Survey for Aquatic Macroinvertebrates for the Lake Mackay SOP Project, Western Australia.

Report by Invertebrate Solutions for Agrimin Ltd

March 2018

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Frontispiece: The water beetle *Eretes australis* from a claypan near Lake Mackay.

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Executive Summary

Agrimin Limited (Agrimin) is developing its Lake Mackay Sulphate of Potash (SOP) Project and requires a number of baseline biological assessments to be carried out. The SOP Project includes 12 tenements covering the majority of Lake Mackay over a total area of 3,500 square kilometres. Lake Mackay is a seasonally inundated salt lake located on the Western Australia (WA) – Northern Territory (NT) border, with most of the lake located within WA.

An aquatic macroinvertebrate survey was undertaken by Dr Colin Trainor (Trainor Ecological Solutions) and Gerry Bradley (Agrimin) using timed active sweep netting of aquatic habitats in the main Lake Mackay area as well as three surrounding claypans to the south of the lake in April 2017. Sampling consisted of walking sweep net samples using a 250 µm dip net.

Two additional opportunistic samples from constructed trenches in Lake Mackay were also collected in January 2018 following local rainfall.

The aquatic macroinvertebrate sampling undertaken in April 2017 recorded no invertebrates within Lake Mackay. Three of the nine samples were collected in claypans to the south of Lake Mackay and these samples recorded eight taxa of aquatic macroinvertebrates from four classes, six orders and six families. The initial survey in April 2017 did not record brine shrimp (Anostraca spp.), however, these ubiquitous arid zone salt lake specialists were recorded in the opportunistic sampling in January 2018.

All the species recorded during the aquatic macroinvertebrate survey are widespread and common throughout the Australian arid zone and, although most records are new for Lake Mackay, they represent an infilling of distributional records rather than range extensions. This is primarily due to the lack of previous collecting in the area, rather than the region containing a unique species assemblage any different from other parts of the central arid region of Australia. The water quality data show that Lake Mackay is hypersaline and the ephemeral claypans in the surrounding region are fresh to brackish and provide excellent habitat for aquatic macroinvertebrates.

The development of the Lake Mackay SOP Project is not anticipated to significantly impact adversely on any species recorded in these surveys. When the specific Project footprint and location of infrastructure areas is finalised, these conclusions should be revisited to ensure they remain valid, however, due to the expected limited extent of any processing and infrastructure areas, the current assessment is not expected to alter.

The following recommendations are made with regard to the potential development of the Lake Mackay SOP Project area:

- If suitable conditions arise then further aquatic macroinvertebrate surveys on Lake Mackay itself should be considered.

1. Introduction

Agrimin Limited (Agrimin) is developing its Lake Mackay Sulphate of Potash (SOP) Project and requires a number of baseline biological assessments to be carried out. The SOP Project includes 12 tenements covering the majority of Lake Mackay over a total area of 3,500 square kilometres. Lake Mackay is a seasonally inundated salt lake located on the Western Australia (WA) – Northern Territory (NT) border, with most of the lake located within WA.

Invertebrate Solutions has been requested by Agrimin to identify all aquatic macroinvertebrates recorded at Lake Mackay and write a report of the findings and their significance.

1.1 Purpose of this report

Agrimin staff and their subconsultant 'Trainor Ecological Solutions' undertook the following scope of works for the Lake Mackay SOP Project area, Western Australia:

- Walking sweep net (250µm) transect samples of 10 sample aquatic macroinvertebrate sites:
    - Transects will attempt to target all habitats present at each site;
    - To be conducted over 2 minutes;
    - Samples to be stored in 95% ethanol; and
    - Site descriptions and locations recorded.
- Opportunistic sweep netting of other water bodies including constructed trenches on Lake Mackay
- Water quality parameters measured:
    - Temperature (^{o}C);
    - pH;
    - salinity (ppm);
    - dissolved oxygen (mg/L and % saturation); and
    - conductivity (µs/cm).

Agrimin subsequently requested Invertebrate Solutions to undertake the following scope of works for the Lake Mackay SOP Project area, Western Australia.

- Identify samples of aquatic macroinvertebrates from sweep nets to the lowest practical taxonomic level;
- Provide recommendations and any suggested requirements for further work to comply with relevant legislation;
- Provide recommendations to minimise potential impacts and any suggested requirements for further work to comply with relevant legislation; and
- Provide a written report containing the above items.

No field surveys for aquatic macroinvertebrates were undertaken by Invertebrate Solutions.

1.2 Project area

The Project includes 12 tenements covering the majority of Lake Mackay over a total area of 3,500 square kilometres. Lake Mackay is a seasonally inundated salt lake located on the Western Australia (WA) – Northern Territory (NT) border, with most of the lake located within WA and is shown in Figure 1.

1.3 Survey effort and timing

An aquatic macroinvertebrate survey was undertaken in the main Lake Mackay area as well as some surrounding claypans to the south of the lake in April 2017. A total of nine samples were collected, including three from claypans (Table 1).

Two additional opportunistic samples from constructed trenches in Lake Mackay were also collected in January 2018 following local rainfall.

Table 1 Sites sampled for aquatic macroinvertebrates

Sample ID	Easting	Northing	Habitat	Date Sampled
AM1	490391	7492584	Lake Mackay salt lake	14-Apr-17
AM2	485598	7494480	Lake Mackay salt lake	14-Apr-17
AM3	485329	7516039	Lake Mackay salt lake	15-Apr-17
AM4	494604	7507954	Lake Mackay salt lake	15-Apr-17
AM5	484254	7512142	Lake Mackay salt lake	16-Apr-17
AM6	482252	7511603	Lake Mackay salt lake	16-Apr-17
AM7	459903	7492753	4 ha Claypan (freshwater)	17-Apr-17
AM8	460774	7494177	0.1 ha Claypan (freshwater)	17-Apr-17
AM9	441755	7496647	20 ha Claypan (freshwater)	17-Apr-17
Trench 05	479984	7507964	Constructed trench on Lake Mackay	21/01/2018
Trench 08	490922	7507101	Constructed trench on Lake Mackay	21/01/2018

Legend

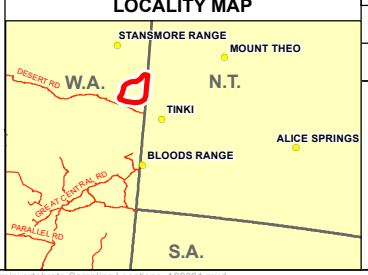
- Project Area
- Mining Tenement
- Aquatic Macroinvertebrate Sample Location

0 3.75 7.5 15
km

Scale: 1:500,000 @ A4

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY MAP



- LOCALITY MAP SOURCED FROM LANDGATE 2006
- MINING TENEMENTS SOURCED LANDGATE 2017
- AERIAL PHOTOGRAPHY SOURCED BASEMAP ESRI

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PROJECT ID	DATE
Lake Mackay SOP Project, WA	1/03/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
ENVIRONMAPS	TM	TM	0

Lake Mackay SOP Aquatic Macroinvertebrate Survey

Figure 1

Lake Mackay SOP Project Survey Area and Aquatic Macroinvertebrate Sampling Locations

ENVIRONMAPS t: 0406 590 006 Environmental Mapping Solutions www.environmaps.com.au

C:\GIS\Jobs\Invertebrate Solutions\Lake Mackay SOP Project, WA\Figures\LakeMacKay SOP Proj_F01 Lake Mackay SOP Project Survey Area and Aquatic Macroinvertebrate Sampling Locations_180301.mxd

1.4 Conservation Legislation and Guidance Statements

Terrestrial invertebrate species are protected under state legislation via the Wildlife Conservation (WC) Act (1950), the Environmental Protection Act (1986) and federally under the Environment Protection and Biodiversity Conservation (EPBC) Act (1999). The assessment of invertebrate fauna for environmental impact assessment (EIA) is undertaken in Western Australia with regard to the Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA2016).

At the state level, the WC Act provides a list of species that have special protection as species listed under the Wildlife Conservation (Specially Protected Fauna) Notice 2018 (DBCA 2018). This notice is updated periodically by the Department of Biodiversity, Conservation and Attractions (DBCA) (formerly Department of Parks and Wildlife, DPaW) and the current list (January 2018) includes numerous subterranean species, mainly from the Cape Range and Pilbara regions including crustaceans, arachnids and myriapods that are considered to be "rare or likely to become extinct, as critically endangered fauna, or are declared to be fauna that is in need of special protection" (DPaW 2016). In addition to the specially protected fauna, DBCA also maintains a list of Priority fauna that are considered to be of conservation significance but do not meet the criteria for formal listing under the WC Act as Scheduled species. The Priority fauna list is irregularly updated by DBCA and, although it offers no formal legislative protection, these species are generally considered in the EIA process.

There is no current ability for the state government of Western Australia to formally list Threatened or Priority Ecological Communities (TECs/PECs), however, a list of such communities is maintained by DBCA and overseen by the Minister for the Environment. Several subterranean ecological communities are recognised as Threatened including the Bundera Cenote Anchialine community on Cape Range, Cameron's Cave near the townsite of Exmouth on Cape Range, stygal root mat communities in both the Yanchep and Margaret River regions and stygobionts in the Ethel Gorge aquifer in the Pilbara. Communities that are not considered by DBCA to be threatened but may be vulnerable to future impacts are classed as PECs and include numerous calcrete aquifers in the Yilgarn region where each calcrete has been shown to contain an endemic stygal community.

The WC Act is expected to be imminently replaced by the new Biodiversity Conservation Act that has yet to be enacted into law. This new act has been passed by the lower house of the State parliament and will be capable of protecting both species and ecological communities under legislation.

The federal EPBC Act protects both species and ecological communities. The most relevant listing for terrestrial invertebrate fauna is the mygalomorph spider *Idiosoma nigrum* that occurs in the Wheatbelt region and is listed as Vulnerable.

1.5 Survey Staff Qualifications

Field sampling for invertebrates was undertaken by ecologists and Agrimin staff and comprised of:

- Dr Colin Trainor *BSc, MSc, PhD*. (Trainor Ecological Solutions)
- Gerry Bradley *BSc (Hons) Zool.* (Agrimin Sustainability Manager)
- Nick Miles (Agrimin Hydrogeologist)

The aquatic macroinvertebrate sampling was undertaken by Dr Colin Trainor, Gerry Bradley and Nick Miles. Invertebrate extraction, sorting and identification was completed by Dr Timothy Moulds.

1.6 Report Limitations and Exclusions

This study was limited to the written scope provided to the client by Invertebrate Solutions (13th February 2018) and in Section 1.1. This study was limited to the extent of information made available to Invertebrate Solutions at the time of undertaking the work. Information not made available to this study, or which subsequently becomes available may alter the conclusions made herein. Assessment of potential impacts to aquatic macroinvertebrates fauna was based on proposed development plans provided by the client.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. Invertebrate Solutions has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by Invertebrate Solutions described in this report (this section and throughout this report). Invertebrate Solutions disclaims liability arising from any of the assumptions being incorrect.

Invertebrate Solutions has prepared this report on the basis of information provided by Agrimin Ltd and others (including Government authorities), which Invertebrate Solutions has not independently verified or checked beyond the agreed scope of work. Invertebrate Solutions does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

Site conditions may change after the date of this report. Invertebrate Solutions does not accept responsibility arising from, or in connection with, any change to the site conditions. Invertebrate Solutions is also not responsible for updating this report if the site conditions change.

Species were identified to the lowest practical taxonomic level, taking into consideration that the taxonomic framework of many invertebrate groups is incomplete and often in need of substantial revision to enable accurate identification. Insufficient information exists for many invertebrate species due to specimens being juvenile, the wrong sex to allow identification, damaged, or inadequate taxonomic frameworks.

Field surveys for aquatic invertebrates require multiple seasonal surveys to fully record all species that may be present in an area, and in varying weather conditions. The current survey was undertaken during a single season with limited additional opportunistic sampling and additional surveys at different times of the year may record additional species.

2. Methods

Trainor Ecological Solutions and Agrimin staff undertook the following tasks for the aquatic macroinvertebrate survey of the Lake Mackay SOP Project area:

- Aquatic macroinvertebrate sampling of 9 sites (undertaken by Colin Trainor).
- Opportunistic sampling of aquatic macroinvertebrates in constructed trenches in Lake Mackay (Agrimin staff).

2.1 Aquatic Macroinvertebrate Survey Methodology

The aquatic macroinvertebrate survey was undertaken by Dr Colin Trainor (Trainor Ecological Solutions) and Gerry Bradley (Agrimin) using timed active sweep netting of aquatic habitats. Sites were chosen in various parts of the lake itself and also in several ephemeral claypans to the south of the lake. Sampling consisted of walking sweep net samples using a 250 µm dip net over a two minute period at each site. The samples were then examined in white plastic trays with all invertebrates collected using forceps and preserved in 70% ethanol.

At each site, a selection of water quality parameters were recorded including temperature (^{o}C), pH, conductivity (µS/cm) and dissolved oxygen (mg/L).

2.3.1 Oxidation reduction potential (ORP)

The oxidation reduction potential (ORP) or redox potential of water is a measure of a system's capacity to oxidise materials through chemical reactions. During reduction-oxidation reactions, one chemical species loses electrons (is oxidised) while another gains electrons (is reduced). Redox is measured indirectly as the ability of an aquatic system to conduct electricity, in millivolts (mV).

The redox state of aquatic environments, i.e. whether they are in an oxidising or reducing environment, is defined by the oxygen content. Typically, in well-aerated aquatic environments, the water provides an oxidising environment and has a positive, or nearing positive, ORP value. Anoxic (zero oxygen) waters are often the result of high biological (BOD) and/or chemical oxygen demand (COD) and have low redox potential (often measured as negative millivolts, mV). The redox potential of aquatic environments controls the reactivity and solubility of many chemical constituents including metals. For example, the redox potential of water has important implications for metal mobility, bio-availability and toxicity.

2.3.2 Temperature

The temperature of ground water in arid Australia is generally fairly constant throughout the year and reflects the average surface temperature of the area. Surface waters are more reflective of the ambient temperatures, with depth and permanency influencing the temperatures recorded.

2.3.3 pH

The concentration of hydrogen ions (H^{+}) is shown as a logarithmic scale, where a low value indicates a high concentration and higher values indicate a more basic solution. The neutral value of 7 is more likely to support aquatic macroinvertebrates.

2.3.4 Electrical conductivity

Electrical conductivity was measured in milli Siemens per centimetre (mS/cm) and provides an indication of salinity. In highly saline waters that are found in salt lakes, the diversity of aquatic macroinvertebrates is generally much reduced with most salt lake ecosystems dominated by brine shrimp (Anostraca). Ephemeral claypans generally contain fresh to brackish water and, hence, can support a more diverse aquatic fauna.

2.3.5 Dissolved oxygen

Dissolved oxygen is usually reported in milligrams per litre (mg/L) or as a percent of air saturation of the water being measured. Dissolved oxygen refers to the level of free, non-compound oxygen present in water and is an important parameter in assessing water quality because of its influence on the aquatic macroinvertebrates that may live in a body of water (Fondriest Environmental, 2013). The amount of dissolved oxygen required for various species varies, with deep profile species requiring less than shallow dwelling species .

Dissolved oxygen levels are dependent upon the temperature, salinity and depth of a water body, with the solubility of oxygen decreasing as temperature and salinity increases (Wetzel 2001).

2.2 Sorting and curation

Sorting for all aquatic macroinvertebrates samples occurred in the Invertebrate Solutions laboratory using an Amscope 45x dissecting microscope and was undertaken by Dr Timothy Moulds. Each taxon was identified to the lowest practical taxonomic rank using published keys and descriptions, and the numbers of each taxon recorded. Each identified taxon was kept in a separate labelled vial and assigned a specimen tracking code. Specimen and site collection data were recorded in an Excel spreadsheet. At the conclusion of the study, all specimens will be lodged at the Western Australian Museum.

2.3 Taxonomy and Nomenclature

Identification of collected invertebrate material was undertaken by Dr Timothy Moulds. The level of specimen identification achievable is dependent on the level of taxonomic knowledge and expertise available. The majority of the taxonomic expertise relating to invertebrate taxa resides with the staff of the Western Australian Museum, while some groups are also worked on by researchers within other government departments and academic institutions. Taxonomic treatments are available for some invertebrate groups, but not all. The EPA expects that invertebrates collected for identification will be identified to the lowest taxonomic level possible. Ideally, this is to the species level, but there will be limits due to the nature of specimens and the availability of taxonomic keys.

3. Results

3.1 Aquatic Macroinvertebrate Survey

The aquatic macroinvertebrate sampling undertaken in April 2017 recorded no invertebrates within Lake Mackay. Three of the nine samples were undertaken in claypans to the south of Lake Mackay and these samples recorded eight taxa of aquatic macroinvertebrates from four classes, six orders and six families (Table 2). Few other records exist for the Lake Mackay region for aquatic macroinvertebrates from either the records of the Western Australian Museum or on the Atlas of Living Australia (www.ALA.org) which reflects a paucity of collecting in the region. The most diverse group recorded was the diving beetles with three species (Plate 1, Plate 2 and Plate 3).

The initial survey in April 2017 did not record brine shrimp (Anostraca spp.), however, these ubiquitous arid zone salt lake specialists were recorded in the opportunistic sampling in January 2018.

Table 2 Aquatic macroinvertebrate recorded in April 2017 and January 2018

Higher Order	Genus and species	Site	Abundance	Notes
Mollusca: Bivalvia: Cyrenidae	*Corbicula australis*	Aquatic Site 9	1	Claypan, widespread
Crustacea: Branchiopoda: Anostraca: Artemiidae	*Artemia* sp.?	Trench 05	4	Specimens rotten and damaged.
Crustacea: Ostracoda: Darwinulidae	*Penthesilenula brasiliensis*	Aquatic Site 9	25	Claypan, Cosmopolitan southern hemisphere
Arachnida: Acarina	Mesostigmata sp.	Aquatic Site 9	1	Terrestrial species
Insecta: Hemiptera: Heteroptera: Notonectidae	*Anisops stali*?	Aquatic Site 7, Aquatic Site 8	8	Claypan, widespread arid species
Insecta: Odonata: Libellulidae	*cf. Rhodotemis lieftincki?*	Aquatic Site 9	1 (larvae)	Widespread in Northern Australia. Specimen rotting and damaged. Collected dead.
Insecta: Coleoptera: Dytiscidae	*Eretes australis*	Aquatic Site 7	4	Claypan, widespread
	Paroster michaelseni?	Aquatic Site 8	1	Claypan, widespread
	Cybister tripunctatus	Aquatic Site 8, Trench 08	1, 2	Claypan and Trench, widespread

Plate 1 The widespread dytiscid diving beetle *Eretes australis* from a claypan near Lake Mackay. Scale 1mm

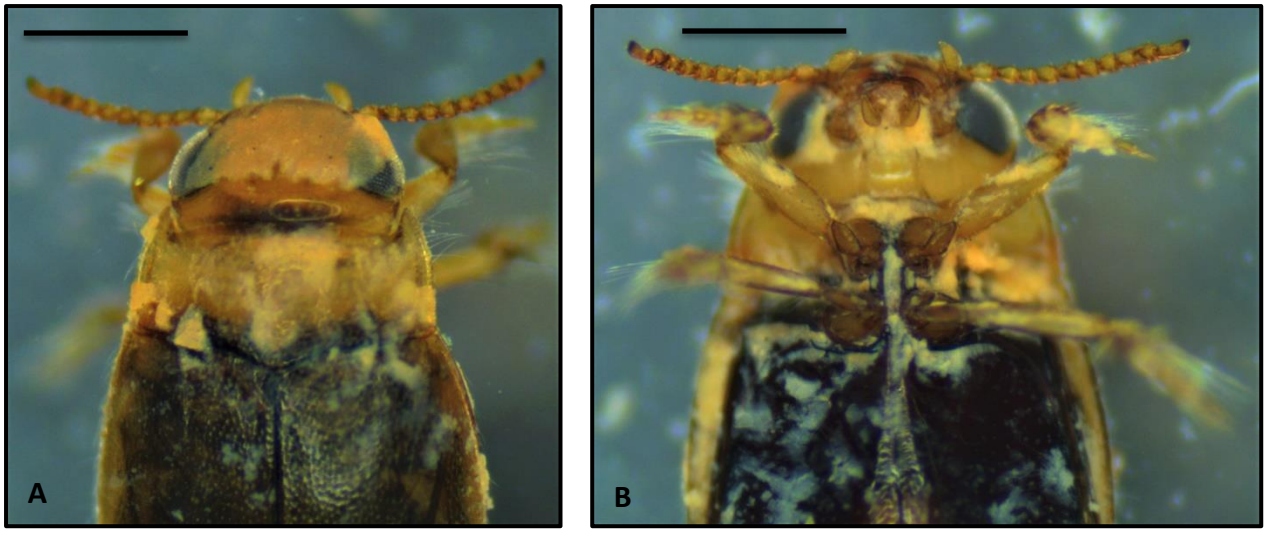

Plate 2 The dytiscid diving beetle *Paroster michaelseni?* from a claypan near Lake Mackay. Scale 1 mm. (A) Dorsal view (B) Ventral view

Plate 3 The dytiscid diving beetle *Cybister tripunctatus* from constructed Trench 08 on Lake Mackay. Scale 1 mm.

3.2 Water Quality

The water quality of each site sampled for aquatic macroinvertebrates is shown in Table 3. The shallow depth of most sites means that the water temperature reflects the ambient temperature of the environment. The pH was found to be higher in the ephemeral freshwater claypans, possibly due to higher organic content. The conductivity measurements show the claypans to be fresh to brackish, while the water within Lake Mackay is hypersaline. The ORP was found to be favourable for invertebrates in all habitats while the dissolved oxygen content was higher in the claypans, possibly due to fresher water allowing for greater saturation compared with the hypersaline water in the lake itself.

Table 3 Water quality for the aquatic macroinvertebrate sites

Site	Description	Water Depth cm	Temperature ˚C	pH	Conductivity (µs/cm)	ORP	Dissolved Oxygen %
1A	Lake Mackay, SE corner	<15	22.0	6.22	140,263	95.0	50.8
2A	Lake Mackay	<15	25.4	7.10	167,626	98.2	53.0
3A	Lake Mackay	<15	18.8	6.25	204,787	122.4	40.4
4A	Lake Mackay	<15	23.7	7.11	243,343	100.6	32.8
5A	Lake Mackay	<2	25.4	6.73	261,732	113.5	26.1
6A	Lake Mackay	<15	24.3	7.59	239,504	94.8	34.7
7A	4 ha, claypan	>30	18.5	8.80	402	-3.5	80.7
8A	0.1 ha, tiny claypan	8	23.2	8.54	2,255	95.3	73.7
9A	21 ha, large claypan	>50	22.5	8.95	3,326	109.7	114.9
Trench 05	Constructed trench in lake	600	-	-	-	-	-
Trench 08	Constructed trench in lake	600	-	-	-	-	-

4. Discussion

4.1 Aquatic Macroinvertebrate Assessment

All of the species recorded during the aquatic macroinvertebrate survey are widespread and common throughout the Australian arid zone and, although most records are new for Lake Mackay, they represent an infilling of distributional records rather than range extensions. The water quality data show that Lake Mackay is hypersaline and the ephemeral claypans in the surrounding region are fresh to brackish and provide excellent habitat for aquatic macroinvertebrates.

The most notable absence from the initial survey in April 2017 was the lack of brine shrimp (Anostraca) from the salt lake samples, although population levels are known to rapidly increase following favourable conditions and then decline rapidly when conditions change. Specimens of Anostraca species. were recorded in the opportunistic sampling in January 2018, however, due to poor storage of the specimens they were rotten at the time of identification, precluding identification beyond a possible genus level of *Artemia* sp.

The development of the SOP project on the lake involving establishing a trench network is expected to have limited impact upon the aquatic macroinvertebrate fauna of the lake itself due to the sheer size of the lake compared with the actual trenching area.

5. Conclusions and Recommendations

The aquatic macroinvertebrate survey at the Lake Mackay SOP Project undertaken in April 2017 and January 2018 recorded limited abundance, but a high diversity of invertebrate species, many of which are new records for the Lake Mackay region. This is primarily due to the lack of previous collecting in the area, rather than the region containing a unique species assemblage any different from other parts of the central arid region of Australia.

All the species recorded during the aquatic macroinvertebrate survey are widespread and common throughout the Australian arid zone and, although most records are new for Lake Mackay, they represent an infilling of distributional records rather than range extensions.

The development of the Lake Mackay SOP Project is not anticipated to significantly impact any species recorded in these surveys. When the specific Project footprint and location of infrastructure areas is finalised these conclusions should be revisited to ensure they remain valid, however, due to the limited extent of any processing and infrastructure facilities, currently being proposed as part of the SOP Project, this assessment is not expected to alter.

5.1 Recommendations

The following recommendations are made with regard to the potential development of the Lake Mackay SOP Project area:

- If suitable conditions arise then further aquatic macroinvertebrate surveys on Lake Mackay itself should be considered.

6. References

EPA (2016). Technical guidance. Sampling of short range endemic invertebrate fauna. Environmental Protection Authority: Perth. 35 pp.

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Appendix 1

Department of Parks and Wildlife Conservation Codes (November 2015)

Department of Parks and Wildlife

CONSERVATION CODES

For Western Australian Flora and Fauna

Specially protected fauna or flora are species* which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.

Categories of specially protected fauna and flora are:

T **Threatened species**

Published as Specially Protected under the *Wildlife Conservation Act 1950,* and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act.

Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the Wildlife Conservation Act.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR **Critically endangered species**

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EN **Endangered species**

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

VU **Vulnerable species**

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EX **Presumed extinct species**

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.

IA **Migratory birds protected under an international agreement**

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.

CD Conservation dependent fauna

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

OS Other specially protected fauna

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

P Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1 Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2 Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3 Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4 Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.
(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).