Tronox Pty Ltd

Cooljarloo West Proposal: Pilot-Scale Stygofauna Survey

Final Report

Prepared for
Tronox Pty Ltd
by Bennelongia Pty Ltd

June 2013
2013/198

Cooljarloo West Proposal: Pilot-Scale Stygofauna Survey

Bennelongia Pty Ltd
5 Bishop Street
Jolimont WA 6913
www.bennelongia.com.au
ACN 124 110 167

June 2013

Report 2013/198

Cover photo: *Hexabathynella* sp. B04 from the Swan Coastal Plain

Client – Tronox Pty Ltd

Report	Version	Prepared by	Checked by	Submitted to Client	
				Method	Date
Draft report	Vers. 1	Andrew Trotter Rowan Lymbery	Dean Main Stuart Halse	email	8.iv.13
	review		Daniel Panickar Jeremy Mitchell		
Final report	Vers. 1	Michael Curran	Stuart Halse	email	4.vi.13

K:\Projects\B_TRON_01\Reports\Subfauna\Survey Final\BEC_Cooljarloo_stygofauna_survey_final_4vi13.docx

EXECUTIVE SUMMARY

Tronox Management Pty Ltd (Tronox) (previously Tiwest Pty Ltd) has operated the Cooljarloo mineral sands mine 175 km north of Perth since 1989. The mine was authorised by the WA Minister for the Environment in 1988 (under Ministerial Statement 37). The mine has subsequently been modified by the following expansions:

- Dredge and/or dry mining of ore bodies 27 200 and 28 000 in the southern portions of the tenement (Ministerial Statement 557); and
- Dry mining of Falcon deposit in the northern end of the tenement (Ministerial Statement 790).

The remaining dredge mine life at Cooljarloo is approximately 15 years and Tronox now proposes to develop additional resources to the west of the current operations to extend the Cooljarloo mine life. The additional resources are known as Cooljarloo West (the Proposal). Subterranean fauna were not assessed under any of the previous environmental impact assessments.

Prior to the field sampling presented in this report, Bennelongia undertook a desktop assessment of subterranean fauna at the Proposal. It was concluded that there would almost certainly be no threat to troglofauna species from the Proposal developments, but that there may be a potential threat to restricted species of stygofauna if such species occur within the Proposal.

There is uncertainty regarding the occurrence and distribution of stygofauna within the Proposal. A review of stygofauna records within a 50 by 50 km search area around the Proposal found relatively few species; however prior survey effort in the area was low. Furthermore, regional aquifers that are prospective habitats for stygofauna occur in the vicinity of the Proposal. It was considered that local barriers to dispersal within these aquifer systems may affect distributions of stygofauna, if they are present, and lead to species having restricted ranges. It was therefore recommended that a pilot-scale stygofauna field survey be undertaken to provide more certain assessment of the extent of threat to stygofauna from the Proposal developments.

This report presents the finding of the pilot-scale stygofauna survey. The specific objectives of the survey were:

- To determine whether stygofauna species do occur in the Proposal.
- To examine the likely ranges of any species that do occur.
- To determine whether a full-scale stygofauna survey is required.

Twenty-five aquatic invertebrate specimens belonging to four higher level groups were collected from 30 stygofauna samples taken in the vicinity of the Proposal. All but one species were of marine origin and were represented by dead (probably fossilised) animals. The only possible stygofaunal animal was a single nematode specimen. However, the poor taxonomic knowledge of nematodes means stygofaunal species cannot be distinguished from soil and surface forms, and they are not included in environmental impact assessments.

Based on the results of the pilot-scale field survey, it is unlikely that a stygofauna community is present in the vicinity of the Proposal. Development of the Proposal is therefore not considered to pose a threat to stygofauna species. Full-scale field survey is not required to further the assessment of stygofauna conservation values.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Tronox Management Pty Ltd (Tronox) (previously Tiwest Pty Ltd) has operated the Cooljarloo mineral sands mine 175 km north of Perth since 1989 (Figure 1.1). The mine was authorised by the Western Australian Minister for the Environment in 1988 (under Ministerial Statement 37). The mine has subsequently been modified by the following expansions:

- Dredge and/or dry mining of ore bodies 27 200 and 28 000 in the southern portions of the tenement (Ministerial Statement 557); and
- Dry mining of Falcon deposit in the northern end of the tenement (Ministerial Statement 790).

The remaining dredge mine life at Cooljarloo is approximately 15 years and Tronox now proposes to develop additional resources to the west of the current operations to extend the Cooljarloo mine life. The additional resources are known as Cooljarloo West (the Proposal) (Figure 1.1). Subterranean fauna were not assessed under any of the previous environmental impact assessments.

The defining characteristic of subterranean fauna is that they spend all, or most, of their lifecycle underground and are morphologically adapted to the subterranean environment. Adaptations include pallid colouration, reduction or loss of eyes, elongated bodies, long, slender appendages and well developed sensory setae. There are two types of subterranean fauna: stygofauna and troglofauna. Stygofauna occur in groundwater, whereas troglofauna are air-breathing and occur at depth in the various unsaturated soil and rock profiles above the watertable (Gibert and Deharveng 2002).

Subterranean fauna have significant scientific value and a higher proportion of subterranean species have the potential to be short-range endemics (SREs), defined by Harvey (2002) as species with ranges of <10,000 km^2, than is the case for any of the surface invertebrate groups considered to contain SRE species, such as mygalomorph spiders (Eberhard et al. 2009; Lamoreux 2004). The restricted ranges of most subterranean fauna species means they are particularly vulnerable to extinction from anthropogenic activities and, hence, are a focus for conservation (see Fontaine *et al*. 2007). In general terms, stygofauna may be threatened by groundwater drawdown and troglofauna by excavation of soil and rock.

Bennelongia (2013) undertook a desktop assessment of the subterranean fauna habitat, requirement for field survey and threat to subterranean fauna associated with the Proposal. It was concluded that there would almost certainly be no threat to troglofauna species from the Proposal developments but that there may be a potential threat to restricted species of stygofauna, if such species occur within the Proposal. It was therefore recommended that a pilot-scale field survey of stygofauna be undertaken to increase the certainty of assessment of risk to stygofauna from Proposal development.

This report presents the findings of the pilot-scale stygofauna survey. The specific objectives of the survey were:

- To determine whether stygofauna species do occur in the Proposal.
- To examine the likely ranges of any species that do occur.
- To determine whether a full-scale stygofauna survey is required.

The results of field survey should be interpreted in conjunction with Bennelongia's (2013) desktop review of subterranean fauna.

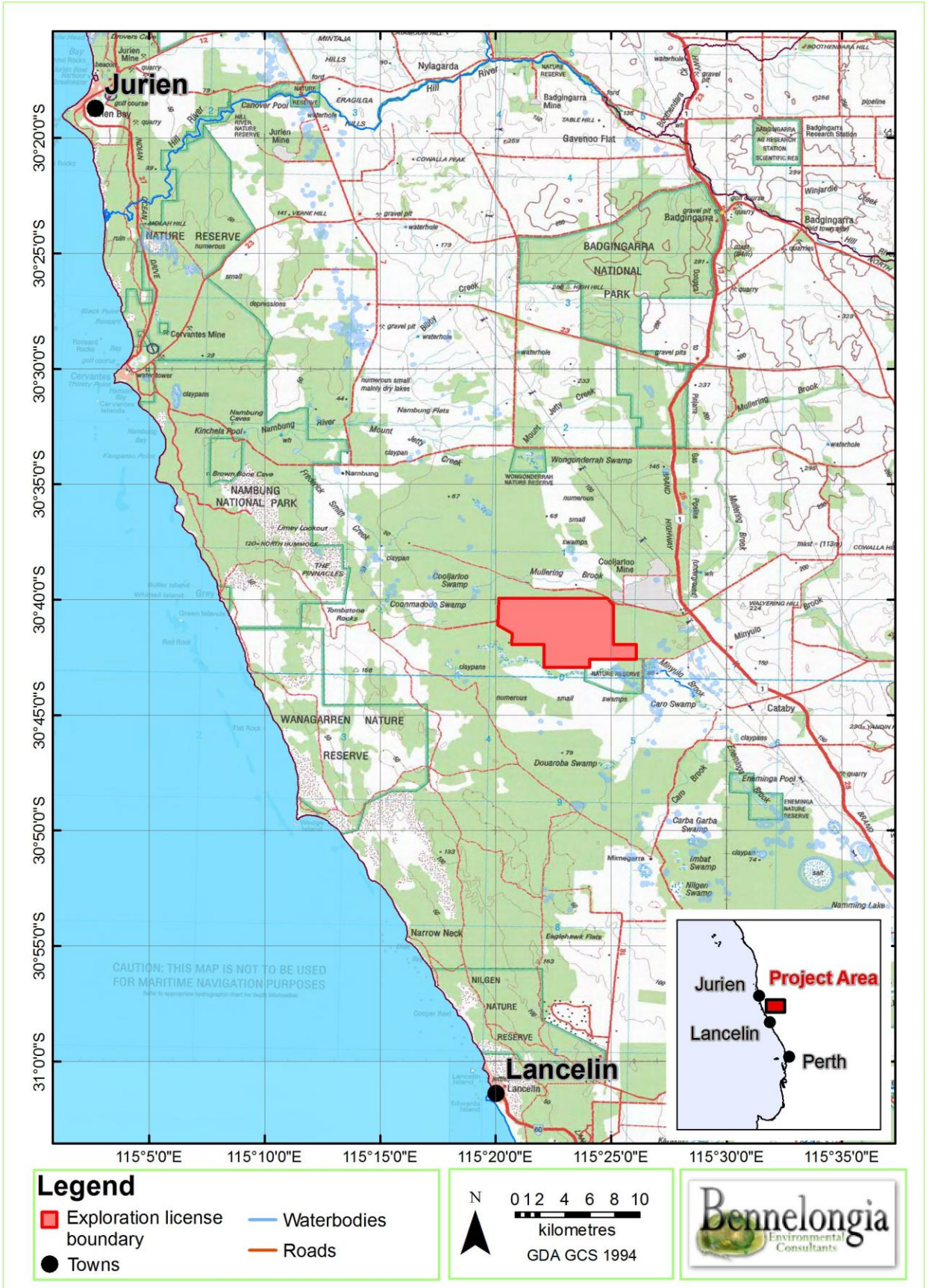

Figure 1.1. Location of the Proposal on the Northern Swan Coastal Plain.

2. SURVEY

2.1. Rationale

The desktop assessment by Bennelongia (2013) reviewed current knowledge of subterranean fauna of the Swan Coastal Plain and in the vicinity of the Proposal and characterised the local habitat of the Proposal within a regional context. It was concluded that Proposal development was unlikely to be a threat to troglofauna, but that there may be a potential threat to stygofauna. The desktop findings for stygofauna are outlined in more detail below.

Stygofauna surveys of the Swan Coastal Plain suggest that most stygofauna species of the region are wide-ranging and few of the species collected are likely to be stygobitic (Schmidt 2005; Bennelongia 2009; Tang and Knott 2009). A review of stygofauna records in a 50 by 50 km search area around the Proposal identified occurrence of between five and seven species; however, this low number of recorded species probably reflects limited stygofauna survey effort in the immediate area. The likelihood of stygofauna species occurring within the Proposal is therefore uncertain.

In general terms, the likelihood of stygofauna occurring in an aquifer is directly related to its transmissivity because stygofauna require interstitial spaces, voids and channels in which to live (Gibert and Deharveng 2002). Review of geology and hydrogeology in the area indicated that there is prospective stygofauna habitat in the vicinity of the Proposal, particularly in the Superficial Formation aquifer system. Based on the extensive nature of the regional aquifer systems, it could be expected that the stygofauna habitat would have considerable connectivity beyond the Proposal. Nevertheless, it is possible that if stygofauna species occur their ranges may be constrained by local dispersal barriers in the vicinity of the Proposal. The potential barriers include faults and escarpments that may restrict lateral movement. In addition, the buried outwash fans and deltaic deposits associated with Mullering Brook and other local water courses may represent potentially isolated stygofauna habitat.

The drawdown associated with proposed mining developments within the Proposal is yet to be modelled, so that the spatial extent of groundwater drawdown associated with the Proposal is not yet known. If spatially extensive drawdown occurs as a result of the Proposal (in addition to potential drawdown from already-approved projects in the vicinity of the Proposal), it may have the potential to threaten persistence of highly restricted stygofauna species. The watertable is quite close to the surface in the Proposal (5-15 mbgl) and threat from drawdown will be greatest for animals that inhabit the shallower component of the Superficial Formation aquifer

In light of the uncertainty regarding the likely occurrence and distribution of stygofauna within the Proposal, and the potential threat from development of the Proposal if restricted species of stygofauna do occur, it was recommended that a pilot-scale survey be undertaken to confirm the presence or absence of stygofauna species within the Proposal and further assess the threat to stygofauna from proposed developments.

2.2. Methods

2.2.1. Sampling Methods

Stygofauna were sampled using the methods outlined by the EPA (2003, 2007). At each bore, six net hauls were collected using a weighted, plankton net. Three hauls were taken with a 50 µm mesh net and three

hauls with a 150 µm mesh net. After the net was lowered to the bottom of the bore it was oscillated up and down briefly to agitate benthic and epibenthic stygofauna into the water column. The net was then slowly retrieved. Contents of the net were transferred to a 125 ml polycarbonate vial after each haul and preserved in 100% ethanol. Nets were washed between bores to minimise contamination among sites.

2.2.2. Sampling Effort and Timing

Altogether 30 stygofauna samples from bores within the vicinity of the Proposal were collected (Figure 2). As the drawdown is yet to be modelled, the status of bores as impact or reference is yet to be determined. Sampling was conducted 4 to 6 February 2013. A complete list of bores sampled is provided in Appendix 1.

2.2.3. Sample Sorting and Species Identification

In the laboratory, samples were elutriated to separate out heavy sediment particles and sieved into size fractions using 250, 90 and 53 µm screens. All samples were sorted under a dissecting microscope. Sorted animals were identified to species or morphospecies using available keys and species descriptions. When necessary, animals were dissected and examined under a compound microscope with interference contrast lighting.

Representative specimens will be lodged at the Western Australian Museum when any assessment report is submitted to the EPA.

2.2.4. Personnel

Fieldwork was undertaken by Grant Pearson and Jim Cocking. Samples were sorted by Grant Pearson, Mike Scanlon, Sean Bennett, and Jim Cocking. All identifications were completed by Jane McRae and Stuart Halse.

2.3. Results

Twenty-five aquatic specimens belonging to four higher level groups were collected from the 30 stygofauna samples taken in the vicinity of the Proposal (Table 2.1). None of these specimens was considered to be stygofauna. The 16 foraminiferans, one gastropod and seven ostracods collected were all probably of marine origin and were collected dead as shells or skeletons (probably fossilised). One nematode collected was possibly stygofaunal but nematodes are not recognised in assessments of stygofauna because of taxonomic issues and the poor state of knowledge for this group.

Table 2.1. Aquatic invertebrates collected within the Proposal.

Taxa	Specimens	Comments
Foraminifera		
Foraminifera sp.	16	Marine origins
Nematoda		
Nematoda sp.	1	Unlikely to be stygofauna, not assessed in EIAs
Gastropoda		
Gastropoda sp.	1	Marine origins
Crustacea		
Ostracoda sp.	7	Marine origins

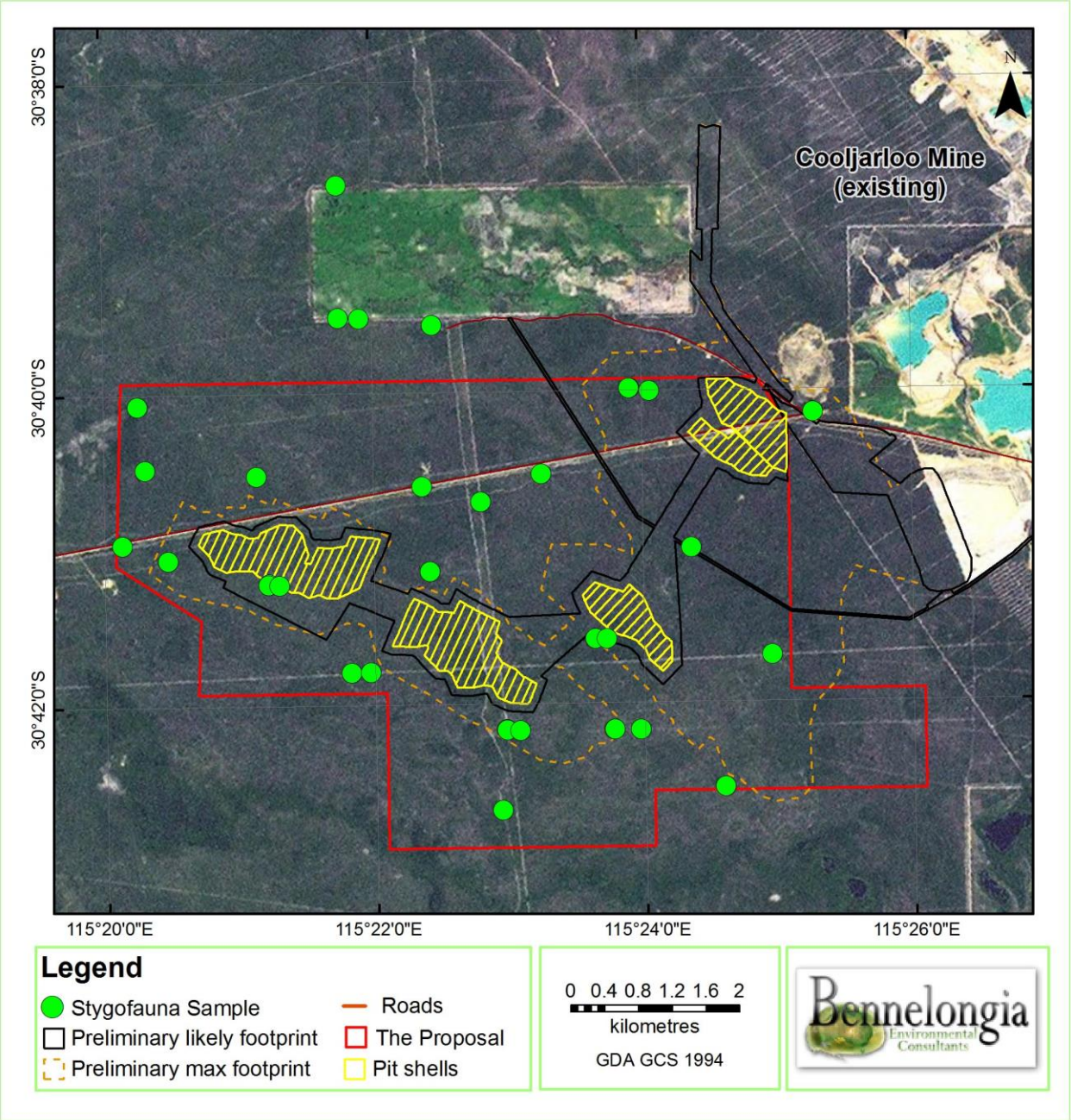

Figure 2.1. Bores sampled for stygofauna within the Proposal (and near vicinity).

3. DISCUSSION AND CONCLUSION

The desktop review concluded that the occurrence and distribution of stygofauna within the Proposal was uncertain (Bennelongia 2013). A review of stygofauna records within a 50 by 50 km search area around the Proposal found relatively few species; however, prior survey effort in the area was low. Furthermore, regional aquifers that are prospective habitats for stygofauna occur in the vicinity of the Proposal. It was considered that local barriers to dispersal within these aquifer systems may affect distributions of stygofauna, if they are present, and lead to species having restricted ranges.

Despite the abundant stygofauna habitats in the vicinity, the field survey within the Proposal collected no definitive stygofauna species. The only possible stygofaunal animal collected within the Proposal was the single nematode specimen. Nematodes are not considered in environmental impact assessments (EPA 2007).

Based on the results of the pilot-scale field survey, it is unlikely that a stygofauna community is present in the vicinity of the Proposal. The Proposal is therefore not considered to pose a threat to stygofauna species. A full-scale field survey is not required to improve the assessment of stygofauna conservation values.

4. REFERENCES

Bennelongia (2009) Subterranean Fauna Assessment at Point Grey. Report 2009/71, Bennelongia Pty Ltd, Jolimont, 15 pp.

Bennelongia (2013) Cooljarloo West Proposal: Subterranean Fauna, Desktop Study and Methods Statement. Report 2013/577, Bennelongia Pty Ltd, Jolimont, 24 pp.

Eberhard, S.M., Halse, S.A., Williams, M.R., Scanlon, M.D., Cocking, J.S., and Barron, H.J. (2009) Exploring the relationship between sampling efficiency and short range endemism for groundwater fauna in the Pilbara region, Western Australia. *Freshwater Biology* **54**, 885-901.

EPA (2003) Guidance for the assessment of environmental factors: consideration of subterranean fauna in groundwater and caves during environmental impact assessment in Western Australia. Guidance Statement 54. Environmental Protection Authority, Perth, pp. 12.

EPA (2007) Sampling methods and survey considerations for subterranean fauna in Western Australia (Technical Appendix to Guidance Statement No. 54). Guidance Statement 54A. Environmental Protection Authority, Perth, 32 pp.

Fontaine, B., Bouchet, B., Van Achterberg, K. et al. (2007) The European Union's 2010 target: putting rare species in focus. *Biological Conservation*, **139**, 167-185.

Gibert, J. and Deharveng, L. (2002) Subterranean ecosystems: a truncated functional biodiversity. *BioScience,* **52,** 473-481.

Harvey, M. (2002) Short-range endemism among the Australian fauna: some examples from non-marine environments. *Invertebrate Systematics,* **16,** 555-570.

Lamoreux, J. (2004) Stygobites are more wide-ranging than troglobites. *Journal of Cave and Karst Studies* **66**, 18-19.

Schmidt, S.I. (2005) Surface water/groundwater interactions and their association with sediment fauna in a Western Australian catchment. Tectum Verlag, Marlburg, 163 pp.

Tang, D., and Knott, B. (2009) Freshwater cyclopoids and harpacticoids (Crustacea: Copepoda) from the Gnangara Mound region of Western Australia. *Zootaxa* **2029**, 1-70.

WorleyParsons (2013) Cooljarloo West Hydrogeological Assessment Report. Tronox Pty Ltd. 301012-01593 – 301012-01593-Rep Rev 0, WorleyParsons, Perth, 285 pp.

5. APPENDICES

Appendix 1. Bores Sampled for Stygofauna

Bore Code	Sample Date	Latitude	Longitude	Static water level (mbgl)	End of hole (mbgl)
B03D	06/02/2013	-30.6679	115.337667	10.47	19
B04D	06/02/2013	-30.6844	115.341250	7.56	21
B05D	04/02/2013	-30.6784	115.380028	13.30	17
MB01	05/02/2013	-30.6444	115.362611	11.02	37
MB03D	06/02/2013	-30.6747	115.338528	11.02	37
MB04D	05/02/2013	-30.6586	115.362583	11.02	37
MB04I	05/02/2013	-30.6586	115.362611	11.02	37
MB06D	05/02/2013	-30.6665	115.398556	5.62	21
MB06S	05/02/2013	-30.6665	115.398500	5.62	21
MB07	04/02/2013	-30.6755	115.387528	3.97	18
MB08D	05/02/2013	-30.6767	115.372722	9.85	37
MB09	06/02/2013	-30.6754	115.352278	9.85	37
MB10	05/02/2013	-30.6827	115.335583	9.85	37
MB11D	05/02/2013	-30.6870	115.353722	10.22	15
MB11S	05/02/2013	-30.6871	115.353639	15.03	18.3
MB12	06/02/2013	-30.6858	115.373611	15.77	27
MB14D	05/02/2013	-30.6965	115.363806	11.49	23
MB14I	05/02/2013	-30.6965	115.363778	12.08	40
MB15D	04/02/2013	-30.7028	115.382889	13.34	45
MB15I	06/02/2013	-30.7028	115.382917	13.49	20
MB16D	05/02/2013	-30.7029	115.396250	11.00	26
MB16S	06/02/2013	-30.7029	115.396278	19.15	36
MB17D	05/02/2013	-30.7114	115.382278	19.00	31
MB18D	05/02/2013	-30.6932	115.394000	19.50	39
MB18S	05/02/2013	-30.6932	115.394028	19.57	32
MB19	05/02/2013	-30.7092	115.409889	13.82	38
MB21D	05/02/2013	-30.6951	115.415861	14.07	18
MB22	05/02/2013	-30.6835	115.406000	18.44	32
MB5A	06/02/2013	-30.6595	115.374194	9.20	42
MBS5	06/02/2013	-30.6692	115.421250	9.14	19