportion of the organic matter that fuels aquifer food webs has its origin at the surface and enters groundwater in particulate or dissolved forms. Therefore, sections of aquifers that are nearer to recharge areas are likely to have higher diversity and abundance than those that are further away since the transfer of organic matter and oxygen is greater at these sites (Datry et al. 2005).

3.1.5. A space for living

Stygofauna can only live in aquifers that have enough space for them to move around in. Space is present in the solute cavities in karst, between pesolithic sediments in calcrete, and fractures in sandstone and basalt. In unconsolidated sedimentary aquifers, the size of pore space between particles often correlates to the size of the animals present, with larger species occurring in aquifers of coarser material (Strayer 1994). Also important when considering the space available for living is the connectivity between pores, cavities, and fractures. These act as migration pathways to allow fauna to move around in the aquifer and are likely to be important in recolonising following disturbance.

3.1.6. Evolutionary history

Most stygofauna evolved from ancestors that once lived in surface freshwater or marine environments. As a result, it is possible that they have retained some of the traits and environmental tolerances of their ancestry. As an example, in coastal areas where ancestral stygofauna species may have come from a marine origin, contemporary taxa may be tolerant of high salinity (Hancock and Steward 2004, Humphreys 2008). Conversely, taxa with a freshwater ancestry may prefer lower salinities (Hancock and Boulton 2008).

3.1.7. Food availability

Stygofauna have adapted to the resource-starved conditions in aquifers and can tolerate low concentrations of organic matter (Strayer 1994, Hahn 2006). Food is available to stygofauna as particulate organic matter, groundwater bacteria, or as roots of phreatic trees. In its dissolved or fine particulate form, organic matter enters aquifers with recharging water. Dissolved organic matter is taken up by groundwater bacteria, which are then imbibed by smaller stygofauna. Most stygofauna are opportunistic omnivores.

3.1.8. Water regime

Local or regional climate and river-flow regimes can influence aquifer recharge, and so affect the organic matter flux in the aquifer. Periods of high, steady rainfall can increase hydrological connectivity between the land surface and the aquifer and can reduce depth to water table. Exchange

between rivers, the hyporheic zone, and aquifers can be an important source of nutrients to stygofauna communities (Dole-Olivier et al. 1994), so flow fluctuations that enhance hyporheic exchange can subsequently enrich stygofauna communities in deeper parts of the aquifer.

3.1.9. Salinity

Stygofauna in inland aquifers are generally restricted to fresh or partly brackish water. Hancock and Boulton (2008) suggest that most taxa collected from alluvial aquifers in NSW and Queensland prefer EC less than 5000 µS/cm. In surveys of coastal areas and near salt lakes in Western Australia, stygofauna were collected from aquifers with salinities at or exceeding sea water (50 000 µS/cm, Watts and Humphreys 2004). No stygofauna in NSW are known from aquifers where EC is this high, but there have been recent collections from an aquifer in the Condomine basin, Qld, where EC was between 36 000 and 56 000 µS/cm (Andrea Prior *pers comm.* Glanville et al. 2016).

3.1.10. pH

In a review of previous stygofauna surveys in Queensland, Edgar (2024) found that stygofauna were present at mean pH of between 7 and 7.57, although the range was between 5.12 and 8.98.

3.1.11. Dissolved oxygen concentration

Stygofauna can tolerate very low concentrations of dissolved oxygen when compared to surface aquatic invertebrates. Hahn (2006) observed a strong decrease in concentrations below 1.0 mg/L, but found some fauna in concentrations down to 0.5 mg/L. Hose et al. (2015) suggested stygofauna rarely occur in groundwater with concentrations below 0.3 mg/L. Some taxa can survive with virtually no oxygen for temporary periods of up to 6 months (Henry and Danielopol 1999, Malard and Hervant 1999).

3.1.12. Temperature

Groundwater temperature appears to influence whether stygofauna may be present in an aquifer. Analysis of existing stygofauna survey data from Queensland, as well as the Kimberley and Pilbara regions of Western Australia suggests that stygofauna are less likely to occur in warmer groundwater in Kimberley (Edgar 2024). In the Pilbara and Kimberley, stygofauna were absent from bores with mean water temperatures warmer than 32°C and 30.5°C respectively. In Queensland, stygofauna were absent from bores with a mean temperature of 24.6°C (Edgar 2024).

4. Methods

This assessment follows the Queensland Government *Guideline for the Environmental Assessment of Subterranean Aquatic Fauna* (DSITI 2015), and guidelines from other states, including the *Risk Assessments Guidelines for Groundwater Dependent Ecosystems* (NSW Office of Water 2012), the *Technical Guidance- Subterranean fauna surveys for environmental impact assessment* (WA EPA 2021) and the *Information Guidelines Explanatory Note for Assessing Groundwater-Dependent Ecosystems* (Doody et al. 2019).

In NSW, Queensland, and Western Australia, survey guidelines recommend two rounds of stygofauna sampling, with a gap of approximately 3 months between surveys. However, under some circumstances, such as when there are no known stygofauna from the area, or there is limited suitable habitat, one survey is sufficient (DSITI 2015). This report includes the results from the initial survey for stygofauna and is deemed suitable for the project location and geology and the low potential to find stygofauna. An additional round would be required if stygofauna are found during the first survey, or the groundwater and geological conditions of the site make it likely that stygofauna will occur (DSITI 2015).

4.1. Sampled bores

Fourteen monitoring bores and four landowner production bores were visited during sampling at Esmeralda (Figure 1). Seven of the monitoring bores were dry. All but one of these had total depths less than 12 m, the exception being ESMB7S with a total depth of 54 m (Table 1).

No details were available for the depth of the landowner production bores, but they extract water from the Gilbert River Formation aquifer. The bores are more than 12 months old. Pumps in these bores are solar powered and were continuously running at the time of sampling. Water is pumped into a series of small dams to provide drinking water for cattle.

Monitoring bores were constructed from 50 mm diameter PVC pipe. All bores sampled were in the Gilbert Formation and had screened depths of between 46-49 m below ground level (BGL), and 77.8-83.8 m BGL. All monitoring bores were less than 12 months old at the time of sampling, with only two being older than 6 months.

All of the monitoring and production bores sampled entered the Gilbert River Formation.

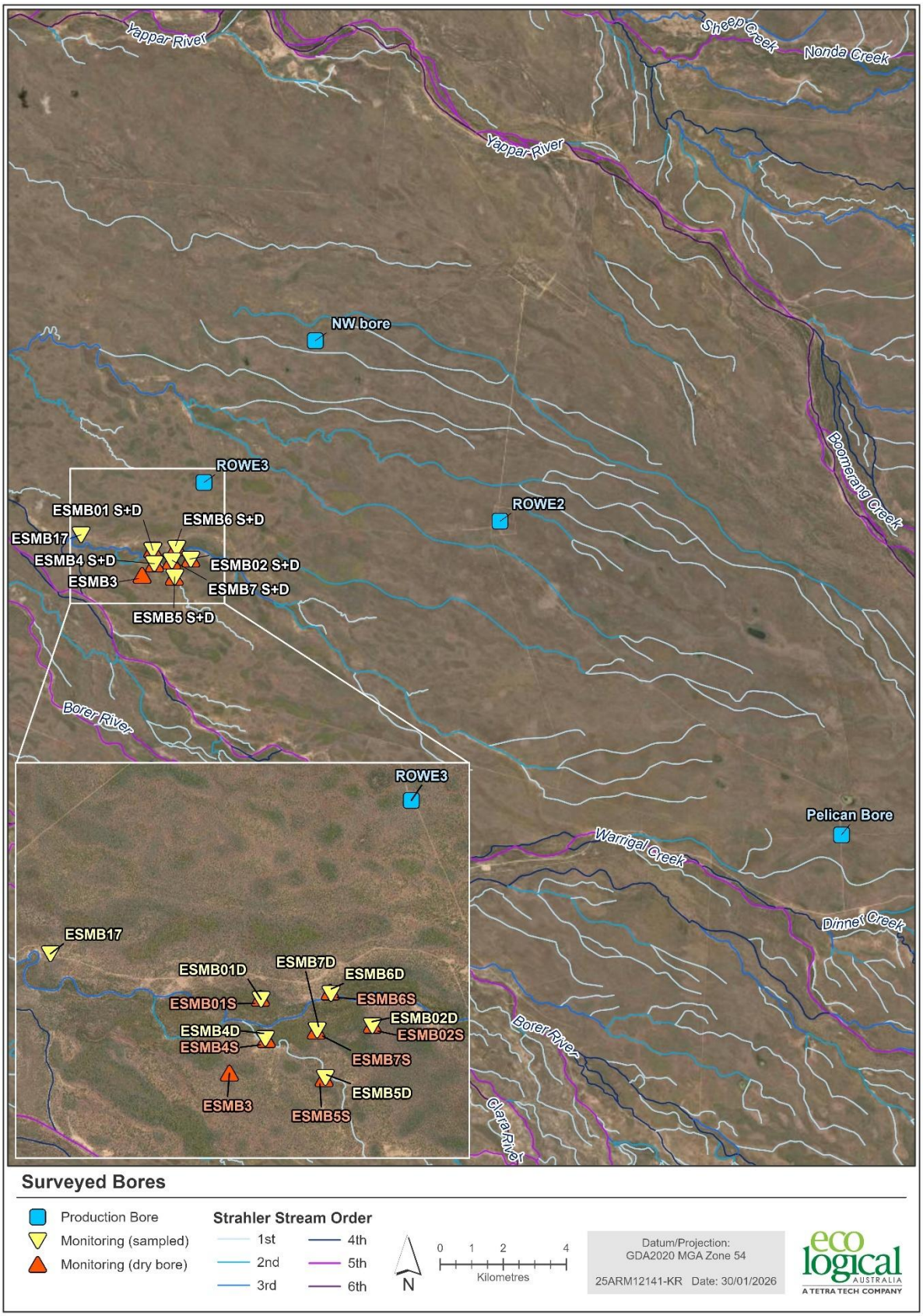


Figure 1: Groundwater bores sampled for stygofauna

Table 1: Details of bores monitored for stygofauna at Esmeralda

Bore ID	Bore type	Zone	Easting	Northing	Total Depth	Depth of screened area (mbgl)	Date of bore completion	Age at sampling date	Was the bore sampled?	Sampling effort	Date visited
ESMB01D	Monitoring	54K	627804	7918987	55.71	49-55	25/07/2024	> 1 year	Yes	6 net, 100 L	10/12/2025
ESMB01S	Monitoring	54K	627798	7918997	12	8.5-11.5	24/07/2024	> 1 year	No (dry)	-	10/12/2025
ESMB02D	Monitoring	54K	629007	7918702	55.75	49-55	28/07/2024	> 1 year	Yes	6 net	10/12/2025
ESMB02S	Monitoring	54K	629007	7918705	11.26	7-10	28/07/2024	> 1 year	No (dry)	-	10/12/2025
ESMB3	Monitoring	54K	627462	7918188	10	7-10	14/09/2025	3 months	No (dry)	-	10/12/2025
ESMB4D	Monitoring	54K	627850	7918563	51.1	46-49	09/09/2025	3 months	Yes	6 net	10/12/2025
ESMB4S	Monitoring	54K	627861	7918550	10	7-10	11/09/2025	3 months	No (dry)	-	10/12/2025
ESMB5D	Monitoring	54K	628499	7918142	53	49-52	14/09/2025	3 months	Yes	6 net, 60 L	10/12/2025
ESMB5S	Monitoring	54K	628485	7918127	10	7-10	14/09/2025	3 months	No (dry)	-	10/12/2025
ESMB6D	Monitoring	54K	628560	7919050	51	47-50	16/09/2025	3 months	Yes	6 net, 100 L	10/12/2025
ESMB6S	Monitoring	54K	628552	7919064	10	7-10	16/09/2025	3 months	No (dry)	-	10/12/2025
ESMB7D	Monitoring	54K	628410	7918655	82.8	77.8-83.8	13/09/2026	3 months	Yes	6 net, 100 L	11/12/2025
ESMB7S	Monitoring	54K	628401	7918643	54	47-50	13/09/2025	3 months	No (dry)	-	11/12/2025
ESMB17	Monitoring	54K	625528	7919479	50	47-50	17/09/2025	3 months	Yes	6 net, 70 L	11/12/2025
ROWE2	Production	54K	638815	7919907	NA	NA	Unknown	> 1 year	Yes	100L	11/12/2025
ROWE3	Production	54K	629428	7921136	NA	NA	Unknown	> 1 year	Yes	100L	11/12/2025
Pelican Bore	Production	54K	649649	7909959	NA	NA	Unknown	> 1 year	Yes	100L	11/12/2025
NW bore	Production	54K	632959	7925633	NA	NA	Unknown	> 1 year	Yes	100L	11/12/2025

4.2. Stygofauna sampling methods

Stygofauna samples were collected from monitoring bores and production bores across the project area.

Monitoring bores were constructed with 50 mm-diameter PVC casing, which were unobstructed by permanent infrastructure (pipes, pumps, fixed loggers). These bores were sampled using a specifically designed net, lowered to the bottom and slowly retrieved. Net contents were emptied at the top of each haul until a total of six hauls were completed. At each bore, water was collected using a bailer prior to net sampling, and physico-chemical parameters (temperature, dissolved oxygen, electrical conductivity, pH) were measured using a YSI-556 meter. The meter was calibrated in the laboratory prior to the field survey, and dissolved oxygen probe was calibrated at the start of each survey day.

For most monitoring bores, additional samples were collected using a Stainless Steel Mega Monsoon XL submersible pump. The pump was used to extract 100 L into 20 L buckets, with water quality measurements taken from the last bucket. All water was then poured through a 63 µm-mesh sieve and the sieve contents transferred to a sample jar.

Production bores contained fixed pumps and were closed at the top, so it was not possible to lower nets to the bottom for sampling. Instead, a tap on the side of the bore was used to remove 100 L of water into 20 L buckets, and this was passed through the 63 µm-mesh sieve to collect a sample.

All stygofauna samples were returned to the ELA laboratory for sorting and identification using a Leica M80 dissecting microscope. Any previously unidentified taxa were assigned a morphospecies name and kept as a reference specimen for future comparison. Specimens were stored in 100 % ethanol to allow the option of future molecular analysis, in case genus-level taxonomy is required.

5. Results

5.1. Water quality

Groundwater temperature was between 31.6 and 34.0 °C (Table 2). pH was between 8 and 9 for all bores except ROWE1, which measured 7.88 (Table 2). Electrical conductivity was low and less than 1.3 mS/cm in most bores. Three of the production bores, ROWE2, ROWE1 and Pelican bores, had EC greater than 2. Dissolved oxygen was lowest in the monitoring bores, being between 7.4 and 27.2 % Saturation for 6 of the monitoring bores, and 41.2 % Saturation for EMSB01. Dissolved Oxygen Concentration was greater than 30 % Saturation for all production bores except NW Bore, which was 19.8 % Saturation (Table 2).

Table 2: Groundwater physico-chemistry for bores sampled at Esmeralda

	ESMB01D	ESMB02D*	ESMB04D*	ESMB05D	ESMB06D	ESMB17	ESMB7D	ROWE3	NW BORE	ROWE2	ROWE1	PELICAN BORE
Temperature (°C)	32.9	32.2	31.6	32.7	32.9	34.0	32.7	32.4	32.4	32.2	32.2	32.4
pH	8.56	8.54	8.64	8.95	8.59	8.69	8.8	8.85	8.68	8.04	7.88	8.17
Electrical Conductivity (mS/cm)	0.786	1.01	0.967	0.941	1.14	1.34	1.03	1.26	1.05	2.63	2.74	2.34
Dissolved Oxygen (mg/L)	3.01	2.03	1.9	1.12	0.51	1.03	1.5	2.37	1.46	2.6	2.95	3.89
Dissolved Oxygen (% Saturation)	41.2	27.2	26	15.5	7.4	14.7	20.1	32.1	19.8	37.6	41.3	52.5
* Water collected with bailer. All others are from 100 L pump sample.												

5.2. Stygofauna

Sampling for stygofauna using either the net or pump or both, occurred at 11 bores (7 monitoring bores and 4 landholder production bores) across the project area. None of the samples contained stygofauna.

6. Discussion

No stygofauna are known from the project area, with the nearest known specimens being collected from Chillagoe, 290 km to the north-east (*Chillagoe thea*) and Lawn Hill, 430 km to the west (*Queenslandnella spinosa*) (Atlas of Living Australia accessed 2 February 2026). Both of these were in or near limestone strata. Raiber et al. (2024) show stygofauna locations in karst and cave systems along O'Shanassy River, south of Lawn Hill.

The shallow tertiary sediments overlying the Gilbert River Formation were dry at the time of sampling, so the six shallow bores for sampling this aquifer could not be sampled. This aquifer appears to go dry for long periods of time (AARC 2025), so it is unlikely to be habitat for stygofauna. If there are permanently saturated sections of aquifer, these may act as refuge areas for stygofauna during dry periods, and sources of colonisation for the aquifer once it becomes saturated.

No stygofauna were collected during the surveys from 11 bores in the Gilbert River Formation. Five of the monitoring bores were approximately 3 months old, which is younger than the 6 months recommended by DSITI (2015) to allow stygofauna colonisation after construction. Nevertheless, younger monitoring bores and production bores were sampled to increase the spread of sampling points, to collect more physico-chemical data, and on the chance that stygofauna may be collected if present.

Most water quality variables were suitable for stygofauna, although temperature and pH were potentially high. From a meta-analysis of stygofauna survey results collected from across northern Australia, Edgar (2024) showed that stygofauna in north Queensland aquifers occurred when groundwater temperatures were between 24.58 and 28.99 °C, and in other areas of northern Australia, up to a maximum of 35.57 °C. As ectotherms, stygofauna are sensitive to changes in temperature but are generally ok if temperatures stay within the range of annual fluctuations (Becher et al 2022). Edgar (2024) also found that stygofauna in Queensland were present at mean pH of between 7 and 7.57, although the range was between 5.12 and 8.98. Edgar (2024) proposes that temperatures and pH above the maximum ranges may be outside of the physiological limits for stygofauna occurrence. Both the pH and temperature measured at Esmeralda were near or above the upper limits of known tolerance, so although there is a chance that there may be stygofauna in the Gilbert River Formation, but it is unlikely based on these variables.

The sandstone of the Gilbert River Formation would only be suitable for stygofauna if it was sufficiently fractured to allow stygofauna movement through the network of cracks and fissures. The extent of fracturing in the Gilbert River Formation at the project location is not known, although it is likely to be greatest near the top of the formation or at fault zones. Without fracturing, the sandstone would lack habitable pore space for stygofauna, and there would be insufficient connectivity with the surface to sustain groundwater food webs.

7. Conclusion

Eleven bores were sampled for stygofauna at Esmeralda, and another seven bores were visited but were dry. The area sampled gave a broad coverage of the project area and included locations in the impact area, and outside of the impact area. Two of the monitoring bores, and four production bores were older than the 6 months recommended for sampling by DSITI (2015). The remainder were 3 months old, and although this is not optimal, they were sampled because there is still a chance that stygofauna would be collected if present.

Despite the low number of bores compliant with the stygofauna sampling requirements of DSITI (2015), there is very little evidence to suggest that stygofauna would inhabit the Gilbert River Formation, or the alluvium beneath the Esmeralda site. What makes stygofauna unlikely are:

- The thinness of the alluvium and the extent to which it goes dry
- The high temperatures and pH of groundwater in the Gilbert River Formation
- The potentially low network of fracturing in the Gilbert River sandstone.

8. References

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