Review of subterranean fauna issues at Learmonth Bundle Project

Undertaken for Subsea 7 by Stuart Halse, Bennelongia Pty Ltd (18 October 2017)

Project background

Subsea 7's proposed Learmonth Bundle Project (hereafter called the Project) is located on the eastern side of Cape Range, south of Exmouth and just south of the RAAF base and airfield at Learmonth. The project will fabricate long lengths of bundled pipework for the oil and gas industry. The fabrication facility will consist of a bundle track of approximately 10 km length and associated infrastructure. The pipe will be launched via a launch way from the bundle track into Exmouth Gulf and towed offshore.

The Project is estimated to require up to 12.7 ML per annum of water to pressure test pipes (hydrotest water) and to supply the office and on-site operations with potable water. It is proposed to obtain this water from one or more wells west of the Minilya-Exmouth Road. Two existing wells in this area are Wogatti Well and Little Bore, which have groundwater salinities of approximately 510 mg/L TDS at and 1020 mg/L, respectively.

Groundwater will be made potable though reverse osmosis (GHD 2017), which means that about 16 ML/annum of groundwater will be required to produce the 12.7 ML needed to operate the Project. About 6.2 ML per annum of 'brine' of approximately 1290 mg/L will be produced by the reverse osmosis plant and will require disposal (see GHD 2017 for details). In addition, the various uses on-site will produce 5.6 ML per annum of waste water that will be fed into a waste water treatment plant and will also need disposal. The options being considered for disposal of brine and waste water include re-injection, a spray field, infiltration/irrigation or lined evaporation pond.

Subterranean fauna in the Project area

The likelihood of subterranean fauna occurring in the Project area has previously been reviewed by Invertebrate Solutions (2017) and it was concluded there is a high to very high likelihood of occurrence of stygofauna and that troglofauna may occur, depending on the type of habitat present.

The likelihood of subterranean fauna occurrence is reviewed again in this report. There has been no survey of subterranean fauna within, or in the immediate vicinity of, the Project area. However, existing information suggests subterranean fauna species are likely to occur. The nationally important wetland 'Cape Range Subterranean Waterways' occurs partially within the Project area. This wetland was listed because of its known or potential values for subterranean fauna. More generally, the occurrence of globally important subterranean fauna values in parts of the Exmouth peninsula were among the reasons for nominating Cape Range as part of the Ningaloo World Heritage site (DEWHA 2010), although subterranean species do not occur necessarily across the whole peninsula.

In the absence of survey, only inferences can be made about the richness of any troglofauna or stygofauna community present in the Project area and the species composition of the community. Importantly, however, it appears that six listed subterranean species may possibly occur in the Project

Postal Address: PO Box 384, Wembley WA 6913 Ph: (08) 9285 8722 Fax: (08) 9285 8811
Street Address: 5 Bishop Street, Jolimont WA 6014 ABN: 55 124 110 167 www.bennelongia.com.au

Area, if suitable habitat is present locally (Table 1). This includes two stygofaunal fish, the blind gudgeon and blind cave eel, both of which have wide ranges on the peninsula and may extend south to the Project area. Both species are listed as vulnerable under the Wildlife Conservation (WC) Act 1950 and the Environment Protection and Biodiversity Conservation (EPBC) Act 1999. The stygofaunal shrimp *Stygiocaris stylifera*, which is a priority 4 species under an informal listing process of the Department of Biodiversity, Conservation and Attractions (DBCA) and subject to slightly less conservation focus, is perhaps more likely to extend south to the Project area. The shrimp will occur in areas with much smaller voids (i.e. less karstic) than the two fish species.

The three listed troglofauna species that may occur in the Project area will only do so if there is karstic habitat above the watertable. On the basis of existing information, this is considered to be unlikely but the level of habitat characterisation to date is insufficient to exclude the possibility of karst being present. The occurrence of other troglofauna species is probably unlikely unless karstic habitat is present.

Irrespective of whether karstic habitat is present (and it should be noted that the occurrence of karstic habitat below the watertable is more likely than above), non-listed stygofauna species are likely to occur in the Project area. As pointed out by Invertebrate Solutions (2017), monitoring of troglofauna north of the Learmonth RAAF base has collected many species not known from other parts of the peninsula. In a similar way, it is expected that if the Project area is surveyed for stygofauna, some of the species collected may be known only from the Project area. If subterranean fauna surveys are commissioned in Project-associated areas, there will also be sampling in surrounding areas to provide some range information for such species.

Table 1. Listed species (either threatened or priority status) that may occur in the Project area.
Priority species are informally listed. CR, critically endangered; VU, vulnerable; P2, priority 2 (poorly known but some records on conservation lands); P4, priority 4 (near threatened or should be monitored).

Species	Group	WC Act	EPBC Act	Comments
Stygofauna				
Milyeringa veritas	Fish (gudgeon)	VU	VU	Known north of Project and on west coast
Ophisternon candidum	eel	VU	VU	Known north of Project and on west coast
Stygiocaris stylifera	shrimp	P4	-	Known north of Project
Troglofauna				
Draculoides vinei	schizomid	P4	-	Known inland of Project area
Indohya damocles	pseudscorpion	CR	-	Known Cameron's Cave
Nocticola flabella	cockroach	P2	-	Known north of Project

While listed stygofauna, and perhaps troglofauna, species may occur in the Project area, it is considered unlikely that either of the two Threatened Ecological Communities (TECs) – the stygofaunal Cape Range Remipede Community (Bundera Sinkhole) and the troglofaunal Camerons Cave Troglobitic Community – are well represented there. TECs are listed by the Minister for the Environment and require particular conservation attention. The stygofauna TEC occurs on the western side of Cape Range in an anchialine situation, which is unlikely to be replicated on the wider coastal plain east of the range. The so-called troglofauna TEC occurs in a small cave within the Exmouth township, more than 30km from the project area and consists of stygofauna, as well as troglofauna, species. While it is considered unlikely that troglofaunal members of the community extend south to the Project area, mostly because troglofauna are characterized by very small ranges (Halse and Pearson 2014), stygofauna species such as the blind gudgeon are more likely to have a southern occurrence.

Framework for assessment

In line with World Heritage listing and the occurrence of a nationally important subterranean wetland, Position Statement 1 of the EPA '*Environmental Protection of the Cape Range Province*' identifies

stygofauna and troglofauna as a major value of the Cape Range area and laid out policies to underpin environmental assessment and decision-making in the area (EPA 1999).

More recently, the EPA outlined general considerations when assessing whether subterranean fauna constitute a key factor in any assessment (EPA 2016). These include:

- The subterranean fauna to be affected by the proposal;
- The potential impacts on these fauna and the causes of these impacts;
- The significance of subterranean conservation values and the risks to these values; and
- Whether any proposed management and mitigation measures to reduce impacts are feasible.

Assessment of impacts on subterranean fauna conservation values

The likely risks to any subterranean fauna conservation values in the Project area are assessed below for different aspects of the Project, using existing information about the Project layout and the likelihood of subterranean fauna occurrence.

Disturbance footprint

The development envelope of the Project is 431 ha. Most surface activities to be undertaken within the development envelope, such as vegetation clearing, building and paving, have only indirect impacts on subterranean fauna and, at most, reduce fauna populations by reducing the organic matter input into the subterranean environment (this is the main energy source for subterranean fauna), loss of plant roots (food and habitat for troglofauna), some use of pesticide and herbicide (control of white ants, other invertebrate pests and weeds) and other activities (Humphreys 2002; Hancock et al. 2005).

Approximately 0.3 ha will be excavated to a depth of 1 m for storage of hydrotest water. This area is so small that it would be unlikely to have a significant impact of any troglofauna species, which are also unlikely to have any substantial occurrence in the top metre of ground habitat. The known minimum range of a troglofauna species in north-western Australia is 89 ha (Biota 2006). Thus, Project development is unlikely to have a major impact on any troglofauna species occurring in the Project area.

Approximately 1 km of the bundle track will intersect part of the nationally important Cape Range Subterranean Waterways, as does approximately 2 km of the more northern access road to the launching facility. With appropriate management to ensure no discharge of petroleum products or other contaminants into the shallow groundwater below the track and road, which are surface developments, there should be little risk to the subterranean fauna values of the wetland. Ground excavation in association with the bundle track is expected to be limited to the foredunes and beach. This habitat of fine, shifting sand with a high salt content is unlikely to be used by troglofauna.

Groundwater abstraction

Abstraction of 21 ML per annum of groundwater is needed to provide potable and hydrotest water. The Department of Water and Environmental Regulation has indicated that the maximum acceptable pumping rate is likely to be 0.3 L/sec. Although it is likely the water can be obtained from three wells, no information about the location of the borefield or the likely extent of groundwater drawdown is available.

There has been no documentation of the vertical salinity profile in groundwater of the borefield area but, based on the situation at the Water Corporation borefield near Exmouth which lies in a similar setting, there is likely to be saline water at depth. Over-pumping would be likely to lower the watertable and lift the underlying saline water, with reduction in the amount of habitat for any stygofauna species present. For this reason, the planned modelling of the operation of the borefield will need to be completed before much comment can be made about the likely impacts on stygofauna conservation values. If the borefield, contains karstic areas and listed stygofauna species are present, the risk of groundwater abstraction to subterranean fauna conservation values may be moderately high despite small abstraction volumes. Therefore, it is recognized that there is a need for better characterisation of the borefield habitat than is currently available and, depending on the results of the characterisation

and borefield modelling, a survey of stygofauna in the vicinity may be required to improve understanding of the potential impacts of abstraction.

Wastewater discharge

Options for disposal of the 12 ML per annum of 'brine' and waste water from the Project are still being evaluated. Waste water will receive secondary treatment in a containerised plant using a submerged air filter. If waste water is released on-site, it is expected to have a biological oxygen demand (BOD) of <20 mg/L, while Total N and Total P concentrations will be <30 mg/L and <8 mg/L, respectively. Chlorine concentrations in the waste-water will be 0.2-2 mg/L. While pre-disturbance data from the Project area are not yet available, background levels of Total N in Exmouth groundwater are ≤0.2 mg/L (Humphreys and Adams 1991) and background levels of BOD in freshwater Queensland wetlands are 0.5-1.3 mg/L (DEHP 2013).

Little information is directly available on the effects of high BOD on subterranean fauna but nitrogen concentrations of 1-12 mg/L caused toxicity in 120 h tests of some sensitive fish, tadpole and invertebrate species (Camargo and Alonso 2006). Sub-lethal effects on sensitive aquatic invertebrates and stygofauna would be expected to occur at concentrations that are lower again. Many crustaceans are sensitive to chlorine, with acute toxicity at concentrations of 0.005 mg/L (e.g. Roberts et al. 1975).

In addition, water in most of the development envelope and the Cape Range Subterranean Waterway is likely to be substantially more saline than the treated wastewater and the 'brine' from the reverse osmosis plant. These are expected to be <30 mg/L and 1290 mg/L, respectively. Reducing groundwater salinity (especially as a result of waste water disposal) is also likely to alter the composition of the stygofauna community.

The options being considered for on-site waste water disposal are re-injection, a spray field, infiltration/irrigation or an evaporation pond. Use of re-injection, a sprayfield or infiltration may result in the occurrence of a narrow plume of fresh water with potentially impacting concentrations of BOD, Total N and chlorine running across the development envelope towards the Gulf, although any plume would be likely to quickly mix with surrounding groundwater. If any significant impacts on stygofauna are likely, disposal will occur via sealed evaporation ponds and off-site transport. Thus, management processes will ensure that any effect on stygofauna conservation values will be low.

Conclusion

This review concludes that:

- It is unlikely that either of the TECs on the Exmouth peninsula are well represented in the Project area.
- Stygofauna species, however, are likely to occur within both the development envelope of the Project and the area from which groundwater will be abstracted.
- The species of stygofauna that may potentially occur include two species listed as vulnerable under the EPBC and WC Acts, as well as one species listed as a priority species by DBCA.
- Stygofauna will be surveyed in the Project area and borefield to document the character of the stygofauna community and whether listed species occur.
- While both the quantity of groundwater to be abstracted and the volumes of wastewater and brine to be disposed of are not large, if abstraction or disposal will impact on stygofauna species (including listed species), alternative disposal or water supply options will be found.
- It is considered that troglofauna are unlikely to occur in the Project area unless karstic habitat is present. A geological survey will be undertaken to determine whether any karstic habitat is present, followed by troglofauna survey if karstic habitat is identified.

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