

## **Appendix E - Stygofauna Literature Review**

## Northern Territory Specific Reports

### **GHD. 2011. Nolans Mine EIS: stygofauna pilot survey. Report prepared for Arafura Resources Ltd, Winnellie, Northern Territory.**

This assessment was undertaken to support the EIS for the rare earth minerals and phosphate mine at Nolans Bore, 135km north of Alice Springs. The investigation was confined to the ore body within the fractured rock aquifer. No stygofauna, or other aquatic invertebrates, were recorded at any of the seven sites within the study area. The study acknowledged that calcrete aquifers to the south-west of the project area were highly likely to contain stygofauna. The study concluded that if locally endemic species were present, severe impacts and potential extinction could occur if localised water drawdown completely emptied calcrete aquifers.

### **Environmental Research Institute of the Supervising Scientist (ERISS). 2005. Australia's tropical rivers – an integrated data assessment and analysis. Report prepared for National Centre for Tropical Wetland Research, Northern Territory.**

This document outlines the milestone report and project objectives for the Tropical Rivers Project. It notes that Stygofauna have not been studied in detail, but that two species of endemic shrimp have been identified in Cutta Cutta Caves.

### **Duguid, A. 2011. Wetlands of the Great Artesian Basin Water Control District (Northern Territory). Northern Territory Government Department of Natural Resources, Environment, the Arts and Sport, Alice Springs, Northern Territory.**

Previous records indicate the presence of aquatic stygofauna in some calcrete aquifers and unconsolidated aquifers in southern Northern Territory. Stygofauna have not been recorded in the Great Artesian Basin Water Control District, however they may occur.

### **Chandler, L., Tomlinson, M., and Humphrey, C. 2017. Water quality and biota in the subsurface sands of Magela Creek – report of a pilot project. Report prepared by Supervising Scientist, Darwin, Northern Territory.**

In total, 13 taxa of stygofauna were recorded in the subsurface saturated sands of Magela Creek, with some potentially being the first record in the Northern Territory. Magela Creek is a seasonal tributary to East Alligator River and flows through the Ranger mine Project area. Potential sources of contamination are considered to be a future threat to the stygofauna community.

### **Erskine, W. D., Begg, G. W., Jolly, P., Georges, A., O'Grady, A., Eamus, D., Rea, N., Dostine, P., Townsend, S., and Padovan, A. 2003. Recommended environmental water requirements for the Daly River, Northern Territory, based on ecological, hydrological and biological principles. Supervising Scientist, Darwin, Northern Territory.**

The existence and distribution of stygofauna was highlighted as a key knowledge gap of the area.

### **Van Dam, R., Bartolo, R., and Bayliss, P. 2008. Identification of ecological assets, pressures and threats. In *Ecological risk assessments for Australia's Northern Tropical Rivers*. Edited by R. Bartolo, P. Bayliss and R. van Dam. Report prepared for Land and Water Australia, Northern Territory.**

The report states that stygofauna are present within the extensive groundwater aquifers in the Daly River area, however they are not well characterised. Areas of endemism amongst stygofauna in karst aquifers of the Devonian Reef system, between Geikie Gorge and Fitzroy Crossing are also reported. Any activity affecting groundwater distribution, flow or quality has the potential to impact unique karst habitats and associated stygofauna.

### **Tickell, S. 2008. Explanatory notes to the Groundwater Map of the Northern Territory. Northern Territory Government Department of Natural Resources, Environment and the Arts and Sport, Darwin, Northern Territory.**

The report refers to unpublished work by W. Humphreys that confirmed the presence of stygofauna in the Katherine area, and at Pungalina Station. Stygofauna was also cited as being confirmed in aquifers in Western Australia which continue into the western side of the Territory.

**Zaar, U. 2009. Gulf water study: water resources of the Robinson and Calvert Rivers region. Report prepared for the Northern Territory Government, Darwin, Northern Territory.**

Stygofauna sampling was undertaken at Bubbling Sands Springs recording one species, *Asellota protojaniridae*, which was recently recorded for the first time in Gregory National Park. This sample provided evidence of stygofauna communities in groundwater at Pungalina.

### **Australian Reports**

**Eco Logical Australia. 2014. Elimatta stygofauna habitat assessment. Report prepared for AustralAsian Resource Consultants, Brisbane, Queensland.**

The assessment was undertaken as part of the EIS for an open cut thermal coal mine located approximately 45 km south west of Taroom in southern Queensland. Four species of stygofauna were identified as occurring within the project area, two of which (*Bathynellidae* sp. and *Dussartcyclops* sp.) are considered to have significant conservation status due to their restricted distribution. The study concluded that all known stygofauna species found within the project area were also likely to be found in areas not impacted by mining.

**Ecologia Environment. 2010. Oakajee terrestrial port development stygofauna assessment. Report prepared for Oakajee Port and Rail, Geraldton, Western Australia.**

Three species of stygofauna were recorded within the project area. However, given the extent of habitat outside the study area these species are considered to extend beyond the project area. Higher levels of nitrite and phosphorus, caused by agricultural land use, did not seem to affect stygofauna habitation.

**Humphreys, W. F., and Eberhard, S. 2001. Subterranean fauna of Christmas Island, Indian Ocean. *Helictite* 37(2): 59-74.**

At least 12 species of cave fauna which are endemic to Christmas Island were recorded in the subterranean habitat. These species were found to be sensitive to a number of threatening processes including, pollution, deforestation, mining, feral species and human visitors.

**Biota Environmental Sciences. 2010. Yandicoogina subterranean fauna assessment: phases 1-5. Report prepared for Rio Tinto Iron Ore, Western Australia.**

A total of 46 stygobitic fauna taxa were collected from the alluvium aquifer during the surveys, many of which had been previously described in locations outside the project area. A direct impact on the subterranean fauna included the reduced availability of stygofauna habitat through the direct removal of the aquifer. Other indirect factors identified included, erosion and sedimentation run-off, groundwater pollution and salinization of groundwater systems.

**Commonwealth of Australia. 2009. Assessment of Australia's terrestrial biodiversity 2008: Case Study: Stygofaunal communities of north-west Western Australia, Report prepared by the Biodiversity Assessment Working Group of the National Land and Water Resources Audit for the Australian Government, Canberra.**

Within the stygofaunal communities of north-west Western Australia, several crustacean species are listed as threatened species under the Western Australia *Wildlife Conservation Act 1950* and Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*. Short range endemism of some species means that they are sensitive to processes that affect the physical environment, i.e., water extraction and dewatering of aquifers for mining, contamination of aquifers and disruption of anchialine groundwater systems. Case study identified water abstraction and dewatering as the major threats to stygofauna, along with contamination of aquifers and reinjection from dewatering activities.

**Eco Logical Australia. 2015. Bylong Coal Project environmental impact statement - stygofauna impact assessment. Report prepared for Hansen Bailey, Singleton, New South Wales.**

This assessment was conducted to support an EIA for the Bylong Coal Mine in western coalfield of NSW. In total, 10 stygofauna taxa were recorded in the shallow alluvium aquifer within the project area, all of which had previously been collected at locations outside the region.

**Eberhard, S. M., Halse, S. A., and Humphreys, W. F. 2005. Stygofauna in the Pilbara region, north-west Western Australia: a review. *Journal of the Royal Society of Western Australia* 88: 167-176.**

To date, 78 species of stygofauna have been recorded within the Pilbara region, indicating significant regional endemism in Pilbara stygofauna communities. Karstic aquifers, karst springs and porous alluvial aquifers were reported to contain high species richness. The knowledge of Pilbara taxa is very incomplete.

**Subterranean Ecology. 2009. Stygofauna survey Tropicana Gold Project Minigwal water supply area. Report prepared for Tropicana Joint Venture, Western Australia.**

No stygofauna were recorded from 10 sampled bore sites. The lower confined sandstone aquifer of the Minigwal Trough was considered to not be highly prospective for stygofauna, based on low void spaces and very limited infiltration of oxygen and organic matter.

**Australian Laboratory Services. 2012. Pilot survey of stygofauna: Red Hill Project. Report prepared for URS Australia Pty Ltd, Brisbane, Queensland.**

No stygofauna were recorded in five groundwater samples collected from the study area. The absence of stygofauna was attributed to potentially unsuitable geological conditions, poor water quality or inappropriate sampling strategy.

**Department of the Environment and Energy. 2017. Literature review: environmental risks posed by chemicals used in coal seam gas operations. Report prepared by the Chemicals and Biotechnology Assessments Section (CBAS), Canberra, ACT.**

This review concludes that stygofauna from the Pilbara and adjacent areas are found wherever groundwater environments provide suitable habitat. The Pilbara region contains the richest known groundwater fauna in Australia, however, increasing literature also indicates the presence of stygofauna in eastern Australia.

**Thurgate, M. E., Gough, J. S., Clarke A. K., Serov, P., Spate, A. 2001. Stygofauna diversity and distribution in Eastern Australian cave and karst areas, *Records of the Western Australian Museum Supplement No. 64*: 49-62.**

The paper recognised the growing discipline of groundwater ecology research and identified the absence of information about ecosystems in Eastern Australia. The paper reviewed and summarised the available information about locations, species and status of groundwater ecology reported in New South Wales, Tasmania and South Australia.

### International Reports

**Scarsbrook, M. R., and Fenwick, G. D. 2003. Preliminary assessment of crustacean distribution patterns in New Zealand groundwater aquifers. *New Zealand Journal of Marine and Freshwater Research* 37(2): 405-413.**

The study investigated stygofauna communities in alluvial aquifers. Copepoda and *Paraleptamphopus* spp. accounted for between 90% and 99% of total fauna found at all sites. The study suggested that physio-chemical characteristics and the location of the sites from a sewage effluent disposal area influenced the abundance of species, likely related to the availability of organic matter in groundwater.

**Shapouri, M., Cancela de Fonseca, L., Lepure, S., Stigter, T., Ribeiro, L., and Silva, A. 2016. The variation of stygofauna along a gradient of salinization in a coastal aquifer. *Hydrology Research* 47(1): 89-103.**

This report studied stygofauna composition in a coastal aquifer in southern Portugal, which was vulnerable to salinization due to seawater intrusion, caused by overexploitation. Groundwater salinity was highly correlated to taxa distribution, with some species (*Eucyclops hadjebensis* and *Acanthocyclops sensitives*) found in low salinity conditions, and other species (*E. graeteri*, *Megacyclops brachypus* and *Daphnia pulex*) found in high salinity conditions.