Lake Morris

Proposed Gypsum Mine

Vegetation

And Flora

Survey

BOTANICAL CONSULTANTS
REPORT
FOR REGAN GRANT
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Summary

The present vegetation and flora survey covers part of Lake Morris which is situated approximately 45kms SSE of Newdegate. This area has been proposed for gypsum mining. The survey was carried out to provide information needed to assess the mining proposal and is a Level 2 vegetation and flora survey in accordance with guideline No. 51 as outlined by the EPA 2004.

The ground survey of the vegetation and flora was carried out on the 2nd and 6th of November 2013. Areas of interest delineated from aerial photographs were visited for accurate vegetation mapping. Twenty five sites were sampled to assist with the vegetation mapping and the flora survey. Plant voucher specimens were collected to assist in accurate plant identification. Information collected at each site included a GPS location, a vegetation description (Muir 1977), vegetation condition (B.J. Keighery 1994), an inventory of plant species, the presence of DRF or priority species, a physical description including soils and topography and a high resolution digital photograph.

The vegetation associations mapped and described in this study include Mallee and *Melaleuca* Scrub/ Thicket covering areas adjacent to the salt lake and in pristine to very good condition. Mixed Low Heath occurs on ridges of gypsiferous soils on the lake bed and is in pristine to excellent condition and *Tecticornia* (samphire) Scrub /Heath which is extensive across the lake bed is also in excellent to pristine condition.

The Mallee, *Melaleuca* Scrub/Thicket and *Tecticornia* Scrub/Heath vegetation associations recorded at Lake Morris are extensive throughout the Lake Magenta salt lake chain. The gypsum ridges with the Mixed Low Heath vegetation cover much smaller areas but are not uncommon in the lake system. Large areas of salt lake vegetation are conserved in the Lake Magenta Nature Reserve and smaller areas in Lake Lockhart Nature Reserve. Although the species composition of these associations is expected to change over distance Lake Morris is only 1 kilometer east of Lake Magenta.

A total of 58 plant species were recorded during the flora and vegetation survey. Five species were introduced or weed species. Due to the time and seasonal constraints the species list only represents part of the flora of the area.

Three priority species were found in the area covered by the proposed gypsum mine. *Frankenia* sp. southern gypsum (M.N. Lyons 2864) P1 was recorded at all sites sampled on the lake bed and 5 of the Mixed Low Heath sites. Recent surveys have found this species to be more common than previously thought and the proposed mine should not impact on the overall conservation of this species. *Pimelea halophila* P2 and *Fitzwillia axilliflora* P2 were also recorded during the survey and their distribution needs to be taken into consideration when planning the extraction of gypsum from the area.

The 'Vunerable' threatened ecological community – 'Herblands and Bunch grasslands on gypsum lunette dunes alongside saline playa lakes' is situated ~ 9.5 kms south of the proposed gypsum mine. This community was not found during the present survey at Lake Morris.

Acknowledgements

Access to the WA Herbarium collections was essential for carrying out the project and is greatly appreciated.

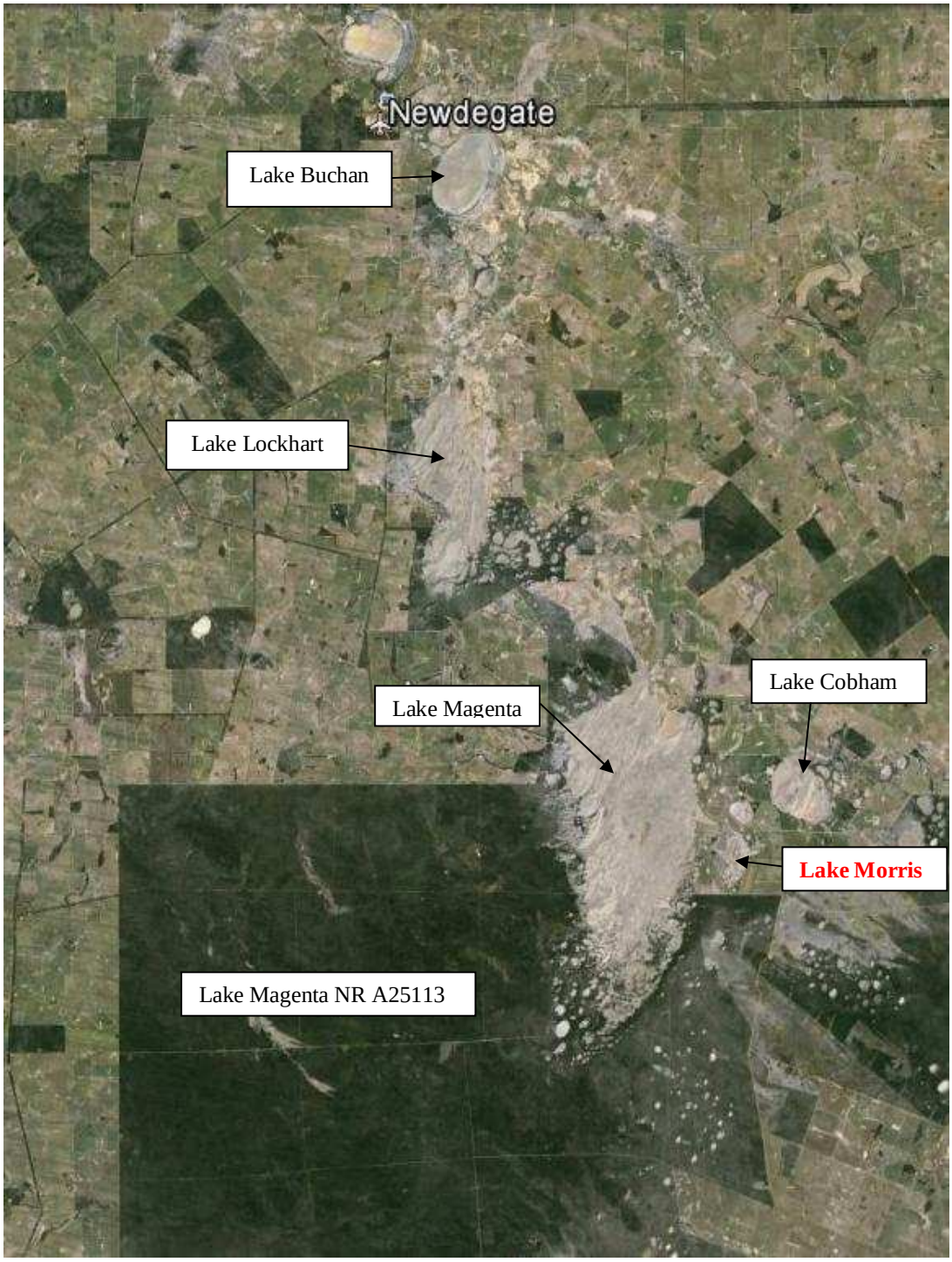
1.0 Introduction

The study area subject to the vegetation and flora survey is part of Lake Morris which has been proposed for gypsum mining. One of the requirements with regard to the assessment of the mining proposal is a Level 2 flora and vegetation survey in accordance with guideline No. 51 as outlined by the EPA 2004.
This includes:

- the description and mapping of vegetation types/associations
- the assessment and mapping of the condition – or range of conditions – of the vegetation
- the representation in a regional context of the vegetation types/associations
- photographs of each vegetation type
- a report on Declared Rare, Priority and other significant flora and threatened ecological communities in the area
- a vegetation degradation summary ie spread of disease +/or weeds

Lake Morris is situated approximately 45 kms SSE of Newdegate town site (see Figure 1) and is part of the Lake Magenta lake chain which includes Lake Buchan, Lake Lockhart, Lake Cobham and Lake Magenta.

Figure 1 Location of Lake Morris



2.0 Method

The ground survey of the vegetation and flora of the study area was carried out on the 2nd and 6th November 2013. The work included site descriptions to assist with the vegetation mapping and flora survey and the collection of voucher specimens.

General vegetation divisions were noted using coloured aerial photography. Areas of interest thus delineated were examined in the field and the vegetation at selected sites described. Because of time limitations some areas were not covered in detail in the ground survey and mapping was carried out by extrapolation of known vegetation associations using the aerial photographs. A GPS was also used in the field to increase the accuracy of the vegetation and flora mapping.

Vegetation association descriptions were based on the classification system devised by Muir (1977) which was specifically designed for describing wheatbelt vegetation (see Table 1). The condition of the vegetation described follows the Vegetation Condition Scale modified from Trudgen 1991 by B.J. Keighery for the Swan Coastal Plain Survey 1994 (Table 3). Sites were selected as areas fairly typical of the vegetation associations described. Sites could be up to 60m diameter after the survey method of Muir (1977) but on narrow dune areas were <60m and only included areas considered typical of the vegetation type being described.

Information recorded at each site included:

- GPS location at the centre of sites.
- Vegetation classification - Muir description (1977)
- Vegetation condition
- Inventory of plant species
- Any DRF or priority species
- Physical description including soils and topography.
- A high resolution digital photograph

Specimens of plant species encountered were collected and identified using keys and by comparison with specimens at the Western Australian Herbarium. Plant specimens of interest will be lodged in the WA Herbarium. Experts involved in revising particular genera were consulted wherever possible to ensure accuracy with identification. Searches for Declared Rare, Priority and other significant flora were made during the traverses walked through the survey area.

The Department of Parks and Wildlife supplied information on Declared Rare and Priority plants known to occur in the area of Lake Cobham and Lake Morris in 2009. Information was included from the Threatened (Declared Rare) Flora database (DEFL), the WA Herbarium Specimen database (waherb) and the Declared Rare and Priority Flora List (this list is searched using place names). The search co-ordinates used were 33°21' - 33°32' S and 119° 11' - 119°22'E (GDA94) – a 10km radial search which includes Lake Morris situated ~2.5 kms SW of Lake Cobham.

The Department of Parks and Wildlife also provided the results of a search undertaken on the Threatened Ecological Communities database. Information has been updated for this report from FloraBase and the Census of WA Plants and Animals where necessary. More recent collections of priority flora by the author have also been included.

MAX V3 was used for the plant species list and plant labels for the WA Herbarium.

TABLE 1 - MUIR SYSTEM OF VEGETATION CLASSIFICATION

LIFE FORM/ HEIGHT CLASS	**CANOPY COVER**			
	DENSE 70-100% d	**MID-DENSE 30-70% c**	**SPARSE 10-30% i**	**VERY SPARSE 2-10% r**
T Trees > 30m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland
M Trees 15-30m	Dense Forest	Forest	Woodland	Open Woodland
LA Trees 5-15m	Dense Low Forest A	Low Forest A	Low Woodland A	Open Low Woodland A
LB Trees < 5m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B
KT Mallee tree form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
KS Mallee shrub form	Dense Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
S Shrubs > 2m	Dense Thicket	Thicket	Scrub	Open Scrub
SA Shrubs 1.5-2.0m	Dense Heath A	Heath A	Low Scrub A	Open Low Scrub A
SB Shrubs 1.0-1.5m	Dense Heath B	Heath B	Low Scrub B	Open Low Scrub B
SC Shrubs 0.5-1.0m	Dense Low Heath C	Low Heath C	Dwarf Scrub C	Open Dwarf Scrub C
SD Shrubs 0.0-0.5m	Dense Low Heath D	Low Heath D	Dwarf Scrub D	Open Dwarf Scrub D
P Mat plants	Dense Mat plants	Mat plants	Open Mat plants	Very Open Mat plants
H Hummock Grass	Dense Hum. Grass	Mid-Dense Hum. Grass	Hummock Grass	Open Hummock Grass
GT Bunch grass > 0.5m	Dense Tall Grass	Tall Grass	Open Tall Grass	Very Open Tall Grass
GL Bunch grass < 0.5m	Dense Low Grass	Low Grass	Open Low Grass	Very Open Low Grass
J Herbaceous spp.	Dense Herbs	Herbs	Open Herbs	Very Open Herbs
VT Sedges > 0.5m	Dense Tall Sedges	Tall Sedges	Open Tall Sedges	Very Open Tall Sedges
VL Sedges < 0.5m	Dense Low Sedges	Low Sedges	Open Low Sedges	Very Open Low Sedges
X Ferns	Dense Ferns	Ferns	Open Ferns	Very Open Ferns
Mosses, liverwort	Dense Mosses	Mosses	Open Mosses	Very Open Mosses

3.0 Results

3.1 Vegetation Survey

3.1.1 Previous surveys in the Lake Morris area.

Lake Morris is situated in the Western Mallee IBRA (Interim Biogeographical Regionalisation for Australia) sub region (Environment Australia 2004). Beard (1976) maps Lake Morris as occurring in the Hyden Vegetation System which is a subdivision of the Roe Botanical District

Beard (1976) describes the vegetation of the salt lake areas as bare salt lake of mud/ salt crystals or vegetated with samphire, lake margins with small *Frankenia* and around the lake edge boree of *Melaleuca* species mainly *Melaleuca thyoides*. A little further out are trees of *Eucalyptus kondininensis*, next *Eucalyptus salmonophloia* and *Eucalyptus longicornis*. In the boree zone the ground may be bare or covered with scattered grasses and samphire. In woodlands a saltbush understorey of *Atriplex* may be seen in the vicinity of salt lakes otherwise the lower layer consists of scattered woody shrubs of *Acacia*, *Eremophila, Pittosporum* and some grasses.

Beard (1976) has mapped the Lake Morris area at a scale of 1:250 000. The map unit covering the study area is Mixed Woodland in lakes country eMi with *Eucalyptus salmonophloia, Eucalyptus longicornis, Eucalyptus salubris* and *Eucalyptus kondininensis.*

Mattiske (1995) recorded data for vegetation growing on gypsiferous soils in the Lake Magenta lake system as part of "A Review of Botanical values on a range of gypsum dunes in the Wheatbelt of WA". This included data from sites situated on Lake Lockhart, Lake Cobham and Lake Magenta and UCL east of Lake Magenta (Threatened Ecological Community, Appendix 2).

A survey of the proposed gypsum mine on Lake Cobham was carried out by the author in 2009. Vegetation associations mapped and described in the lake Cobham survey include *Eucalyptus kondininenses* (Kondinin blackbutt) Woodland covering small areas on dunes in Excellent to Very Good condition. *Atriplex* (salt bush) Scrub/Heath covering small areas on dunes and ridges on the lake bed with vegetation classified as Excellent to Very Good. *Tecticornia* (samphire) Scrub /Heath which is extensive across the lake bed and mostly in Excellent condition. *Tecticornia* (samphire) Scrub /Heath Degraded was described in areas previously mined and cleared for access. In these areas the vegetation was in Degraded to Good condition.

"Survey and Analysis of Plant Communities Growing on Gypsum in the WA Wheatbelt" by Anne Rick (2011) included data collected from field work carried out in the Lake Magenta lake chain. Data from quadrats situated on gypsiferous soils on Lake Burkett, Lake Buchan, Lake Lockhart, Lake Cobham and Lake Magenta were included in the study and data from the Mattiske report (1995) was also included in the final analysis.

3.1.2 Current Survey

The vegetation associations mapped and described in the survey of the proposed gypsum mine at Lake Morris are outlined in Table 2. Descriptions of the vegetation and flora recorded at specific sites can be found in Appendix 1. The distribution of these vegetation associations within the survey area is shown on the vegetation map, Figure 2.

Table 2 Vegetation Associations of the proposed gypsum mine at Lake Morris.

Vegetation Association	**Map Unit**	**Soils**	**Topography**	**Sites**	**Comments**
Mallee	Eu	Sandy soils over clay	Adjacent to the salt lake on higher ground	1	Mallee areas are extensive in the region
Melaleuca Scrub/Thicket	Me	Shallow sandy soils over clay	Strip of vegetation adjacent to the lake bed	2 , 25	Common throughout the Lake Magenta salt lake system
Mixed Low Heath	M	gypsum	Low ridges on the lake bed.	4, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 23, 24	Confined to ridges of gypsum on the lake bed. Covers small areas but not uncommon in the lake system. Priority flora present.
Tecticornia (samphire) Scrub /Heath	Te	Gypsum over clay	Lake bed and slight rises	3, 5, 6, 7, 8, 9, 20, 21, 22	Extensive across the lake bed and in the Lake Magenta lake system. *Frankenia* sp southern gypsum P1 present

Mallee Formations

Mallee **Map Unit Eu**

The Mallee association covers higher ground on the edge of the lake. Tree Mallee including *Eucalyptus scyphocalyx* forms a mid dense layer to 6ms with scattered trees of *Eucalyptus urna*. The understorey consists of a sparse layer of *Melaleuca acuminata, Melaleuca lateriflora, Melaleuca thyoides, Melaleuca lanceolata* and *Melaleuca brophyi* shrubs over 2m in height over a sparse layer of *Darwinia* sp. Karonie, *Cyathostemon tenuifolius, Conostephium drummondii* and *Exocarpos aphyllus* shrubs to 1.5ms. Ground covers included a very sparse layer of shrubs to 0.5ms including *Rinzia communis, Darwinia* sp. Karonie and *Calytrix leschenaultii*. Annual and perennial herbs form a very sparse layer including *Waitzia acuminata, Levenhookia stipitata* and *Centrolepis pilosa*.

Photograph 1 **Mallee at site 1**

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Shrubland Formations

Melaleuca Scrub/Thicket Map Unit Me

Melaleuca Scrub/Thicket covers higher ground on the edge of the lake shore on sandy soils over clay. *Melaleuca* shrubs over 2 ms form a patchy mid dense layer becoming sparse closer to the lake edge. Species recorded include *Melaleuca thyoides, Melaleuca brophyi, Melaleuca halmaturorum* and *Melaleuca hamulosa*. Scattered shrubs to 1.5ms include *Darwinia* sp. Karonie , *Conostephium drummondii, Lycium australe* and *Cyathostemon tenuifolius.* Scattered shrubs to 0.5ms include *Carpobrotus modestus* and *Tecticornia* species.

**Mesembryanthemum nodiflorum*, **Lolium* species and **Arctotheca calendula* weed species were recorded at site LM 25.

Photograph 2 Melaleuca Scrub/Heath at site LM 2

Mixed Low Heath **Map Unit M**

Mixed Low Heath covers small areas mainly on low ridges on the lake bed. These areas are richer in plant species compared to the *Tecticornia* Scrub /Heath which occurs on the lower areas of the lake bed subject to inundation. Shrubs usually to 0.5m form a sparse to mid dense layer including *Tecticornia halocnemoides. Tecticornia moniliformis, Tecticornia* ?*syncarpa, Atriplex paludosa, Didymanthus roei, Lawrencia squamata, Maireana oppositifolia, **Frankenia* **sp. southern gypsum P1**, *Disphyma crassifolia, Rhagodia drummondii, Leucopogon* sp. Kau Rock, *Frankenia tetrapetala, **Pimelea halophila* **P2** and *Lepidium rotundum*.

Scattered shrubs to 1.0 ms at sites LM 11 and LM 12 and to 2 ms ms at site LM 13 include *Darwinia* sp. Karonie, *Melaleuca brevifolia* and *Scaevola spinescens*. *Austrostipa juncifolia* grass to 1.0ms in height form a very sparse stratum at site LM15. Scattered grasses recorded include *Austrostipa juncifolia, Austrostipa pycnostachya* and *Austrostipa vickeryana* and twining vines include *Billardiera lehmanniana* and *Comesperma integerrimum.*

Scattered annual herbs recorded include *Calandrinia ?*sp Meckering, *Trichanthodium skirriphorum, Isotoma scapigera**, Fitzwillia axilliflora* **P2**, *Brachyscome ciliaris, Asteridea chaetopoda* and *Kippistia suaedifolia*. Scattered perennial herbs include *Lomandra micrantha* subsp. *teretifolia*. The grass weed **Parapholis incurva* was also recorded.

Photograph 3 **Mixed Low Heath at site LM 12**

Photograph 4 Mixed Low Heath at site LM 13

Photograph 5 Mixed Low Heath at site LM 15

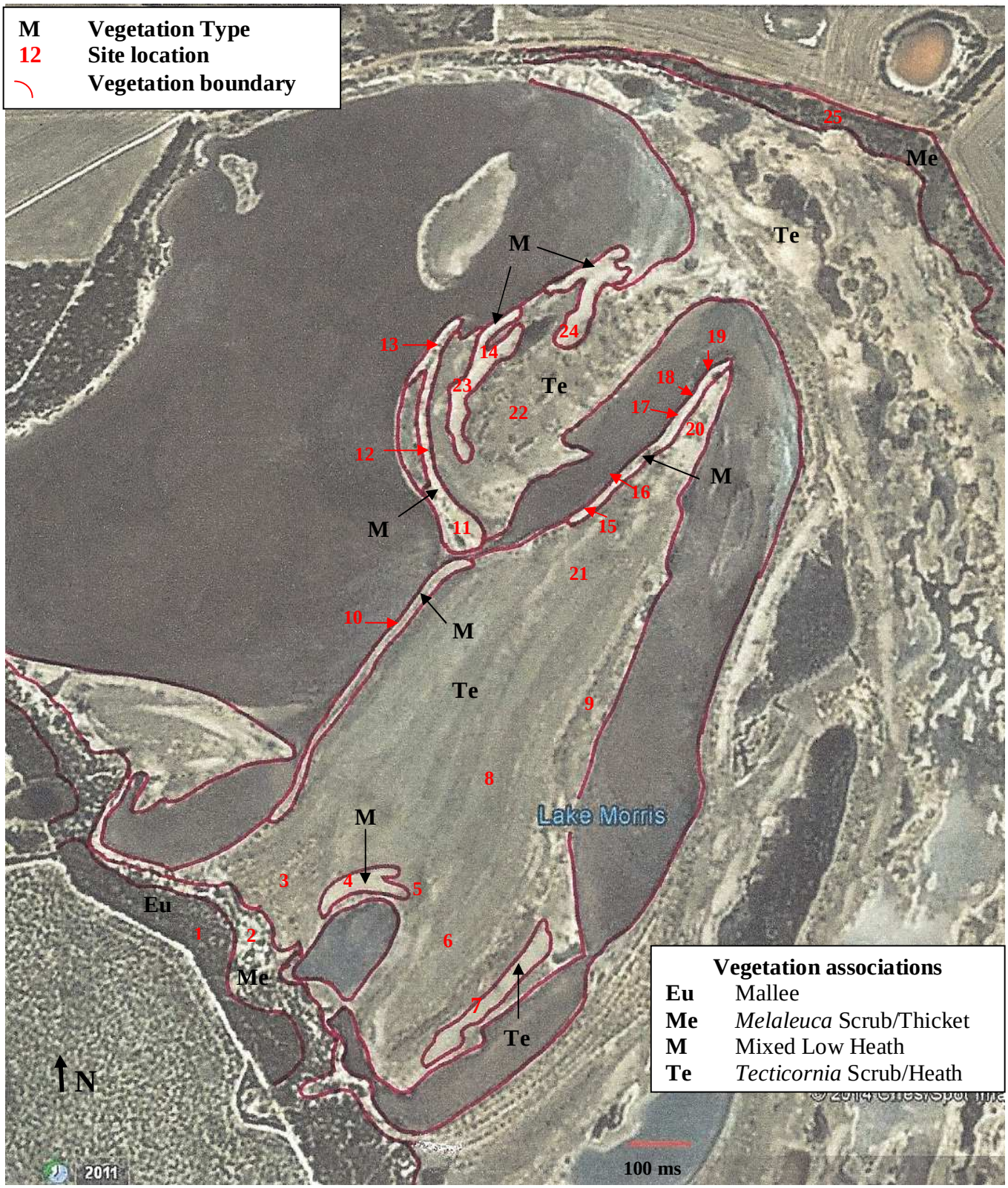
***Tecticornia* (samphire) Scrub/Heath** **Map Unit Te**

Tecticornia Scrub/Heath occurs over large areas of the lake bed on gypsum over clay. Shrubs to 0.5m form a sparse to mid dense stratum. *Tecticornia* species are dominant including *Tecticornia halocnemoides*, *Tecticornia moniliformis, Tecticornia pergranulata, Tecticornia loriae* and *Tecticornia syncarpa*. Occasional shrubs of *Didymanthus roei, Maireana oppositifolia, Disphyma crassifolia* and ***Frankenia* sp. southern gypsum P1** and annual herb *Caladenia* ?sp. Meckeringalso also occur in the association.

Weed species **Parapholis incurva* and * *Spergularis marina* were also recorded.

Photograph 6 ***Tecticornia* (samphire) Scrub/Heath at site LM 3**

Figure 2 Vegetation map of the proposed gypsum mine at Lake Morris



3.1.3 Vegetation Condition

The vegetation condition scale is outlined in Table 3. Weed species are indicated with an * in species lists presented in Appendix 1 and 3.

Table 3 Vegetation Condition Scale

Table 3 : Vegetation Condition Scale Modified from Trudgen 1991 by B.J. Keighery for the Swan Coastal Plain Survey 1994
1 = Pristine Pristine or nearly so, no obvious signs of disturbance
2 = Excellent Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. For example damage to trees caused by fire, the presence of non - aggressive weeds and occasional vehicle tracks.
3 = Very Good Vegetation structure altered, obvious signs of disturbance. For example disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
4 = Good Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate to it. For example disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
5 = Degraded Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds, partial clearing, dieback and grazing.
6 = Completely degraded The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora composing weed or crop species with isolated native trees or shrubs.

The Mallee vegetation association was generally in Excellent to Pristine condition with no obvious signs of disturbance except in areas directly adjacent to farmland. The *Melaleuca* Scrub/Thicket was in Excellent to Pristine condition in the more isolated areas on the south western edge of the salt lake however in areas to the north east adjacent to the road and farmland the vegetation was in Very Good condition with **Mesembryanthemum nodiflorum*, **Lolium* species (rye grass) and **Arctotheca calendula* (cape weed) recorded.

Tecticornia Scrub/Heath was extensive, covering large areas of the lake bed interspersed with areas of bare salt lake. This association was usually in Excellent condition with **Parapholis incurva* and **Spergularia marina* the only weed species recorded.

Mixed Low Heath was generally in Pristine to Excellent condition with **Parapholis incurva* the only weed species recorded.

3.2 Flora Survey

3.2.1 Flora of the Study Area.

A total of 58 plant species are recorded in Appendix 3 as occurring in the study area. Five species are introduced or weed species. Identifications with the name followed by ? are uncertain due to a lack of flowering or fruiting material or to confusion in the current taxonomy of the group concerned. The nomenclature follows that of the Census of Western Australian Plants and Animals (The WA Herbarium data base). MAX V3 was used for the plant species list and plant labels for the WA Herbarium.

Due to the time and seasonal constraints, Appendix 3 only represents part of the flora of the area. The spring survey will provide the most comprehensive species list however further survey work at different times of the year will increase our knowledge of the flora of the area.

The families with the largest representatives of genera and species are listed in Table 4. The families Myrtaceae, Chenopodiaceae (salt bush, samphire etc), Asteraceae (daisies) Poaceae (grasses), Ericaceae and Frankeniaceae were the most strongly represented in the flora of the study area as would be expected in the salt lake areas. Most of the proposed gypsum mine covers the lake bed areas but species of *Melaleuca* and *Eucalyptus* occur adjacent to the lake on higher terrain.

Table 4 The number of species and genera represented within the major families in the study area.

Family	No. species	No. Genera	Introduced Weeds
Myrtaceae (*Melaleuca*, *Eucalyptus*)	13	6	0
Chenopodiaceae (salt bush, samphire etc)	9	5	0
Asteraceae (daisies)	7	7	1
Poaceae (grasses)	5	3	2
Ericaceae	2	2	0
Frankeniaceae	2	1	0

3.2.2 Species of Interest

Research on Rare and Priority flora occurring in the Lake Morris area was carried out prior to the field work. Tables 5, 6 and 7 summarize the results. Table 5 is taken from the 2009 survey of Lake Cobham (Rick 2010) and has been updated from FloraBase and MAX V3 with the Census of WA plants and animals. It includes a list of 31 Declared Rare and Priority plant species previously recorded for Lake Cobham which is approximately 2.5 kms NE of Lake Morris. Information was supplied by the Department of Parks and Wildlife in 2009 from the Threatened (Declared Rare) Flora database (DEFL) and the WA Herbarium Specimen database (waherb). The search co-ordinates used were 33°21' - 33°32' S and 119° 11' - 119°22'E (GDA94) – a 10km radial of Lake Cobham. Species were also included from the Declared Rare and Priority Flora List (this list is searched using place names). This resulted in the inclusion of species outside the 10 km range.

Table 6 is a list of Rare and Priority flora recorded as growing on gypsum soils and includes species from the Lake King and Lake Grace lake chains that have not previously been recorded for the Lake Morris area. Table 7 includes Rare and Priority species recorded for salt lake habitats but have not been recorded for gypsiferous soils. Information from Rick (2011) has been used to compile tables 6 and 7 with updates from FloraBase.

The species recorded in Tables 5, 6 and 7 have been classified by the Department of Parks and Wildlife into categories which reflect their conservation status. These categories are listed below:

R: Declared Rare Flora - Extant Taxa
Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

X: Declared Rare Flora - Presumed Extinct Flora
Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which known wild populations have been destroyed more recently, and have been gazetted as such.

1: Priority One - Poorly Known Taxa
Taxa which are known from one or a few (generally <5) populations, which are under threat either due to small population size, or being on lands under immediate threat, eg. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, eg. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two - Poorly Known Taxa
Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (ie. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three - Poorly Known Taxa

Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.

4: Priority Four - Rare Taxa

Taxa which are considered to have been adequately surveyed and which whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years

Table 5 Declared Rare and Priority flora occurring in the Lake Cobham – Lake Morris Area

Taxon Name	Cons Code	Habitat	Habit
Acacia mutabilis subsp. *stipulifera*	P3	loam soils	Shrub
Acacia undosa	P3	Flat valley floor, mallee shrubland, sandy clay over laterite, sandy clay loam, sandy loam, clayey sand	Shrub
Banksia porrecta	P4	Gentle slope, deep sand. Open Scrub. *Hakea* sps, *Banksia* sps, *Adenanthos cuneatus, Eremaea pauciflora, Isopogon teretifolius, Stirlingia* sp	Shrub
Banksia pteridifolia subsp. *inretita*	P2	Lateritic soils. Scrub Heath and mallee	Shrub
Banksia xylothemelia	P3	Lateritic soils. Scrub Heath and mallee	Shrub
Bossiaea divaricata	P4	Mallee Heath, *Eucalyptus argyphea* Woodland, lateritic soils, loam clay soils	Shrub
Calytrix nematoclada	P3	Gentle slope, deep sand. Open Scrub. *Hakea* sps, *Banksia* sps, *Adenanthos cuneatus, Eremaea pauciflora, Isopogon teretifolius, Stirlingia* sp.	Shrub
Eremophila serpens	P4	Sandy rises or in depressions adjacent to salt lakes, *Melaleuca* shrubland, islands on salt lakes	Shrub
Eremophila verticillata	R	Adjacent to salt lake. Loam soils over dolomite and sandy clay loam. Disturbed area - dolomite mine and Woodland area	Shrub
Eucalyptus microschema	P3	Sandy rise, yellow sand on laterite. Mallee Heath	Mallee
Eutaxia nanophylla	P3	Mallee, *Eucalyptus wandoo, Melaleuca* heath, loam , sandy loam, clay, clayey sand	Shrub
Frankenia drummondii	P3	Adjacent to salt lakes, dunes, sandy loam, 1 record on gypsum.	Prostrate shrub

Fitzwillia axilliflora	P2	Salt lakes including gypsum areas	Annual herb
Frankenia sp. southern gypsum (M.N. Lyons 2864)	P1	Salt lake bed on gypsum**.** Low Heath/Low Scrub of *Tecticornia* and *Fankenia* sps.	Prostrate shrub
Goodenia salina	P2	Ridges/low dunes of gypsum	Perennial herb
Grevillea involucrata	R	Lateritic soils. Scrub Heath, mallee heath	Shrub
Haegiela tatei	P4	Salt lakes on gypsum	Annual herb
Hakea brachyptera	P3	Deep sand. Open Scrub Mallee. *Leptospermum* sp., *Hakea* sps, *Banksia blechnifolia, Isopogon buxifolius*	Shrub
Lechenaultia acutiloba	P3	Deep sand. Disturbed area on track	Branched shrub
Leucopogon sp. Lake Magenta (KR Newbey 3387)	P1	Shrubland, Heath, lateritic soils	Shrub
Leucopogon florulentus	P3	Shrubland, mallee, mallee over broombush, lateritic soils, sandy clay, sandy loam, clay loam	Shrub
Melaleuca sculponeata	P3	Light grey sand over clay. Mallee Heath	Shrub
Microseris scapigera	P3	Salt lakes, gypsum, sand, dunes, low rise	Perennial herb
Millotia steetziana	P2	Sand and loam, sand over clay, rise in salt lake. One record on gypsum	Annual herb
Pultenaea daena	P3	Adjacent to salt lake. Loam soils over dolomite and sandy soils. Disturbed area - dolomite mine and burnt area adjacent to salt lake. Mallee sps, *Melaleuca* sps, *Acacia* sp, *Scaevola* sp, and *Halgania* sp.	Shrub
Roycea pycnophylloides	R	Bare clay in open sandy semi-saline flats or seasonally wet clay pans. Recorded on gypsum**.** *Tecticornia halocnemoides, Melaleuca lateriflora, Melaleuca scalena*	Perennial herb
Sphaerolobium validum	P3	Heath, Mallee shrubland, Eucalyptus pleurocarpa, lateritic soils, sand	Shrub
Spyridium mucronatum subsp. *recurvum*	P3	Mallee, Melaleuca, sandy soils over clay, sandy loam clay, sandy soils	Shrub
Stylidium pulviniforme	P3	Bed of salt lake - clay soils. Low Heath D of *Tecticornia* and *Frankenia* sps.	Perennial herb
Tecticornia uniflora	P4	Bed of salt lake. Low Heath D of *Tecticornia* and *Frankenia* sps.	Shrub
Thysanotus acerosifolius	P2	Heath, mallee, sandplain, lateritic soils	Perennial herb

Table 6 Rare and Priority flora recorded on gypsum soils in the Lake Magenta, Lake King and Lake Grace lake chains and surrounds.

Taxon	Cons Code	Site Description from database	Geographical Distribution	Suggested Gypsophile (g) or gypsum tolerant (t)
Angianthus halophilus	P3	Sandy ridge/island in lake - gypsum	Lake King, Lake Grace, Lake Cairlocup	t
Austrostipa geoffreyi	P1	Lake margins and dunes gypsum , sand, gypsum dune	Lake Grace, Lake King	g
Eucalyptus exigua	P3	Embankment lake edge clay, gypsum	Lake King north to COO2 sub region NW to Cowcowing	t
Eucalyptus quaerenda	P3	gypsum, sandy soils over clay and sandy soils, near salt lake	Lake Altham area to Lake King and upper Phillips River	t
Fitzwillia axilliflora	P2	saline lake, edge salt lake, saline basin, gypsum	Newdegate /Lake Bryde North to Morawa area	t
Frankenia drummondii	P3	lunette/low dune adjacent saline pan - sandy loam soils, loamy sand road verge, gypsum dune, sandy clay, low rise trace gypsum loamy sand, sand dune sand, sandy loam, 10m from salt pan	Kondinin to Salmon Gums south to Gnowangerup Shire	t
Frankenia sp. southern gypsum (M.N. Lyons 2864)	P1	Low rise gypsum, gypsum, saline grey clay	S Pingaring, Quarry Lake area, Lake Magenta. L King, L Cobham	g
Goodenia integerrima	R	gypsum clay, clay sand, margin salt lake, islet in salt lake, sandy island in salt lake	Lake King	g

Goodenia salina	P2	gypsiferous dune on shore of saline pan, previous gypsum mine, islet in salt lake, loamy sand , gypsum	Lake King, Lake Altham, Lake Cairlocup, L Cobham	g
Haegiela tatei	P4	gypsum dune, sand dune, Greens mining lease, gypsum	Mainly MAL1 and MAL2 sub regions. 2 sites in COO2 and 1 site east of Geraldton	t
Hydrocotyle sp. Hexaptera (T Erickson TEE 173)	P1	sandy island, sand fringing salt lake, low flat subject to inundation, gypsum	Lake King,	g
Microseris scapigera	P3	Kopi dune, lunette adjacent to saline pan, sand, gypsum	Mainly MAL1 and MAL2 sub regions	t
Millotia steetziana	P2	saline flat, sandy soils over clay, rise adjacent to salt lake - sand, sandy soil, sand/loam rise in saline drainage line, gypsum	Kondinin, Chinocup, Lake King	t
Pimelea halophila	P2	sandy island, raised white island, islet in salt lake, clayey sand, sand over clay, adjacent to gypsum mine, edge of salt lake clay loam, sandy soil with gypsum	Lake King in Lake Grace shire, Ravensthorpe shire, Esperance shire	t
Roycea pycnophylloides	R	samphire/gypsum dune edge of salt lake, low rise, loamy sand trace gypsum , sandy salt lands, very low sandy rise, clay pan, sand, clay, seasonally inundated flat, lake, sand salt clay pan, clay, adjacent to salt lake	Cunderdin to lake King and south to Kent shire	t
Sarcocornia globosa	P3	Saline flat adjacent to salt lake, sand , sandy clay, gypsum, Southern shore	Chinocup and Lake Fox to East Geraldton	t

Table 9 Rare and priority flora recorded for salt lakes but not on gypsum soils in the Lake Magenta, Lake King and Lake Grace lake chains and surrounds.

Taxon		Site description from data base	Geographical Distribution	Comments
Drosera salina	P2	Drainage line sand, adjacent salt lake sandy soils over clay, sand over clay silt	Esperance, Kent and Lake Grace shires	Associated with salt lake margins
Eremophila serpens	P4	sandy soils, sandy loam, dunes, margin of salt lakes	Hyden, Newdegate, Esperance	Associated with salt lakes
Eremophila subteretifolia	R	sand or sandy loam, margin of salt lakes	Lake king area and NW Ravensthorpe	Associated with salt lakes
Hydrocotyle muriculata	P1	raised margin of salt lake, clay loam	Broomhill-Tambellup, Cranbrook, Kent, Kulin and L Grace shires	SE edge of salt lake, gypsum tolerant species associated
Lepidobolus spiralis	P2	sand fringing salt lake	Lake King, Frank Hann NP	edge of salt lakes
Pauridia salina (previously *Hypoxis salina*)	P1	saline drainage line, sandy soils over clay	Chinocup Lake King	Associated with salt lake margins and gypsum tolerant species associated
Pultenaea daena	P3	Adjacent to salt lake. Loam soils over dolomite and sandy soils. Disturbed area - dolomite mine and burnt area adjacent to salt lake.	Esperance, Jerramungup, Kondinin, Lake Grace, Ravensthorpe shires	
Stylidium pulviniforme	P3	small dune west shore, sand, clay	Lake Cobham to Salmon Gums and into Dundas and Yilgarn shires	Salt lakes, saline sand
Tecticornia uniflora	P4	Bed of salt lake	Albany to Kent shire	
Tribonanthes minor	P3	sand within saline drainage line, slight rise above salt lake , shallow sand at lake edge, sand over clay, flat terrain	Lake king, Chinocup	Salt Lake edge

Three priority species were found in the area covered by the proposed gypsum mine at Lake Morris, *Frankenia* sp. southern gypsum (M.N. Lyons 2864) P1, *Fitzwillia axilliflora* P2 and *Pimelea halophila* P2. *Eremophila verticillata* (Declared Rare Flora) has 2 sub populations adjacent to Lake Cobham. The proposed gypsum mine at Lake Morris is about 2.5 kms from the rare flora populations and should not impact on them.

***Frankenia* sp. southern gypsum (M.N. Lyons 2864) P1**

Frankenia sp. southern gypsum (M.N. Lyons 2864) is a spreading to prostrate shrub growing on gypsiferous soils. This species was recorded at all *Tecticornia* Scrub/Heath Sites and 5 of the Mixed Low Heath sites. *Frankenia* sp. southern gypsum (M.N. Lyons 2864) was also recorded at 13 out of 25 10x10m quadrats sampled in the Lake Magenta Lake Chain including Lake Burkett, Lake Lockhart, Lake Magenta and Lake Cobham in survey work carried out by the author in 2009. This *Frankenia* was found on gypsum dunes, slight rises on the lake bed and lake bed on gypsiferous soils ranging from 97-3% gypsum content. These quadrats were sampled as part of a "Survey and Analysis of Plant Communities Growing on Gypsum in the WA Wheatbelt" by Anne Rick (2011).

Previously *Frankenia* sp. southern gypsum (M.N. Lyons 2864) was known only from Lake King, Lake Varley, Quarry Lake and Fisher Lake with only three voucher collections present at the WA Herbarium. The genus *Frankenia* is at present being revised and confusion relating to a number of species still remains. The new 2009 and 2013 collections from the Lake Magenta lake chain indicate that this species is not as rare as previously thought. It is not expected that the proposed mining will therefore greatly impact on the conservation of this species. It should be noted that *Frankenia* sp. southern gypsum (M.N. Lyons 2864) was also recorded at Lake Cobham in areas regenerating after past mining operations.

Photograph 7 *Frankenia* sp. southern gypsum (M.N. Lyons 2864) at Site LM 3

***Pimelea halophila* P2**

Pimelea halophila is a dwarf, cushion-like shrub, 1.5cm to 15 cm in height and flowers from August to October. It occurs on clayey sand, sand over clay and sandy soils with gypsum in salt lake habitats. This species has previously been known to occur from Lake King to North and East of Esperance and has recently been revised from P4 to P2. The present record is a range extension. 193 plants were recorded along the gypsum ridge from site LM 16 to LM 19. Figure 3 maps the extent of the population in the survey area.

Photograph 8 *Pimelea halophila* P2 at Lake Morris

***Fitzwillia axilliflora* P2**

Fitzwillia axilliflora is an annual herb 3 to 13.5 cm in height, flowering from September to November and growing in sand, clay loam and gypsum associated with salt lakes. This species has been recorded in the shires of Kent, Lake Grace, Morawa and Wyalkatchem. In the present survey *Fitzwillia axilliflora* was recorded at site LM 13. Figure 4 maps the extent of the population.

Figure 3 The distribution of priority flora *Fitzwillia axilliflora* P2 and *Pimelea halophila* P2 at Lake Morris.

3.3 Conservation Significance

Threatened Ecological Communities
The Department of Parks and Wildlife provided results of a search undertaken on the Threatened Ecological Communities database. The following ecological community is recorded approximately 9.5 kms south of the proposed gypsum mine.

The 'Vunerable' threatened ecological community – 'Herblands and Bunch grasslands on gypsum lunette dunes alongside saline playa lakes'

The description of this community from Mattiske (1995) site G226 is included in Appendix 2. The level of gypsum at this site was 5% at 0 and 50cms. This community was not found during the present survey at Lake Morris.

Conservation Significance of Vegetation associations
The Mallee, *Melaleuca* Scrub/Thicket (adjacent to lake) and *Tecticornia* Scrub/Heath (lake bed) vegetation associations recorded at Lake Morris are extensive throughout the Lake Magenta salt lake system. The gypsum ridges with the Mixed Low Heath vegetation cover much smaller areas but are not uncommon in the lake system. Large areas of salt lake vegetation are conserved in the Lake Magenta Nature Reserve and smaller areas in Lake Lockhart Nature Reserve. Although the species composition of these associations is expected to change over distance Lake Morris is only 1 kilometer east of Lake Magenta.

Conservation Significance of Priority Species
Frankenia sp. southern gypsum (M.N. Lyons 2864) P1 occurs throughout the area surveyed. Recent surveys in the Lake Magenta and Lake King lake chains have found this species to be more common than previously thought (Rick 2009, 2011) and the proposed mine should not impact on the overall conservation of this species especially as it was recorded in areas regenerating after previous mining operations at lake Cobham.

Of greatest concern is the presence of priority flora *Fitzwillia axilliflora* P2 and *Pimelea halophila* P2. The distribution of these species needs to be taken into consideration when planning the extraction of gypsum from the area.

3.4 Survey Limitations

The survey work was limited because of the following seasonal and time constraints. Fieldwork which covers only two days of the year cannot be expected to exclude the possibility that there are still rare flora in the sites surveyed that have not as yet been located. Although the best time for survey is during the spring some plant species will flower at other times of the year, some species do not flower every year and some species are not identifiable or even visible except for short periods of time.

Searches carried out at other times of the year, especially early spring may find other populations of rare flora and increase the plant species list for the area.

4.0 References

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Appendix 1

Lake Morris

Proposed Gypsum Mine

Vegetation and Flora

Site

Descriptions

Site LM 1 **Mallee** **Map unit Eu**

Soils and Topography: Higher ground adjacent to the salt lake on gently sloping terrain on sandy soils over clay**.**

GPS (WGS 84) 33° 28′ 34.5″ 119◦ 14′ 02.0″

Diagnosis (Muir 1977): Tree Mallee (and scattered trees) over Scrub over Low Scrub B over Open Dwarf Scrub D over Very Open Herbs

Condition: Pristine to excellent

Vegetation Description

Stratum 1 Tree mallee to 6ms (30-70% canopy cover) including *Eucalyptus scyphocalyx* and scattered trees of *Eucalyptus urna*.

Stratum 2 Shrubs over 2m (10-20% canopy cover) including *Melaleuca acuminata, Melaleuca lateriflora, Melaleuca thyoides, Melaleuca lanceolata* and *Melaleuca brophyi.*

Stratum 3 Shrubs to 1.5ms (10-20% canopy cover) including *Darwinia* sp. Karonie, *Cyathostemon tenuifolius, Conostephium drummondii* and *Exocarpos aphyllus.*

Stratum 4 Shrubs to 0.5ms (2-10% canopy cover) including *Rinzia communis, Darwinia* sp. Karonie and *Calytrix leschenaultii.*

Stratum 5 Perennial and annual herbs (2-10% canopy cover) including *Waitzia acuminata* (abundant), *Levenhookia stipitata* and *Centrolepis pilosa*.

Site LM 2 **Melaleuca Scrub/Thicket** **Map Unit Me**

Soils and Topography: Edge of salt lake. Sandy soils over clay

GPS (WGS 84) 33° 28′ 33.42″ 119° 14′ 03.04″

Diagnosis (Muir 1977): Thicket (Scrub closer to the lake edge)

Condition: Pristine to excellent

Vegetation Description

Stratum 1 Shrubs over 2ms (30 - 70% canopy cover). Patchy in distribution becoming sparse (10-30% canopy cover) closer to the lake edge. Species recorded include *Melaleuca thyoides*, *Melaleuca brophyi* and *Melaleuca hamulosa*.

Scattered shrubs to 1.5 ms include Darwinia sp Karonie, *Conostephium drummondii* and *Cyathostemon tenuifolius.*

Scattered shrubs to 0.5ms include *Rinzia communis and Tecticornia* (samphire) species.

Site LM 3	***Tecticornia* Heath**	**Map Unit Te**
Soils and Topography:	Lake Bed, area subject to inundation. Gypsum over clay soils	
Way point:	003	
GPS (WGS 84)	33° 28′ 31.9″	119° 14′ 07.9″
Diagnosis (Muir 1977):	Low Heath D	
Condition:	Pristine	

Vegetation Description

Stratum 1 Shrubs to 20cms (30-70% canopy cover). Samphire shrubs including *Tecticornia halocnemoides* and *Tecticornia syncarpa* are dominant. *Frankenia* sp southern gypsum P1 was also recorded at this site.

Site LM 4	**Mixed Low Heath**	**Map Unit M**

Soils and Topography: Ridge of gypsum adjacent to a small lake. Gypsiferous soils over clay**.**

Way point: 004

GPS (WGS 84) 33° 28′ 32.7″ 119° 14′ 10.1″

Diagnosis (Muir 1977): Low Heath D

Condition: Excellent condition. The weed *Parapholis incurva was recorded

Vegetation Description

Stratum 1 Shrubs to 30cms (30-70% canopy cover). Samphire shrubs prominent including *Tecticornia halocnemoides* and *Tecticornia ?syncarpa*. Other species recorded include *Lawrencia squamata, Maireana oppositifolia* and *Frankenia* sp. southern gypsum P1.

Scattered annual herbs include *Calandrinia* ?sp Meckering and *Trichanthodium skirriphorum.*

Scattered grass weed **Parapholis incurva* recorded

Site LM 5	***Tecticornia* Heath**	**Map Unit Te**

Soils and Topography: Lake bed, slight depression with wet soils, area subject to inundation. Gypsiferous soils over clay

Way point: 005

GPS (WGS 84) 33° 28′ 33.1″ 119° 14′ 15.1″

Diagnosis (Muir 1977): Low Heath D

Condition: Excellent condition. The weed species *Spergularia marina and *Parapholis incurva were recorded.

Vegetation Description

Stratum 1 Shrubs to 20cms (30-70% canopy cover). Samphire dominant including *Tecticornia halocnemoides* and *Tecticornia ?syncarpa*. Other shrub species recorded include *Frankenia* sp southern gypsum P1.

Scattered Calandrinia ?sp.Meckering herbs

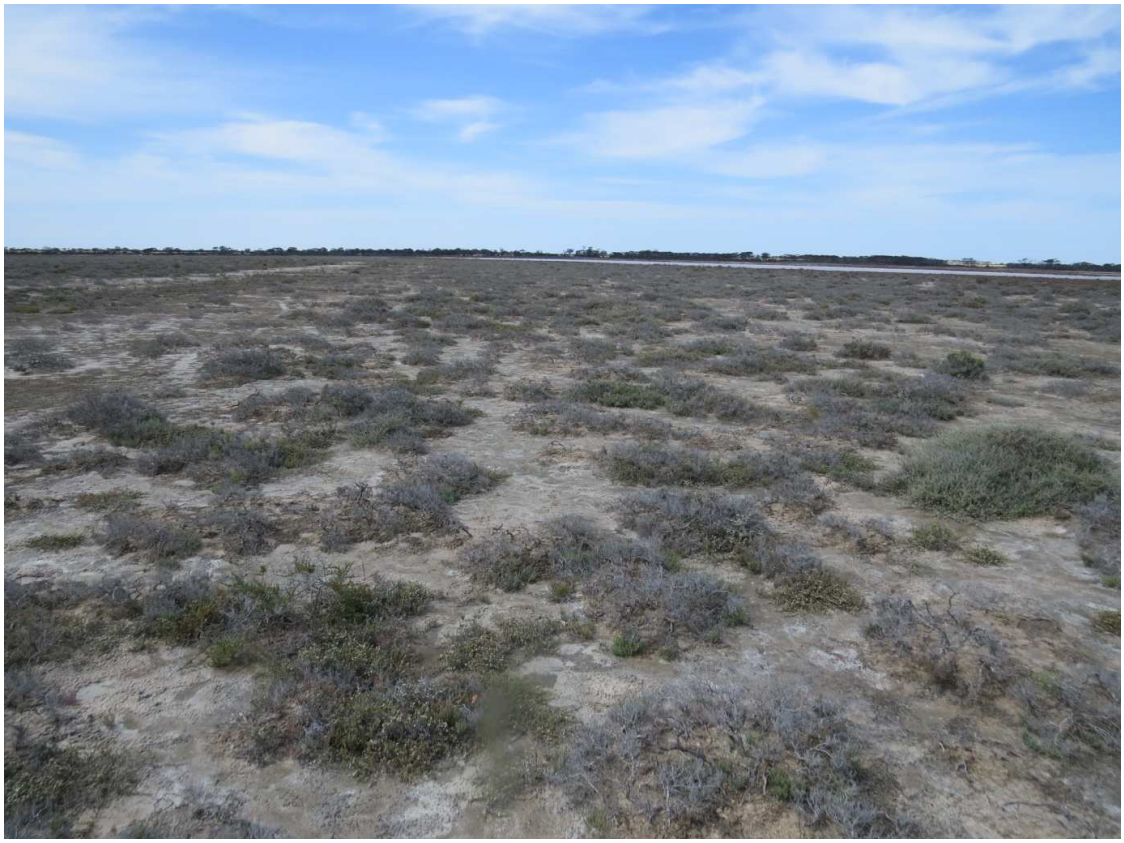
Scattered weed species including grass *Parapholis incurva and annual herb *Spergularia marina.

Site LM 6	***Tecticornia* Heath**	**Map Unit Te**
Soils and Topography:	Lake bed, area subject to inundation. Gypsiferous soils over clay	
Way point:	006	
GPS (WGS 84)	33° 28′ 34.7″	119° 14′ 18.1″
Diagnosis (Muir 1977):	Low Heath D	
Condition:	Excellent. Some dead shrubs	

Vegetation Description

Stratum 1 Shrubs to 20cms (30-70% canopy cover). Samphire shrubs including *Tecticornia moniliformis* are dominant. *Frankenia* sp. southern gypsum P1 and *Maireana oppositifolia* were also recorded.

Scattered herbs of Calandrinia ?sp. Meckering



Site LM 7 ***Tecticornia* Scrub** **Map Unit Te**

Soils and Topography: Lake bed, subject to inundation, slight ridge. Gypsiferous soils over clay.

Way point: 007

GPS (WGS 84) 33° 28′ 38.6″ 119° 14′ 20.1″

Diagnosis (Muir 1977): Dwarf Scrub D

Condition: Excellent with sparse vegetation and some dead plants

Vegetation Description

Stratum 1 Shrubs 20cms (10-30% canopy cover). Samphire dominant including *Tecticornia loriae* and *Tecticornia ?syncarpa*. Other shrubs recorded include *Frankenia* sp. southern gypsum P1 and *Didymanthus roei*.

Scattered annual herbs of *Calandrinia* ?sp. Meckering.

Site LM 8 ***Tecticornia* Scrub** **Map Unit Te**

Soils and Topography: Lake bed, subject to inundation. Gypsiferous soils over clay

Way point: 008

GPS (WGS 84) 33° 28′ 26.2″ 119° 14′ 19.4″

Diagnosis (Muir 1977): Dwarf Scrub D

Condition: Excellent. Some weed – grass ***Parapholis incurva***

Vegetation Description

Stratum 1 Shrubs to 30cms (10-30% canopy cover). Samphire shrubs are dominant including *Tecticornia loriae* and *Tecticornia halocnemoides*. *Frankenia* sp. southern gypsum P1 and *Maireana oppositifolia* were also recorded.

Scattered annual herbs of Calandrinia ?sp. Meckering

Scattered grass weed ***Parapholis incurva***.

Site LM 9	***Tecticornia* Heath**	**Map Unit Te**
Soils and Topography:	Lake bed, subject to inundation, flat next to lake edge, gypsiferous soils over clay	
Way point:	009	
GPS (WGS 84)	33° 28′ 23.2″	119° 14′ 25.6″
Diagnosis (Muir 1977):	Low Heath D	
Condition:	Excellent to pristine	

Vegetation Description

Stratum 1 Shrubs to 20cms (30-70% canopy cover). Samphire shrubs are dominant including *Tecticornia ?syncarpa* and *Tecticornia ?halocnemoides*. *Frankenia* sp. southern gypsum P1 was also recorded.

Scattered annual herb of *Calandrinia* ?sp. Meckering

Site LM 10	**Mixed Low Heath**	**Map Unit M**
Soils and Topography:	Gypsum ridge adjacent to the water's edge. Gypsiferous soils over clay	
Way point:	010	
GPS (WGS 84)	33° 28′ 17.5″	119° 14′ 12.9″
Diagnosis (Muir 1977):	Low Heath D	
Condition:	Pristine	

Vegetation Description

Stratum 1 Shrubs to 40cms (30-70% canopy cover) including *Tecticornia* species (prominent), *Disphyma crassifolia*, *Lawrencia squamata*, *Maireana oppositifolia* and *Frankenia* sp.southern gypsum P1

Scattered annual herbs including *Calandrinia* ?sp. Meckering, *Isotoma scapigera* and *Trichanthodium skirrophorum* were also recorded.

Site LM 11	**Mixed Low Heath**	**Map Unit M**

Soils and Topography: Gypsum ridge, adjacent to lake edge.

Way point: 011

GPS (WGS 84) 33° 28′ 12.4″ 119° 14′ 16.8″

Diagnosis (Muir 1977): Low Heath D. Scattered shrubs to 1.0ms.

Condition: Pristine to excellent

Vegetation Description

Stratum 1 Shrubs to 0.5ms (30-70% canopy cover) including *Tecticornia moniliformis* (prominent), *Lawrencia squamata*, *Rhagodia drummondii*, *Frankenia* sp. southern gypsum P1, *Disphyma crassifolia*, *Leucopogon* sp. Kau Rock and *Frankenia tetrapetala*.

Scattered shrubs to1.0m including *Darwinia* sp. karonie, *Melaleuca brevifolia* and *Scaevola spinescens*
Scattered annual herbs including *Isotoma scapigera* and *Calandrinia* ?sp. Meckering
Scattered perennial herb *Lomandra micrantha* subsp. *teretifolia*
Scattered grasses including *Austrostipa juncifolia* and *Austrostipa pycnostachya*
Creeping vine *Billardiera lehmanniana*

Site LM 12 **Mixed Low Heath** **Map Unit M**

Soils and Topography: Gypsum ridge adjacent to the lake edge.

Way point: 012

GPS (WGS 84) 33° 28′ 08.7″ 119° 14′ 13.8″

Diagnosis (Muir 1977): Low Heath D. Scattered shrubs to 1.0ms.

Condition: Pristine to excellent

Vegetation Description

Stratum 1 Shrubs to 0.5ms (30-70% canopy cover) including *Tecticornia* species, *Rhagodia drummondii, Lawrencia squamata, Maireana oppositifolia, Frankenia tetrapetala* and *Disphyma crassifolia.*

Scattered shrubs to 1.0m include *Darwinia* sp. Karonie, *Melaleuca brevifolia* and *Scaevola spinescens.*
Scattered annual herbs include *Isotoma scapigera* and *Calandrinia* ?sp. Meckering
Scattered perennial herb *Lomandra micrantha* subsp. *teretifolia*
Scattered grasses include *Austrostipa juncifolia* and *Austrostipa pycnostachyus*
Billardiera lehmanniana twinning vine

Site LM 13	**Mixed Low Heath**	**Map Unit M**

Soils and Topography: Ridge of gypsum adjacent to the lake edge.

Way point: 013

GPS (WGS 84) 33° 28′ 01.1″ 119° 14′ 14.0″

Diagnosis (Muir 1977): Low Heath D. Scattered shrubs to 2m.

Condition: Excellent

Vegetation Description

Stratum 1 Shrubs to 0.5m (30-70% canopy cover) including *Tecticornia* species (prominent), *Disphyma crassifolia, Lawrencia squamata*, *Maireana oppositifolia, Atriplex paludosa, Rhagodia drummondii, Leucopogon* sp. Kau Rock and *Frankenia tetrapetala*.

Scattered shrubs to 2m including *Melaleuca brevifolia* and *Darwinia* sp. Karonie
Scattered grasses to 1.5m including *Austrostipa juncifolia* and *Austrostipa pycnostachya*
Scattered herbaceous species including *Fitzwillia axilliflora* P2, *Brachyscome ciliaris*, *Trichanthodium skirrophorum, Isotoma scapigera, Calandrinia* ?sp. Meckering and *Lomandra micrantha* subsp. *teretifolia*.
Twinning Vine - *Comesperma integerrimum*
Grass weed **Parapholis incurva*

Site LM 14	**Mixed Low Heath**	**Map Unit M**
Soils and Topography:	Ridge of gypsum adjacent to the lake edge. Gypsiferous soils over clay at depth	
Way point:	014	
GPS (WGS 84)	33° 28′ 00″	119° 14′ 17.9″
Diagnosis (Muir 1977):	Low Heath D	
Condition:	Excellent	

Vegetation Description

Stratum 1 Shrubs to 0.5 m in height (30-70% canopy cover) including *Tecticornia* species (dominant), *Disphyma crassifolia, Maireana oppositifolia, Lawrencia squamata, Leucopogon* sp. Kau Rock and *Darwinia* sp. Karonie.

Scattered herbaceous species including *Isotoma scapigera, Trichanthodium skirrophorum, Lomandra micrantha* subsp. *teretifolia* and *Calandrinia* ?sp. Meckering. Scattered grasses including *Austrostipa juncifolia, Austrostipa pycnostachya* and the weed **Parapholis incurva*

Site LM 15	**Mixed Low Heath**	**Map Unit M**

Soils and Topography: Ridge of gypsum adjacent to the lake edge.

Way point: 015

GPS (WGS 84) 33° 28′ 10.8″ 119° 14′ 25.3″

Diagnosis (Muir 1977): Very Open Tall grass over Low Heath D

Condition: Pristine to excellent

Vegetation Description

Stratum 1 *Austrostipa juncifolia* grass to 1.0m (2-10% canopy cover)

Stratum 2 Shrubs to 0.5ms (30-70% canopy cover) including *Tecticornia moniliformis* (prominent), *Maireana oppositifolia, Lawrencia squamata* and *Disphyma crassifolia*.

Scattered annual herbs including *Isotoma scapigera, Asteridea chaetopoda, Trichanthodium skirrophorum* and *Calandrinia* ?sp. Meckering
Scattered perennial herb *Lomandra micrantha* subsp. t*eretifolia*

Site LM 16	**Start of *Pimelea halophila* P2 population**	
Soils and Topography:	Gypsum ridge.	
Way point:	016	
GPS (WGS 84)	33° 28′ 10.1″	119° 14′ 26.2″
Diagnosis (Muir 1977):	Low Heath D	
Condition:	Pristine	

Vegetation Description

Stratum 1 Shrubs to 0.5ms (30-70% canopy cover) with *Tecticornia* species prominent including *Tecticornia moniliformis*. Other shrub species recorded include *Pimelea halophila* P2, *Lepidium rotundum*, *Disphyma crassifolia, Maireana oppositifolia, Lawrencia squamata*, *Leucopogon* sp. Kau Rock and *Frankenia* sp. southern gypsum P1.

Scattered herbaceous species including *Isotoma scapigera* and *Calandrinia* ?sp. Meckering

***Pimelea halophila* P2**

Site LM 17	**Low Mixed Heath**	**Map Unit M**
Soils and Topography:	Gypsum ridge	
Way point:	017	
GPS (WGS 84)	33° 28′ 05.5″	119° 14′ 31.3″
Diagnosis (Muir 1977):	Low Heath D	
Condition:	Excellent to pristine	

Vegetation Description

Stratum 1 Shrubs to 0.5ms (30-70% canopy cover) with *Tecticornia moniliformis* prominent. Other low shrubs recorded include *Lawrencia squamata, Maireana oppositifolia, Disphyma crassifolia, Lepidium rotundum* and *Pimelea halophila* P2

Scattered herbaceous species including *Brachyscome ciliaris, Calandrinia* ?sp. Meckering, *Isotoma scapigera, Kippistia suaedifolia* and *Trichanthodium skirrophorum*
Scattered grasses including *Austrostipa juncifolia, Austrostipa pycnostachya* and *Austrostipa vickeryana*
Billardiera lehmanniana twinning vine

Site LM 19	**End of Gypsum ridge and *Pimelea halophila* population**	
Way point:	019	
GPS (WGS 84)	33° 28′ 03.1″	119° 14′ 33.0″

Site LM 20	***Tecticornia* Heath**	**Map Unit Te**
Soils and Topography:	Lake bed, subject to inundation, gypsiferous soils over clay	
Way point:	020	
GPS (WGS 84)	33° 28′ 06.2″	119° 14′ 32.9″
Diagnosis (Muir 1977):	Low Heath D	
Condition:	Pristine	

Vegetation Description

Stratum 1 Shrubs to 0.5ms (30-70% canopy cover) with samphires dominant including *Tecticornia syncarpa* and *Tecticornia* sp. 6626. *Frankenia* sp. southern gypsum P2, *Lawrencia squamata* and *Maireana oppositifolia* were also recorded.

Scattered herb Calandrinia ?sp. Meckering

Site LM 21	***Tecticornia* Heath**	**Map Unit Te**
Soils and Topography:	Lake bed, subject to inundation. Gypsiferous soils over clay.	
Way point:	021	
GPS (WGS 84)	33° 28′ 13.5″	119° 14′ 26.2″
Diagnosis (Muir 1977):	Low Heath D	
Condition:	Excellent	

Vegetation Description

Stratum 1 Shrubs to 0.5m (30-70% canopy cover). *Tecticornia halocnemoides* and *Tecticornia pergranulata* are dominant. *Frankenia* sp. southern gypsum P1, *Maireana oppositifolia* and *Disphyma crassifolia* were also recorded.

Scattered *Calandrinia* ?sp. Meckering herbs

Scattered weeds of **Spergularia marina* and **Parapholis incurva*

Site LM 22	***Tecticornia* Heath**	**Map Unit Te**
Soils and Topography:	Lake bed, subject to inundation. Gypsiferous soils over clay.	
Way point:	022	
GPS (WGS 84)	33° 28′ 05.6″	119° 14′ 20.0″
Diagnosis (Muir 1977):	Low Heath D	
Condition:	Pristine	

Vegetation Description

Stratum 1 Shrubs to 0.5m (30-70% canopy cover) with *Tecticornia halocnemoides* and *Tecticornia loriae* dominant. *Frankenia* sp. southern gypsum P1 was also recorded at this site.

Site LM 23	**Mixed Low Heath**		**Map Unit M**
Soils and Topography:	Gypsum ridge		
Way point:	023		
GPS (WGS 84)	33° 28′ 03.7″	119° 14′ 16.2″	
Diagnosis (Muir 1977):	Low Heath D		
Condition:	Excellent		

Vegetation Description

Stratum 1 Shrubs to 0.5ms (30-70% canopy cover) with *Tecticornia* species prominent. Other low shrubs recorded include *Lawrencia squamata, Maireana oppositifolia* and *Disphyma crassifolia*

Scattered herbaceous species including *Calandrinia* ?sp. Meckering, *Isotoma scapigera* and *Trichanthodium skirrophorum*

Site LM 24	**Mixed Low Scrub**		**Map Unit M**
Soils and Topography:	Gypsum ridge		
Way point:	024		
GPS (WGS 84)	33° 28′ 00.1″	119° 14′ 22.9″	
Diagnosis (Muir 1977):	Dwarf Scrub D		
Condition:	Excellent		

Vegetation Description

Stratum 1 Shrubs to 0.5ms (10-30% canopy cover) with *Tecticornia* species prominent. Other low shrubs recorded include *Lawrencia squamata, Maireana oppositifolia, Maireana* sp 6636 and *Frankenia* sp. southern gypsum P1.

Scattered herbaceous species include *Calandrinia* ?sp. Meckering, *Isotoma scapigera* and *Trichanthodium skirrophorum*

Site LM 25 ***Melaleuca* Scrub/Thicket** **Map Unit Me**

Soils and Topography: Edge of salt lake. Sandy soils over clay

GPS (WGS 84) 33° 27′ 47.0″ 119° 14′ 42.0″

Diagnosis (Muir 1977): Scrub over Dwarf Scrub D

Condition: Very Good. Weeds present and some loss of native species.

Vegetation Description

Stratum 1 Shrubs to 4ms in height (10-30% canopy cover) form a patchy distribution. Species recorded include *Melaleuca thyoides* and *Melaleuca halmaturorum.*

Stratum 2 Shrubs to 0.5m (10-30%) including *Tecticornia* species, *Maireana* species, *Frankenia tetrapetala, Disphyma crassifolia, Carpobrotus modestus* and *Lycium australe*

Scattered grass *Austrostipa juncifolia*

Weed species recorded include **Mesembryanthemum nodiflorum, *Lolium* species (rye grass) and ***** *Arctotheca calendula* (cape weed)

Appendix 2

Threatened Ecological Community

Site from

Mattiske (1995)

Mattiske Site G226

Location: VCL east of Reserve 25113

Location Notes: Two adjacent small lakes, 2.4km west of intersection of Magenta Rd and Reserve Rd.

Recorder: Mal Graham **Date:** 2/12/94

Topography: Top of eastern lake edge dune.

Soils: Grey sandy clay

Soil analysis: 5% gypsum

GPS 33° 34' 47" 119° 13' 41"

Comments: Not grazed by livestock despite appearance in photo. Site is apparently natural and undisturbed.

Site	Locn. (within 5m of central point)	Species	Height cm	% cover
G226	5	?Chenopodiaceae sp.	1	5
G226	5	*Danthonia caespitosa = Austrodanthonia setacea* group	1	45
G226	5	*Lawrencia squamata*	20	2
G226	5	*Maireana marginata*	3	0.01
G226	5	*Podolepis rugosa = Podolepis rugata*	10	0.01
G226	5	*Senecio lautus* ssp. *maritimus = Senecio pinnatifolius* var. *maritimus*	4	0.01
G226	+5	*Asteridea chaetopoda*	3	0.01
G226	+5	*Atriplex paludosa* subsp.?*cordata*	20	0.01
G226	+5	*Halosarcia syncarpa = Tecticornia syncarpa*	30	0.01
G226	+5	*Halosarcia* aff. *syncarpa = Tecticornia syncarpa*	30	0.1
G226	+5	*Scaevola spinescens*	40	0.01
G226	+5	*Stipa juncifolia = Austrostipa juncifolia*	50	0.01

Photograph 63: Site No. G226. Location: VCL East of Reserve 25113

Appendix 3

Lake Morris

Proposed Gypsum Mine

Plant

Species

List

Species List for the Proposed Gypsum Mine At Lake Morris

***Introduced weed species**

	Taxon Name	Collecting Number
110	**Aizoaceae**	
	Carpobrotus modestus	
	Disphyma crassifolium	
	*Mesembryanthemum nodiflorum	
054B	**Asparagaceae**	
	Lomandra micrantha subsp. teretifolia	6601
345	**Asteraceae**	
	*Arctotheca calendula	
	Asteridea chaetopoda	6618
	Brachyscome ciliaris	6609
	Fitzwillia axilliflora	6611
	Kippistia suaedifolia	6625
	Trichanthodium skirrophorum	6619
	Waitzia acuminata	
138	**Brassicaceae**	
	Lepidium rotundum	6621
339	**Campanulaceae**	
	Isotoma scapigera	6617
113	**Caryophyllaceae**	
	*Spergularia marina	6579
40	**Centrolepidaceae**	
	Centrolepis pilosa	6563
105	**Chenopodiaceae**	
	Atriplex paludosa	6604
	Didymanthus roei	6584
	Maireana oppositifolia	6615
	Rhagodia drummondii	6597 6610
	Tecticornia halocnemoides	6566 6567 6572 6573 6575 6576 6578 6587 6588 6629 6632 6633 6634
	Tecticornia loriae	6581 6583 6585 6586 6635
	Tecticornia moniliformis	6580 6591 6592 6614 6623
	Tecticornia pergranulata	6631
	Tecticornia syncarpa	6570 6574 6582 6627
	Tecticornia sp	6626
287	**Ericaceae**	
	Conostephium drummondii	6562
	Leucopogon sp. Kau Rock (M.A. Burgman 1126)	6600
236	**Frankeniaceae**	
	Frankenia sp. southern gypsum (M.N. Lyons 2864)	6568 6577 6589 6598 6628 6630

	Frankenia tetrapetala	6607 6612 6637
341	**Goodeniaceae**	
	Scaevola spinescens	6595
221	**Malvaceae**	
	Lawrencia squamata	6590
273	**Myrtaceae**	
	Calytrix leschenaultii	
	Cyathostemon tenuifolius	6561
	Darwinia sp. Karonie (K. Newbey 8503)	6560 6593
	Eucalyptus scyphocalyx	6565
	Eucalyptus urna	
	Melaleuca acuminata	
	Melaleuca brevifolia	6594
	Melaleuca halmaturorum	
	Melaleuca brophyi	6558
	Melaleuca hamulosa	6559
	Melaleuca lanceolata	6571
	Melaleuca lateriflora	
	Melaleuca thyoides	
	Rinzia communis	
152	**Pittosporaceae**	
	Billardiera lehmanniana	6596
31	**Poaceae**	
	Austrostipa juncifolia	6599 6603 6613
	Austrostipa pycnostachya	6605
	Austrostipa pycnostachya	6602
	Austrostipa vickeryana	6624
	*Lolium species	
	*Parapholis incurva	6569
183	**Polygalaceae**	
	Comesperma integerrimum	6606
111	**Portulacaceae**	
	Calandrinia ?sp. Meckering (F. Obbens 42/02)	6616
92	**Santalaceae**	
	Exocarpos aphyllus	
315	**Solanaceae**	
	Lycium australe	
343	**Stylidiaceae**	
	Levenhookia stipitata	6564
263	**Thymelaeaceae**	
	Pimelea halophila	6620

Appendix 4

Way Point maps


013
014
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Lake Morris
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© 2014 Cnes/Spot Image
33°28'18.55"


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