Memo

To: Les Purves

From: Jarrad Clark and Dr Grant Wells

CC: Michael Klvac and Warwick Jones

Date: 9 January 2018

Subject: Mardie Salt Project preliminary flora and vegetation assessment

1 INTRODUCTION

This Memo report presents the findings of a flora and vegetation reconnaissance survey undertaken to inform the Pre-Feasibility Study for the Mardie Salt Project (the Project).

BCI Minerals Ltd (BCI) is investigating the feasibility of developing the Project, a sodium chloride (NaCl) salt production Project owned 100% by BCI on tenements between Dampier and Onslow in the north-west of Western Australia.

Phoenix Environmental Sciences Pty Ltd (Phoenix 2017b) undertook an environmental desktop study and brief site reconnaissance of the four Project tenements to define the potential environmental values present within the study area, including:

- terrestrial flora and vegetation (reported here)
- terrestrial fauna (including vertebrate and invertebrate fauna)
- subterranean fauna
- aquatic invertebrate fauna.

Based on the desktop study findings (Phoenix 2017b), the scope of baseline environmental surveys for the above factors required to support environmental approvals for the Project was identified. Of immediate concern for the Pre-Feasibility Study is the identification of any potential fatal flaws related to these factors.

The desktop study determined that a 'detailed flora and vegetation survey' is required as the study area potentially supports highly diverse flora, potentially significant flora and vegetation and, the scale and nature of the potential impacts are likely to be significant (Phoenix 2017b). While unlikely to present a fatal flaw for the Project, a reconnaissance survey for terrestrial flora and vegetation was undertaken as:

1. flora and vegetation values may require consideration in Project design
2. detailed flora and vegetation surveys are complex, lengthy, usually a great proportion of the overall environmental approvals budget, and benefit greatly from a reconnaissance surveys
3. detailed flora and vegetation surveys often require multiple sampling events in the same season or in different seasons, a reconnaissance survey will help to identify, schedule and cost such scenarios
4. a reconnaissance survey will characterise the flora and identify the vegetation units present early in the process, therefore assisting to identify areas of potential high botanical value to inform the design of the detailed flora and vegetation survey and the Night Parrot survey and analysis.

The outcomes of the reconnaissance survey were to include:

1. completion of one sampling event
2. further identification of suitable habitat for conservation significant flora
3. identification of suitable habitat for the Night Parrot to inform survey design for the species

4. high level delineation of vegetation types and vegetation condition to inform detailed survey design, i.e. required number of quadrat/relevé surveys, requirement for riparian and lake transect surveys, and identification of suitable survey locations
5. high level assessment of the presence of the Horseflat land system of the Roebourne Plains Priority Ecological Community (PEC).

2 METHODS

Proposed survey locations were identified from aerial photography of the Project study area. Sites were selected based on apparent changes in vegetation. The selected survey locations along with satellite imagery and locations of Priority flora identified from the desktop review (Phoenix 2017b) were then uploaded onto GPS enabled PDA's.

A field survey of the Project study area was undertaken by Dr Grant Wells and Alice Watt on 9 December 2018. In addition, vegetation along a proposed access/haul road to the Project from Great Northern highway and tenements to the north of the Project study area were also surveyed. The field survey was conducted utilising a helicopter to fly to the preselected survey locations and any other areas of interest identified during the field survey.

At each location visited either a relevé survey or simple vegetation description were recorded. For relevé surveys the following data was recorded:

- location – the geographic coordinates in WGS84 projection
- description of vegetation – a broad description utilising the structural formation and height classes based on National Vegetation Information System (NVIS 2003)
- habitat – a brief description of landform and habitat
- geology – a broad description of surface soil type and rock type
- disturbance history – a description of any observed disturbance including an estimate of time since last fire, weed invasions, soil disturbance, human activity and fauna activity
- vegetation condition – the condition of the vegetation was recorded utilising the condition scale of (EPA 2016)
- estimated height and percentage foliage cover (PFC) of plant strata
- photograph – a colour photograph of the vegetation.

Plant specimens were collected for prominent species that displayed sufficient taxonomic characters to facilitate identification to species level. Particular attention was paid to *Tecticornia* spp. in fruit/seed as these species are frequently unable to be identified to species level when sterile.

3 RESULTS

The vegetation recorded for the Project study area, haul road and adjacent tenements may be broadly split into seven types (Table 1). A large section of the Project study area and adjacent tenements comprised large bare mudflats devoid of vegetation. Vegetation of the Project study area and adjacent tenements was dominated by the *Tecticornia* spp. chenopod shrublands on the tidal mudflats and low sandy rises, and shrublands over *Triodia* grasslands and spinifex steppe on coastal dunes, sand islands on the mudflats and adjacent sandy plains. Mangrove shrublands comprised a smaller component of the vegetation on the coastal foreshore and riparian vegetation of tidal creeks.

The haul road vegetation was dominated by shrublands over *Triodia* grasslands and low mixed grasslands, *Eragrostis* spp.

One vegetation type recorded in the haul road survey area, Low mixed grassland, *Eragrostis* spp., may align with the Priority 3 PEC, Horseflat Land System of the Roebourne Plains. No other vegetation type recorded was considered to resemble any of conservation significance.

Vegetation condition in the Project study area was recorded to be in Poor to Excellent condition with the majority of the vegetation recorded to be in excellent condition (EPA 2016), i.e. Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement. Areas recorded in Poor condition (still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds) were heavily grazed, dissected by livestock tracks and had either upper shrub strata (e.g. Mesquite, *Prosopis* spp.) or low grass strata (e.g. Buffel Grass, *Cenchrus* spp.) dominated by aggressive weeds. Some areas were recorded in Very Good condition due to the presence of weed species at low densities.

Vegetation condition in the adjacent tenements was recorded to be in Very Good to Excellent condition. Areas were recorded in Very Good condition due to the presence of weed species at low densities.

Vegetation condition in the haul road study area range from Very Good to Excellent. Areas were recorded in Very Good condition due to medium level grazing, dissection by livestock tracks and presence of weed at low densities.

Suitable habitat was present in the study area for 14 of the 43 potential conservation significant flora identified in the desktop review (Phoenix 2017b) as potentially occurring in the study area. The suitable habitat comprised primarily, the coastal dunes, sand islands on the mudflats, and adjacent sandy plains. Notably, no suitable habitat for the EPBC Act listed vulnerable species *Eleocharis papillosa* occurred in the survey area. *Eleocharis papillosa* occurs in temporary wetlands, predominantly freshwater and semi-saline swamps, which do not occur in the study area.

Overall, diversity of the perennial species in most of the vegetation types identified was low. Diversity appeared to be highest in some of the low *Tecticornia* spp. shrublands.

One declared pest *Prosopis* sp. was recorded in the Project study area and in the adjacent tenements, where it is widespread and abundant.

Patches of old growth *Triodia* grasslands were present in the study area primarily restricted to the sandy islands on the tidal mudflats. These islands appear to be the most optimal habitat for the Night Parrot in the survey area and have been targeted with Automatic Recording Units (ARUs).

Table 1 Broad vegetation types recorded in the study area, haul road and adjacent tenements

Vegetation description	Habitat	Representative photo
Low open *Tecticornia* spp. chenopod shrublands	Tidal mudflats	
Low open *Tecticornia* spp. chenopod shrublands over low open mixed grasslands	Sandy rises on tidal mudflats	
Mid Mangrove shrublands over low *Tecticornia* spp. chenopod shrublands	Coastal margins, banks of tidal creeks	
Spinifex (*Triodia* spp.) steppe	Sand islands in tidal mudflats, plains, coastal dunes	

Vegetation description	Habitat	Representative photo
Shrublands over *Triodia* spp. grasslands	Sand islands in tidal mudflats, plains, coastal dunes	
Low mixed grassland, *Eragrostis* spp.	Flat and undulating plains (haul road survey area)	
Low open *Eucalyptus* sp. woodland over *Acacia* spp. shrubland over *Triodia* spp. hummock grassland	Riparian vegetation of creekline	

Table 2 Conservation significant flora identified in the desktop review for which suitable habitat was recorded in the study area

Family	Species	Cons. status	Description and habitat (DPaW 2017)	Likelihood of occurrence
Asteraceae	*Helichrysum oligochaetum*	P1	Erect annual, herb, to ca 0.25 m high. Flowers yellow, August to November. Red clay on alluvial plains.	Possible, but very limited habitat in study area
Fabaceae	*Tephrosia rosea* var. Port Hedland (A.S. George 1114)	P1	Erect, spreading shrub 120 cm tall x 120 cm wide with flowers deep pink in September. Coastal and near-coastal locations in sandy and sandy loam soils often tan, deep sands in coastal dunes.	Possible
Goodeniaceae	*Goodenia pallida*	P1	Erect herb, to 0.5 m high. Flowers purple, August. Red soils.	Possible
Malvaceae	*Abutilon* sp. Onslow	P1	Semi-prostrate shrub to 2 m in diameter with yellow flowers, August to October. Red sand on sandplain, cracking clay loam on flat plain.	Possible
Aizoaceae	*Trianthema* sp. Python Pool (G.R. Guerin & M.E. Trudgen GG 1023)	P2	Annual, prostrate and open herb: 0.02 m high and 0.20 m wide. Pink flower, March – May, July, September. Low undulating hills, plain in brown clayey-sand, rocky soil on flat plain.	Possible
Amaranthaceae	*Gomphrena pusilla*	P2	Slender branching annual, herb, to 0.2 m high. Flowers white, March to April or June. Fine beach sand. Behind foredune, on limestone.	Possible
Aizoaceae	*Carpobrotus* sp. Thevenard Island (M. White 050)	P3	Prostrate, succulent perennial, herb, leaves sessile, triangular in cross-section; fruit turbinate. Flowers cream, August. Coarse white sand. Dune tops, disturbed areas.	Possible
Apocynaceae	*Gymnanthera cunninghamii*	P3	Erect shrub, 1-2 m high. Flowers cream-yellow-green, January to December. Sandy soils.	Possible

Family	Species	Cons. status	Description and habitat (DPaW 2017)	Likelihood of occurrence
Fabaceae	*Acacia glaucocaesia*	P3	Dense, glabrous shrub or tree, 1.8-6 m high. Flowers yellow, July to September. Red loam, sandy loam clay on floodplains.	Possible but very limited habitat in study area
Malvaceae	*Corchorus congener*	P3	Spreading shrub, to 0.6 m high. Flowers yellow, April to June or August to November. Sand and red sandy loam with limestone in sand dunes or plains.	Possible
Malvaceae	*Triumfetta echinata*	P3	Prostrate shrub, to 0.3 m high. Flowers August Red sandy soils, sand dunes.	Possible
Meliaceae	*Owenia acidula*	P3	Tree, 3-8 m high. Flowers white-brown/cream. Drainage lines, floodplains and creeks, clay, sandy clay and silty loam soils.	Possible but very limited habitat in study area
Solanaceae	*Solanum albostellatum*	P3	Annual or perennial herb up to 15 cm high with pale mauve flowers. Floodplains, crabhole, cracking clay soils.	Possible in haul road study area
Goodeniaceae	*Goodenia nuda*	P4	Erect to ascending herb, to 0.5 m high. Flowers yellow, April to August. Red-brown sandy loam on floodplains.	Possible but very limited habitat in study area

4 DISCUSSION

The desktop study (Phoenix 2017b) identified that a 'detailed flora and vegetation survey' is required as the study area potentially supports highly diverse flora, potentially significant flora and vegetation and, the scale and nature of the potential impacts are likely to be significant. The results of the reconnaissance survey indicate less floristic diversity within the vegetation of the study areas than that suggested by the desktop study, particularly for perennial flora species. As the reconnaissance survey was conducted during the dry season the diversity of annual flora remains unknown but it is anticipated that overall diversity of the vegetation types present will not be particularly high due to the paucity of perennial flora diversity.

The survey verified potential habitat for 14 conservation significant flora identified from the desktop review (Phoenix 2017b) comprised of four P1, two P2, six P3 and one P4 species, but notably no habitat for the Federally listed (under the EPBC Act) vulnerable species *Eleocharis papillosa* was present. It therefore appears unlikely that any Threatened species occur within the study area.

Targeted surveys for the Priority species should focus on the coastal dunes, sand islands on mudflats, sandy plains and floodplains of creeklines.

The *Tecticornia* shrublands appeared the most diverse vegetation types in the study areas. Three conservation significant *Tecticornia* spp. were identified as potentially present in the study area however, despite the presence of *Tecticornia* communities in the Project study area, it was considered unlikely that these species may be present as they have only been recorded on inland salt lake systems, not coastal tidal flats. However, recent surveys in *Tecticornia* communities conducted by Phoenix (e.g. Phoenix 2017a, c; Phoenix 2017d) have identified large range extensions for Priority *Tecticornia* spp. and discovered taxa considered to potentially represent undescribed new species. It is therefore recommended that detailed transect/quadrat surveys be conducted for these vegetation types during the detailed survey in accordance with the current guidance (EPA 2016) to ensure adequate survey of these vegetation types.

The haul road study area contained one vegetation type which may align with the Priority 3 PEC Horseflat Land System of the Roebourne Plains. Detailed quadrat surveys will be required in this vegetation type during the optimal survey period (autumn) to obtain the data required to determine whether this vegetation type is representative of the PEC. The haul road route may need to consider this community in its design, depending on the communities' extent.

The Spinifex (*Triodia* spp.) grasslands on the sandy islands on the tidal mudflats represent the most optimal habitat for the Night Parrot in the study areas. Notably, survey for this species utilising ARUs has commenced at several of the islands and elsewhere.

The reconnaissance survey has been highly beneficial in that it has determined that the number of vegetation types in the study area was far fewer than was apparent from the aerial imagery used to selected survey locations. The data gathered will facilitate design of an efficient and cost effective detailed survey with survey locations selected to ensure adequate representation of each of the major vegetation types recorded including good spatial spread across the study areas. Importantly however, it has also determined that flora and vegetation values are unlikely to represent a fatal flaw to the Project and have any major Project design implications, beyond the need to potentially alter one of the haul road route options to avoid impacts to the Priority 3 PEC Horseflat Land System of the Roebourne Plains.

Yours Sincerely,

Jarrad Clark (Principal Zoologist and Project Manager) and Dr Grant Wells (Principal Botanist)

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