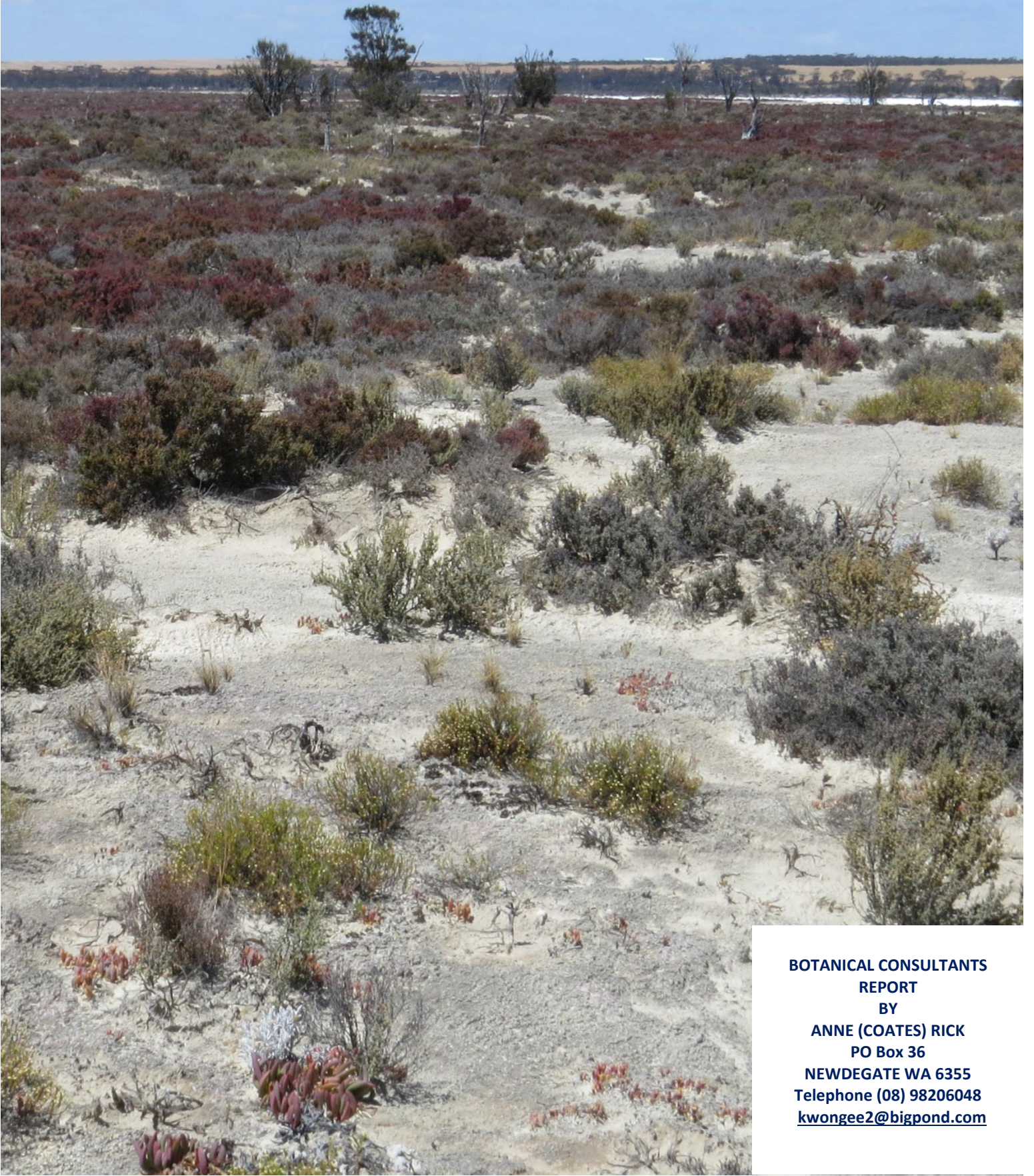


Lake Kathleen Vegetation and Flora Survey



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REPORT
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The scope of the survey may have been limited by time, budget, season, access and or other constraints. In the undertaking of this work the author has made every effort to ensure accuracy of the information provided. Data presented, maps, opinions and conclusions made in the report are done in good faith and the author is not responsible for the interpretation of this information subsequently by others.

SUMMARY

The study area subject to the vegetation and flora survey is the Unallocated Crown Land (UCL) included in exploration licence E70/4815 covering Lake Kathleen. The survey was carried out in order to provide information required for approvals to mine gypsum on the lake. Lake Kathleen is situated approximately 10km north of the Lake King town site in the Lake Grace Shire.

The ground survey of the vegetation and flora was carried out on the 21st and 22nd November 2017. Data collection was through targeted and opportunistic searches including multiple quadrats, releves and traverses. Areas of interest delineated from aerial photographs were visited for accurate vegetation mapping. 10x10m quadrats and releves were sampled to assist with the vegetation mapping and the flora survey. Plant voucher specimens were collected to assist in accurate plant identification. Searches for Threatened, Priority and other significant flora were made during the traverses walked through the survey area.

Information collected at each site or quadrat included a GPS location, a vegetation description (Muir 1977) (ESCAVI 2003), vegetation condition (B.J. Keighery 1994), an inventory of plant species, the presence of Threatened or Priority Flora and a physical description including soils and topography. A high resolution digital photograph was also taken.

The vegetation types mapped and described in this study include *Tecticornia* (samphire) shrublands growing on gypsum over clay on the lake bed, mixed species shrubland occurring on low rises/ridges of gypsum, *Casuarina obesa* open woodland occurring on dunes/ridges and *Melaleuca* shrublands fringing the edge of the lake. Adjacent to the lake, largely on privately owned land, are woodlands of *Eucalyptus kondininensis* (Kondinin blackbutt), *Eucalyptus longicornis* (morrel) and *Eucalyptus salubris* (gimlet).

Chains of salt lakes such as the Lake King system are important vegetation corridors in an already extensively cleared landscape. In general salt lake chains and gypsum dune systems constitute a relatively small portion of the overall native vegetation of the Western Mallee sub region and therefore have a high conservation value. Large areas of the salt lake country have yet to be surveyed and it is therefore difficult to assess the extent of vegetation types confined to gypsum in the sub region.

No Threatened Ecological communities occurring on gypsiferous soils were found during the present survey. However woodlands adjacent to the Lake Kathleen salt lake on privately owned land may meet key diagnostic characteristics for the "Eucalypt Woodlands of the WA Wheatbelt" which have been classified as Critically Endangered and Priority 1: Red Morrel Woodland of the Wheatbelt (a component of the Eucalypt Woodlands of the WA Wheatbelt EPBC listed TEC). The presence of these adjacent woodlands needs to be taken into consideration when planning operations involving clearing.

A total of 87 plant species were recorded during the flora and vegetation survey including 7 introduced species or weeds. Due to the time and seasonal constraints the species list only represents part of the flora of the area.

No Threatened Flora were found in the area of the UCL on Lake Kathleen during the present survey. Five priority species were recorded including *Austrostipa geoffreyi* P1 (1 population), *Fitzwillia axilliflora* P2 (4 populations), *Angianthus halophilus* P3 (2 population), *Frankenia* sp. southern gypsum (M.N. Lyons 2864) P3 (extensive) and *Haegiela tatei* P4 (1 population).

Fitzwillia axilliflora P2 has not been previously recorded in the Lake King salt lake chain. *Austrostipa geoffreyi* P1, *Angianthus halophilus* P3 and *Haegiela tatei* P4 have been recorded from areas adjacent to the causeway in the Lake King Nature Reserve. The extent of these species within this Nature Reserve is not known and further survey work is needed. These species need to be taken into consideration when planning mining activities.

Other significant flora include *Kippistia suaedifolia* (possible gypsophile), *Cratystylis conocephala* (range extension) and *Calendrinia* sp ?Meckering a possible new species. *Kippistia suaedifolia* has a wide distribution in WA, *Cratystylis conocephala* is mainly in areas adjacent to the UCL surveyed and *Calendrinia* sp ?Meckering is not uncommon in the Magenta and Lake King salt lake chains on gypsum. Mining activities should not affect the overall conservation of these species.

Frankenia sp. southern gypsum (M.N. Lyons 2864) P3 was recorded in the *Tecticornia* (samphire) shrublands and mixed species shrublands on the lake bed. Recent surveys however have found this species to be more common than previously thought and further mining operations should not impact on the overall conservation of this species

ACKNOWLEDGEMENTS

The assistance of Western Australian Herbarium staff and other Botanists, particularly Greg Keighery (*Angianthus*), Terry McFarlane (*Thysanotus*) and Frank Obbens (*Calandrinia*), in helping to identify specimens collected at lake Kathleen is gratefully appreciated. Access to the WA Herbarium collections was essential for carrying out the survey.

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1.0 INTRODUCTION

1.1 Survey Objectives

The study area subject to the vegetation and flora survey is the Unallocated Crown Land (UCL) included in exploration licence E70/4815 covering Lake Kathleen. The survey was carried out in order to provide information required for approvals to mine gypsum on the lake. The field work for the present survey was completed before the new Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment was published by the EPA in December 2016. This report follows the new guidance for a detailed survey in most cases. Explanations are provided where deviation from the guidance occur. This report includes

- the description and mapping of vegetation types
- the assessment and mapping of the condition of the vegetation
- the representation in a regional and local context of the vegetation and flora
- a list of plant species recorded during the survey
- a report on Threatened, Priority and other significant flora and Threatened Ecological Communities in the area
- Data collection through targeted and opportunistic searches including multiple quadrats, relevés and traverses

1.2 Background Information

The Interim Biogeographical Regionalisation of Australia Version 7 (2012) divides Western Australia into 23 IBRA Bioregions which are subdivided into 53 IBRA sub regions. IBRA regions are large geographically distinct areas of similar climate, geology, landform, vegetation and fauna communities. The boundaries of the IBRA regions are broadly comparable with the earlier Beard's phytogeographic regions made up of Botanical districts and sub districts. The survey area at Lake Kathleen is situated in the Western Mallee IBRA sub region.

The Western Mallee is a sparsely populated sub region with an area of about 47,000 square kilometers. The sub region is largely cleared for agriculture with about 31% of the sub region's native vegetation remaining. These areas are under environmental stress from threats such as rising salinity (especially valley floor woodlands), vegetation fragmentation, weeds, fire and feral animals. Areas low on the landscape eg salt lakes are also at risk from excess nutrient run off. Around 10% of the sub region is held within nature reserves for conservation purposes covering about 25% of the remaining native vegetation (Sheperd et al 2002). The trends are for decline or rapid decline in vegetation associations and many ecosystems are unknown. Salt lake chains and gypsum dune systems constitute a relatively small portion of the overall native vegetation (McKenzie et al 2002).

The sub region is semi-arid, with a warm, dry, Mediterranean climate. It has seven to eight dry months, and a winter rainfall typically between 250 and 500 millimetres (10–19 in). Industries other than Agriculture include gypsum mining and a tourist industry centered on Wave Rock near Hyden.

There are 3 major salt lake systems in the sub region including the Lake Grace, Lake Magenta and the Lake King salt lake chains. Lake Kathleen is part of the Lake King salt lake chain which

includes Lake Pallarup, Lake King, Lake Camm, Lake Fox, Lake Gulson, Lake Varley, Lake Carmody and Lake Hurlstone (Figure 1). Lake Kathleen is situated approximately 10km north of the Lake King town site in the Lake Grace Shire. Figures 2 from the Department of Mines and Petroleum show the cadastral information and the outline of exploration license E70/4815. The vegetation and flora covering the UCL within the exploration license was surveyed (~920ha). Adjacent privately owned property was not included in the survey (see Figure 3). The area surveyed includes the lake bed and fringing vegetation.



Figure 3: Lake Kathleen showing the boundary of UCL and exploration license E70/4815



1.3 Desk Top Survey

1.3.1 Previous surveys in the Lake Kathleen area.

The survey area is situated in the Western Mallee Interim Biogeographical Regionalisation of Australia (IBRA) sub region and Beard's Hyden Vegetation System which is a subdivision of the Roe Botanical District.

Beard (1979) describes the vegetation of the salt lake areas in the Hyden Vegetation System 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. 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 (1979) has mapped the Lake Kathleen area at a scale of 1:250 000. The map unit covering the study area is bare salt lake and map unit eMi (*Eucalyptus salmonophloia*-*Eucalyptus longicornis*) covering woodland areas to the east of the lake. The area is surrounded by mallee (map unit eSi).

Mattiske Consulting Pty Ltd recorded information from 7 quadrats situated in the Lake King salt lake chain in 1995 as part of "A Review of Botanical values on a range of gypsum dunes in the Wheatbelt of WA". The Mattiske report also includes a description of a site on UCL east of Lake Magenta which is now a Threatened Ecological Community (Appendix 3).

"Survey and Analysis of Plant Communities Growing on Gypsum in the WA Wheatbelt" by Anne Rick (2011) includes quadrat data collected on gypsiferous soils in the Lake King, Lake Magenta and Lake Grace salt lake systems. 7 quadrats from Mattiske (1995), 5 quadrats from Lyons et al (2004) and 5 quadrats from Gibson et al (2004) were situated in the Lake King salt lake chain.

Vegetation and Flora surveys carried out by the author in the Lake Magenta and Lake King salt lake chains in relation to gypsum mining include Lake Cobham (Rick 2010), Lake Morris (2014), Proposed Gypsum Mine M70/1342 south Lake King (2015), Lake Buchan (2016a) and Lake Carmody (2016b).

1.3.2 Threatened Ecological Communities

In Western Australia the Minister for Environment may list an ecological community as being threatened if the community is presumed to be totally destroyed or at risk of becoming totally destroyed. As of May 2014, 376 ecological communities in WA have been entered into the threatened ecological community database. The WA Minister for Environment has endorsed 69 of these and the remaining 307 are allocated to one of five priority categories. Ecological communities with insufficient information available to

be considered a threatened ecological community, or which are rare but not currently threatened, are placed on the Priority list and referred to as Priority Ecological Communities. 25 of these threatened ecological communities are also listed under the Commonwealth's Environment Protection and Biodiversity Conservation Act 1999.

Information on Threatened Ecological Communities growing on gypsum was originally obtained from The Department of Parks and Wildlife Threatened Ecological Communities data base in 2009. This was updated from the Department of Parks and Wildlife Website (2016a 2016b) and the Department of the Environment – EPBC Act Protected Matters report (2015).

The following ecological community is recorded ~77km SSW of Lake Kathleen in the Lake Magenta Lake Chain. The description of this community from Mattiske (1995) G226 is included in Appendix 3. The level of gypsum at this site was 5% at 0 and 50cms.

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

The priority ecological community below is situated in the Lake Grace salt lake chain ~131 km SW of Lake Kathleen.

Priority 2: Ecological Community - Gypsum Dunes (Lake Chinocup) *Eucalyptus* aff. *incrassata* mallee over low scrub on gypsum dunes.

Critically Endangered - Eucalypt Woodlands of the WA Wheatbelt

The Threatened Ecological Community "Eucalypt Woodlands of the Western Australian Wheatbelt" has been listed under the Commonwealth's Environment Protection and Biodiversity Conservation Act 1999 as Critically Endangered. Western Australia has listed this threatened community as a Priority 3 (iii) Ecological Community.

Priority 1: Red Morrell Woodland of the Wheatbelt (a component of the Eucalypt Woodlands of the WA Wheatbelt EPBC listed TEC)

Tall open woodlands of *Eucalyptus longicornis* (red morrell) found in the wheatbelt on lateritic, ironstone or granitic soil types. Sometimes found with *Eucalyptus salmonophloia* (salmon gum) or *Eucalyptus loxophleba* (York gum) woodlands and has very little understorey. It is also found directly above lake systems in the central and eastern wheatbelt. The landscape unit in which it is found is valley floors, usually adjacent to saline areas.

1.3.3 Threatened and Priority Flora

Department of Parks and Wildlife Conservation Codes

The Department of Parks and Wildlife classifies Threatened and Priority Flora into categories which reflect their conservation status. These categories are listed below:

T Threatened Species

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

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. These categories include Critically endangered, Endangered, Vulnerable and Presumed extinct species

P Priority Species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Flora lists under Priority 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. 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 list for other than taxonomic reasons, are placed in Priority 4. These species require further monitoring.

Details of codes can be found in Appendix 5

The Department of Parks and Wildlife supplied information on Threatened and Priority flora known to occur in the Lake Kathleen area. 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) and information from Rick (2011). This information has been updated using NatureMap (<https://naturemap.dpaw.wa.gov.au/>) and FloraBase (<http://florabase.dpaw.wa.gov.au/>)

Appendix 6 lists Threatened and Priority Flora occurring in the Lake King Salt Lake System. Species that have been recorded on gypsum soils are in red. Species that have been recorded within a 5km, 10km and 20km radius of Lake Kathleen on NatureMap are also indicated. Appendix 7 includes Threatened and Priority Flora recorded on gypsum in the Lake Magenta, Lake King and Lake Grace salt lake chains.

2.0 METHOD

2.1 Scope of survey

This survey was carried out in order to provide information required for approvals to mine gypsum on Lake Kathleen. The field work for the present survey was completed before the new Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment was published by the EPA in December 2016. However this report follows the new guidance for a detailed survey except for the requirement for multivariate analysis. This was not carried out due to time limitations and can be carried out at a later date if seen to be necessary.

2.2 Field Survey

The ground survey of the vegetation and flora of the study area was carried out on 21st and 22nd November 2016. The work included data collection through targeted and opportunistic searches. Traverses were made through the survey area to collect data to map vegetation boundaries, describe vegetation types and examine habitat where rare flora was likely to occur.

General vegetation divisions were noted using aerial photography. Areas of interest thus delineated were examined in the field and the vegetation at selected sites (relevés) described. Quadrats were sampled in areas characteristic of the vegetation types encountered. Because of time limitations and difficulties with access 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 used in the field to increase the accuracy of the vegetation and flora mapping.

Vegetation type descriptions were based on the National Vegetation Information System (NVIS) (ESCAVI 2003) as per the Guidance requirements (EPA 2016) Table 2. The classification system devised by Muir (1977) which was specifically designed for describing wheatbelt vegetation was also used (see Table 1). The Muir descriptions were included so that comparisons can be made with previous surveys that have used this classification system in the past. The Muir classification system has been used extensively in the Wheatbelt and Mallee regions.

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).

19 quadrats were sampled in areas typical of the vegetation types described. These quadrats were in general 10x10m however 5x20m quadrats were used where sampling sites were narrow ridges. Data from 18 relevés was also recorded to assist with vegetation mapping, vegetation descriptions and the compilation of a comprehensive plant species list. Relevés were up to 30m in diameter but only included areas considered typical of the vegetation type being described.

Information recorded at each releve or quadrat included:

- GPS location at the centre of releves and the NW corner of quadrats.
- Vegetation classification - Muir description (1977) and NVIS (2003)
- Vegetation condition
- Inventory of plant species
- Any threatened or priority species
- Physical description including soils and topography.
- % canopy cover of each species in the quadrats
- A high resolution digital photograph (northern boundary of quadrats)

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 Threatened, Priority and other significant flora were made during the traverses walked through the survey area.

2.3 Survey Limitations

Information on previous salt lake vegetation and flora surveys that have been carried out in the Western Mallee sub region has been summarized in Section 1.3 of this report. Extensive areas of salt lake country have still to be surveyed and our knowledge of gypsum vegetation and flora is still limited. It is therefore difficult to assess the rarity of gypsum vegetation types and some plant species in this sub region.

The author has over 30 years work experience as a Botanical Consultant specifically in plant identification, vegetation mapping and rare flora work in the Avon Wheatbelt and Western Mallee sub regions and lives locally at Newdegate. She is also a member of the Great Southern District Threatened Flora Recovery Team (Department of Parks and Wildlife)

Due to the time and seasonal constraints, Appendix 4 only represents part of the flora of the area. The spring was the best time of year for the flora survey and will provide the most comprehensive species list however further survey work at different times of the year will increase our knowledge of the flora at Lake Kathleen. 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.

Good winter rains in 2016 resulted in a good spring wild flower season however by the time of this November survey some of the herbaceous species were drying out but were still recognizable. The author checked plants of *Goodenia integerrima* (Threatened flora) adjacent to the Lake King causeway at the time of the survey. These plants were at the end of their flowering time but were still identifiable. Fieldwork which covers only 2

days of the year cannot be expected to exclude the possibility that there are still rare flora on the lake that have not as yet been located.

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. Notes in the species list (Appendix 4) explain any issues. See section 4.3 Other Significant Flora for an explanation of the taxonomy of *Calandrinia* sp.?Meckering which is a possible new species.

Most of the UCL was covered in detail during the survey however due to problems with access from the western shore where part of the lake had not dried out after winter rains a small section west of releves 2 and 3 was not included in the field work. In this area vegetation mapping was carried out by extrapolation of known vegetation types using aerial photography.

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 M Trees 15-30m LA Trees 5-15m LB Trees < 5m	Dense Tall Forest Dense Forest Dense Low Forest A Dense Low Forest B	Tall Forest Forest Low Forest A Low Forest B	Tall Woodland Woodland Low Woodland A Low Woodland B	Open Tall Woodland Open Woodland Open Low Woodland A Open Low Woodland B
KT Mallee tree form KS Mallee shrub form	Dense Tree Mallee Dense Shrub Mallee	Tree Mallee Shrub Mallee	Open Tree Mallee Open Shrub Mallee	Very Open Tree Mallee Very Open Shrub Mallee
S Shrubs > 2m SA Shrubs 1.5-2.0m SB Shrubs 1.0-1.5m SC Shrubs 0.5-1.0m SD Shrubs 0.0-0.5m	Dense Thicket Dense Heath A Dense Heath B Dense Low Heath C Dense Low Heath D	Thicket Heath A Heath B Low Heath C Low Heath D	Scrub Low Scrub A Low Scrub B Dwarf Scrub C Dwarf Scrub D	Open Scrub Open Low Scrub A Open Low Scrub B Open Dwarf Scrub C Open Dwarf Scrub D
P Mat plants H Hummock Grass GT Bunch grass > 0.5m GL Bunch grass < 0.5m J Herbaceous spp.	Dense Mat plants Dense Hum. Grass Dense Tall Grass Dense Low Grass Dense Herbs	Mat plants Mid-Dense Hum. Grass Tall Grass Low Grass Herbs	Open Mat plants Hummock Grass Open Tall Grass Open Low Grass Open Herbs	Very Open Mat plants Open Hummock Grass Very Open Tall Grass Very Open Low Grass Very Open Herbs
VT Sedges > 0.5m VL Sedges < 0.5m	Dense Tall Sedges Dense Low Sedges	Tall Sedges Low Sedges	Open Tall Sedges Open Low Sedges	Very Open Tall Sedges Very Open Low Sedges
X Ferns Mosses, liverwort	Dense Ferns Dense Mosses	Ferns Mosses	Open Ferns Open Mosses	Very Open Ferns Very Open Mosses

Table 2: NVIS structural Formation Terminology (ESCAVI 2003)

Cover Characteristics								
	Foliage cover *	70-100	30-70	10-30	<10	≈0	0-5	unknown
	Crown cover **	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
	% Cover ***	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
	Cover code	d	c	i	r	bi	bc	unknown
Growth Form	Height Ranges (m)	Structural Formation Classes						
tree, palm	<10,10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	mallee trees
shrub, cycad, grass-tree, tree-fern	<1,1-2,>2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrubs
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrubs
heath shrub	<1,1-2,>2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrubs
chenopod shrub	<1,1-2,>2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrubs
samphire shrub	<0.5,>0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrubs
hummock grass	<2,>2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grasses
tussock grass	<0.5,>0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grasses
other grass	<0.5,>0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
sedge	<0.5,>0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
rush	<0.5,>0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes
forb	<0.5,>0.5	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs
fern	<1,1-2,>2	closed fernland	fermland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	ferns
bryophyte	<0.5	closed bryophyteland	bryophyteland	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophytes
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichens
vine	<10,10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines
aquatic	0-0.5,<1	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics	aquatics
seagrass	0-0.5,<1	closed seagrass bed	seagrassbed	open seagrassbed	sparse seagrassbed	isolated seagrasses	isolated clumps of seagrasses	seagrasses

Table 3: Vegetation Condition Scale

Table 3 : Vegetation Condition Scale Modified from Trudgen 1991 by B.J. Keighery for the Swan Coastal Plain Survey 1993
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.

3.0 VEGETATION SURVEY

3.1 Lake Kathleen Vegetation Types

The vegetation types mapped and described in this study are outlined in Table 4. Descriptions of the vegetation and flora recorded at releves and quadrats can be found in Appendix 1 and 2. Muir (1977) and NVIS vegetation descriptions are included. The distribution of these vegetation associations within the survey area is shown on the vegetation maps, Figure 4 and 5. Way points indicating the exact location of releves and quadrats are shown on the aerial photographs in Appendix 8.

Table 4 - Vegetation Types on UCL at Lake Kathleen

Vegetation Association	Map Unit	Soils	Topography	Sites and quadrats	Comments
<i>Eucalyptus kondininensis</i> (Kondinin blackbutt) woodland	Ek	Sandy loam and clay soils	Higher ground adjacent to the salt lake	Releves 12, 13, 17	Mainly on private property adjacent to the UCL surveyed
<i>Eucalyptus longicornis</i> (morrel) woodland	El	Loam	Higher ground adjacent to the salt lake, gentle slope	Releve 16	Mainly on private property adjacent to the UCL surveyed
<i>Eucalyptus salubris</i> (gimlet) woodland	Es	Sandy loam over clay	Adjacent to the salt lake, gentle slope	Releve 6	Mainly on private property adjacent to the UCL surveyed
<i>Casuarina obesa</i> open woodland	Co	Gypsum	Dunes/ridges on the lake bed	Releves 4, 10, 15 Quadrats 3, 4, 5, 10	Covering small areas on the lake bed
<i>Melaleuca</i> shrubland	Me	Sand or sandy loam over clay	Edge of the salt lake	Releves 5, 11	narrow strip of vegetation fringing the shore of the salt lake
Mixed species shrubland	Hm	Gypsum	Low ridges /rises on the lake bed	Releves 1, 2, 3, 7, 8, 9, Quadrats 1, 2, 7, 14, 15, 16, 19	Commonly occurring, small areas <2ha. <i>Angianthus halophilus</i> P3, <i>Fitzwillia axilliflora</i> P2, <i>Haegiela tatei</i> P4, <i>Austrostipa geoffreyi</i> P1, <i>Frankenia</i> sp. southern gypsum P3
<i>Tecticornia</i> (samphire) shrubland	Te	Gypsum over clay	Lake bed, flat terrain. Areas subject to inundation	Releve 14 Quadrats 6, 8, 9, 11, 12, 13, 17, 18	Extensive <i>Frankenia</i> sp. southern gypsum P3

***Eucalyptus kondininensis* (Kondinin blackbutt) woodland Ek**

Eucalyptus kondininensis (Kondinin blackbutt) woodlands cover higher ground adjacent to the salt lake, mainly to the east and south of the lake on privately owned land. Trees to 10ms form a sparse upper stratum with canopy cover (10-30%), occasionally to very sparse (2-10%) at releve 17. A mid layer is present at releves 12 and 13 consisting of a mid dense (30-70% canopy cover) stratum of *Melaleuca* shrubs to 3ms in height. Species recorded include *Melaleuca thyoidea*, *Melaleuca brophyi*, *Melaleuca halmaturorum* and *Melaleuca ?scalena*.

At Releve 17 a ground layer is present. *Eremophila decipiens* and *Lycium australe* shrubs to 1.0m form a very sparse (2-10%) layer and chenopod shrubs to 0.5m (30-70% canopy cover) form a mid dense layer including *Atriplex ?paludosa* and *Tecticornia* species.

Other shrub species recorded include *Cyathostemon blackettii*, *Phebalium filifolium*, *Threlkeldia diffusa*, *Conostephium roei*, *Darwinia* sp. Karonie, *Frankenia tetrapetala*, *Disphyma crassifolium* and *Lawrenzia squamata*. Grasses recorded including *Austrostipa elegantissima*, *Austrostipa* species and *Neurachne alopecuroidea*. Scattered perennial herbs (rush) include *Dianella revoluta* and scattered annual herbs (forbs) include *Calandrinia eremaea* and *Crassula exerta*.

The condition of this vegetation type was generally Excellent except in areas adjacent to the Road where grass weeds including wild oats were recorded. **Mesembryanthemum nodiflorum* was also recorded.



***Eucalyptus kondininensis* (Kondinin blackbutt) woodland at Lake Kathleen**

***Eucalyptus longicornis* (Morrel) woodland**

EI

Eucalyptus longicornis Woodland occurs on loam soils near the eastern shore of the salt lake. Almost all of this vegetation association occurs on privately owned land adjacent to the UCL surveyed.

Trees to 20m form a sparse stratum (10-30% canopy cover) with *Eucalyptus longicornis* dominant. Scattered trees of *Eucalyptus kondininensis* and *Eucalyptus ?salicola* and *Eucalyptus ?horistes* mallee were also recorded.

Shrubs of *Melaleuca quadrifaria* form a sparse mid layer (10-30% canopy cover) with scattered shrubs of *Exocarpos aphyllus* to 1.5m. Shrubs to 1.0m form a mid dense ground layer (30-70% canopy cover) including *Cratystylis conocephala* (range extension), *Atriplex ?paludosa*, *Eremophila decipiens*, *Rhagodia drummondii* and *Lycium australis*. *Threlkeldia diffusa* and *Maireana brevifolia* chodod shrubs to 0.5m were also recorded.

The condition of this vegetation type was excellent.



***Eucalyptus longicornis* (Morrel) woodland adjacent to Lake Kathleen**

***Eucalyptus salubris* (gimlet) woodland**

Es

Eucalyptus salubris Woodland was recorded on sandy loam soils over clay near the southern edge of the lake. The vegetation type extends onto privately owned land to the south.

Trees to 8m form a mid dense upper stratum (30-70% canopy cover). A very sparse stratum of *Eucalyptus celastroides* mallee was also recorded. The mid layer consists of a sparse stratum (10-30% canopy cover) of *Melaleuca* shrubs to 3m including *Melaleuca thyoides* and *Melaleuca halmaturorum*. The ground layer consists of a very sparse stratum (2-10% canopy cover) of shrubs 0.5-1.0m including *Eremophila decipiens*, *Rhagodia drummondii*, *Cyathostemon blackettii*, *Microcybe multiflora*, *Phebalium filifolium* and *Olearia muelleri*. Other species recorded include *Threlkeldia diffusa*, *Zygophyllum auranticum*, *Enchylaena tomentosa* and *Acacia erinacea* (shrubs to 0.5m), perennial herbs *Thysanotus lavenduliflorum* and *Ptilotus holosericeus* and scattered annual herbs *Angiathus tomentosus* and *Asteridea athrixioides*.

The condition of this vegetation type was Excellent with weed species **Mesembryanthemum nodiflorum* and **Pentameris airoides* recorded.



***Eucalyptus salubris* (gimlet) woodland adjacent to Lake Kathleen**

***Casuarina obesa* (salt sheoak) open woodland**

Co

Casuarina obesa open woodland occurs on dunes/ridges of gypsum on the lake bed. One area (releve 15) was situated on the edge of the lake. Trees of *Casuarina obesa* to 5m in height form a very sparse upper stratum (2-10% canopy cover). This stratum is patchy and occasionally reaches 10-30% canopy cover. The mid and ground layers are variable. In places shrubs 0.5-1.0m occasionally to 1.5m form a sparse stratum 10-30% canopy cover. Shrub species recorded include *Melaleuca halmaturorum*, *Melaleuca ?scalena*, *Alyxia buxifolia*, *Exocarpos aphyllus*, *Darwinia* sp Karonie and *Leucopogon* sp Kau Rock. Chenopod shrubs including *Maireana brevifolia*, *Maireana oppositifolia*, *Rhagodia drummondii*, *Threlkeldia diffusa*, *Maireana erioclada*, *Tecticornia moniliformis* (samphire), and shrubs including *Lawrenzia squamata*, *Zygophyllum aurantiacum* and *Disphyma crassifolium* to 0.5m form a sparse stratum (10-30% canopy cover) in some areas.

Sedges recorded include *Lepidosperma ?tenue* and *Gahnia ancistrophylla*, grasses include *Austrostipa juncifolia* and *Austrostipa pycnocephala*, perennial herbs include *Comesperma integerrimum* (vine), *Billardiera lehmanniana* (vine), *Dianella brevicaulis* (rush), *Calandrinia* sp. ?Meckering and *Carpobrotus modestus* and annual herbs include *Asteridea chaetopoda* and *Isotoma scapigera*.

This vegetation type was in excellent condition with **Mesembryanthemum nodiflorum* the only weed species recorded.



***Casuarina obesa* (salt sheoak) open woodland on Lake Kathleen**

Melaleuca shrubland

Me

Melaleuca shrubland occurs on the edge of the lake sometimes only as a thin strip before the woodland vegetation which occurs on higher ground. This vegetation type grows in sandy soils over clay. *Melaleuca* shrubs to 3 m form a mid dense stratum 30-70% canopy cover. Species recorded include *Melaleuca thyoides*, *Melaleuca halmaturorum*, *Melaleuca brophyi*, *Melaleuca hamulosa* and *Melaleuca ?scalena*. Scattered shrubs to 1.0m were also recorded including *Scaevola spinescens*, *Eremophila decipiens*, *Rhagodia drummondii* and *Cyathostemon blackettii*.

A ground layer is sometimes present. Shrubs and chenopod shrubs 0.5m in height form a sparse layer (10-30% canopy cover) at releve 5. Species recorded include *Maireana brevifolia*, *Threlkeldia diffusa*, *Disphyma crassifolium*, *Frankenia tetrapetala*, *Disphyma crassifolium* and *Tecticornia ?pergranulata* (samphire shrub). Other species recorded include *Austrostipa elegantissima* (grass), *Comesperma integerrima* (vine) and *Podolepis capillaris* (annual herb/forb).

This vegetation type was in excellent condition with weed species **Mesembryanthemum nodiflorum* and **Sonchus oleraceus* recorded.



Melaleuca shrubland at Lake Kathleen

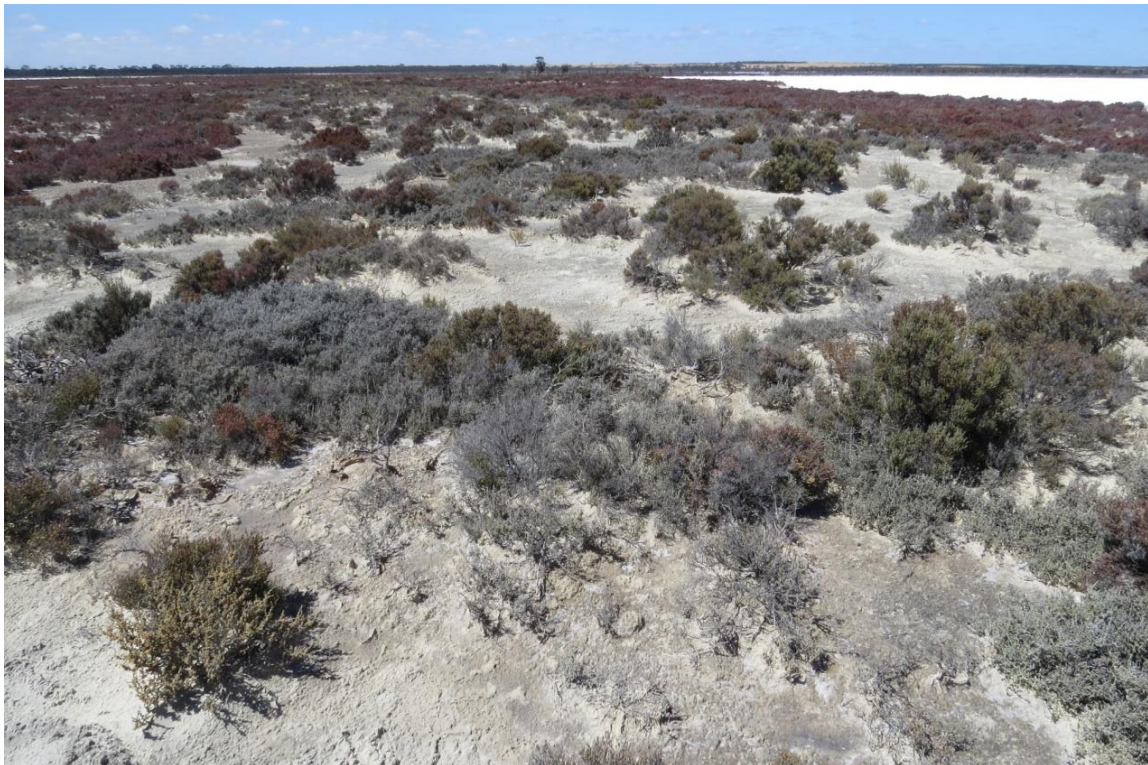
Mixed species shrubland

Hm

Mixed species shrubland occurs on low ridges/rises of gypsum on the lake bed. In most areas shrubs to 0.5m form a mid dense stratum (30-70% canopy cover). Characteristic species include *Maireana oppositifolia* (chopod shrub), *Lawrencia squamata* (shrub), *Disphyma crassifolium* (shrub) and *Tecticornia* (samphire) species (*Tecticornia syncarpa*, *Tecticornia loriae*, *Tecticornia halocnemoides* subsp *caudata* and *Tecticornia moniliformis*). Other shrub species recorded include *Leucopogon* sp Kau Rock, *Darwinia* sp Karonie and *Melaleuca halmaturorum* (2 sites), *Frankenia* sp southern gypsum P3 and *Frankenia cinerea* (one site only). Other species recorded include the perennial herbs *Lawrencia glomerata*, *Calandrinia* sp. ?Meckering, *Carpobrotus modestus* and *Billardiera lehmanniana* (vine), annual herbs *Isotoma scapigera*, *Trichanthodium skirrophorum*, *Asteridea chaetopoda*, *Kippistia suaedifolia*, *Haegiela tatei* P4 (one site), *Angianthus halophilus* P3 and *Fitzwillia axilliflora* P2, grasses *Austrostipa pycnostachya*, *Austrostipa* ?*puberula*, *Austrostipa juncifolia*, *Austrostipa geoffreyi* P1 and *Eragrostis dielsii* (1 site), and *Triglochin minutissima* (sedge/rush).

This vegetation type was in excellent condition with weed species *Mesembryanthemum nodiflorum* *Spergularia rubra*, *Paraphosis incurva*, and *Sonchus oleraceus* recorded.

All 5 priority species (red) recorded during the survey occur in the mixed species shrubland.



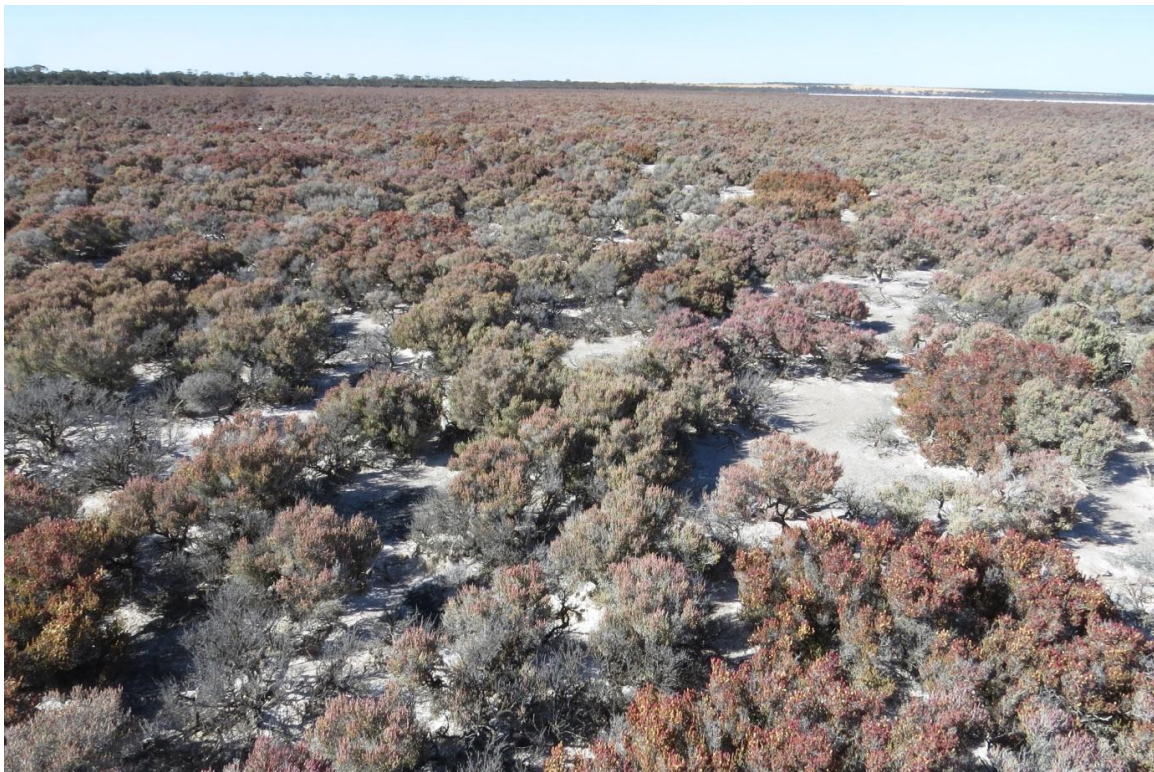
Mixed species shrubland on Lake Kathleen

***Tecticornia* (samphire) shrubland**

Te

Tecticornia (samphire) shrubland is found on the lake bed on flat terrain growing in gypsum soils over clay. These areas are subject to inundation. Shrubs to 0.5m form a mid dense stratum (30-70% canopy cover). Occasionally this layer is sparse (10-30% canopy cover). *Tecticornia* species recorded include *Tecticornia halocnemoides*, *Tecticornia peltata* and *Tecticornia loriae*. *Frankenia* sp southern gypsum P3 (shrub) and *Calandrinia* sp. ?Meckering (perennial herb) were also recorded in this vegetation type.

This vegetation type was in excellent condition



***Tecticornia* (samphire) shrubland on Lake Kathleen**

Figure 4: Vegetation map of Gypsum Mining Lease E70/4815 Lake Kathleen (North)

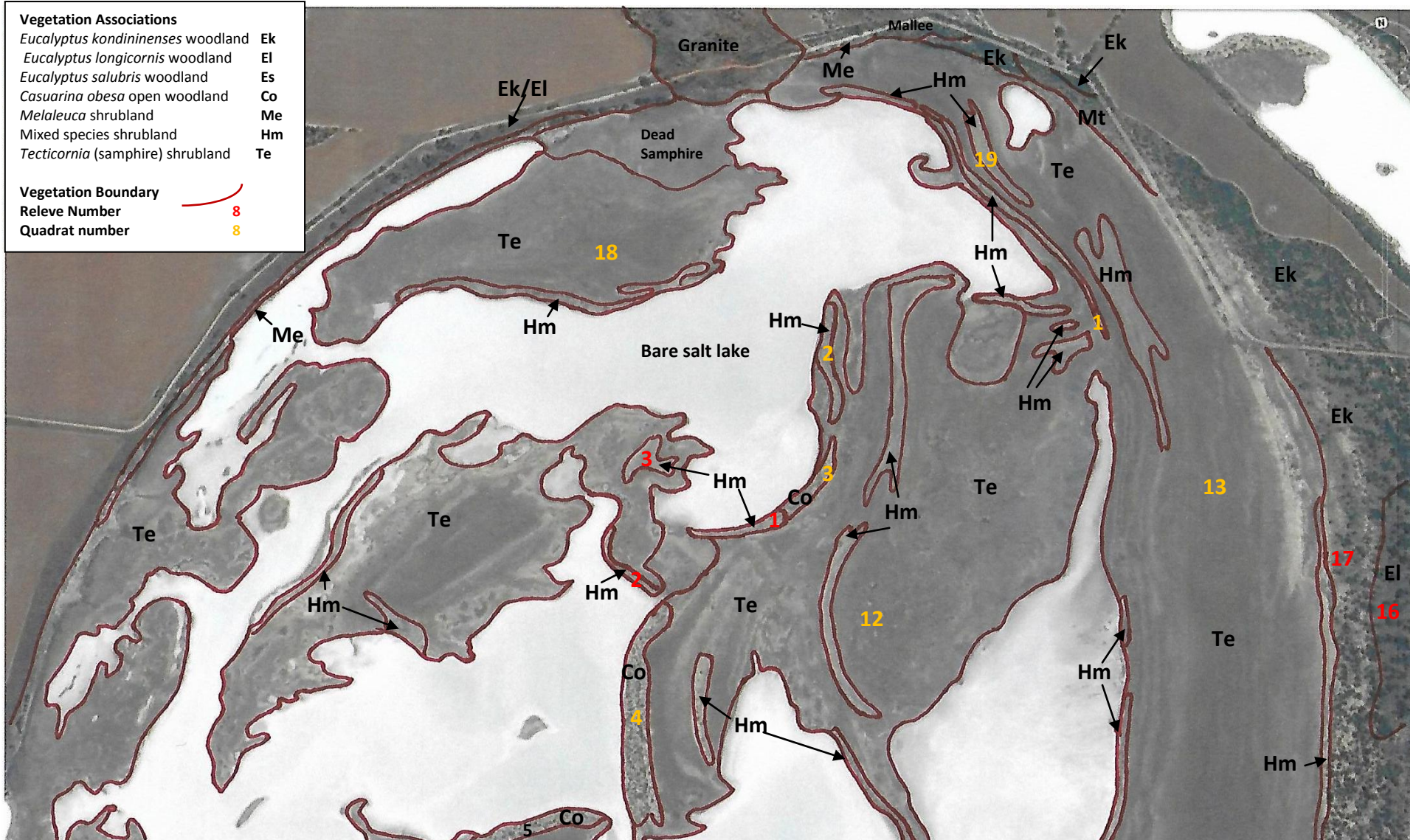
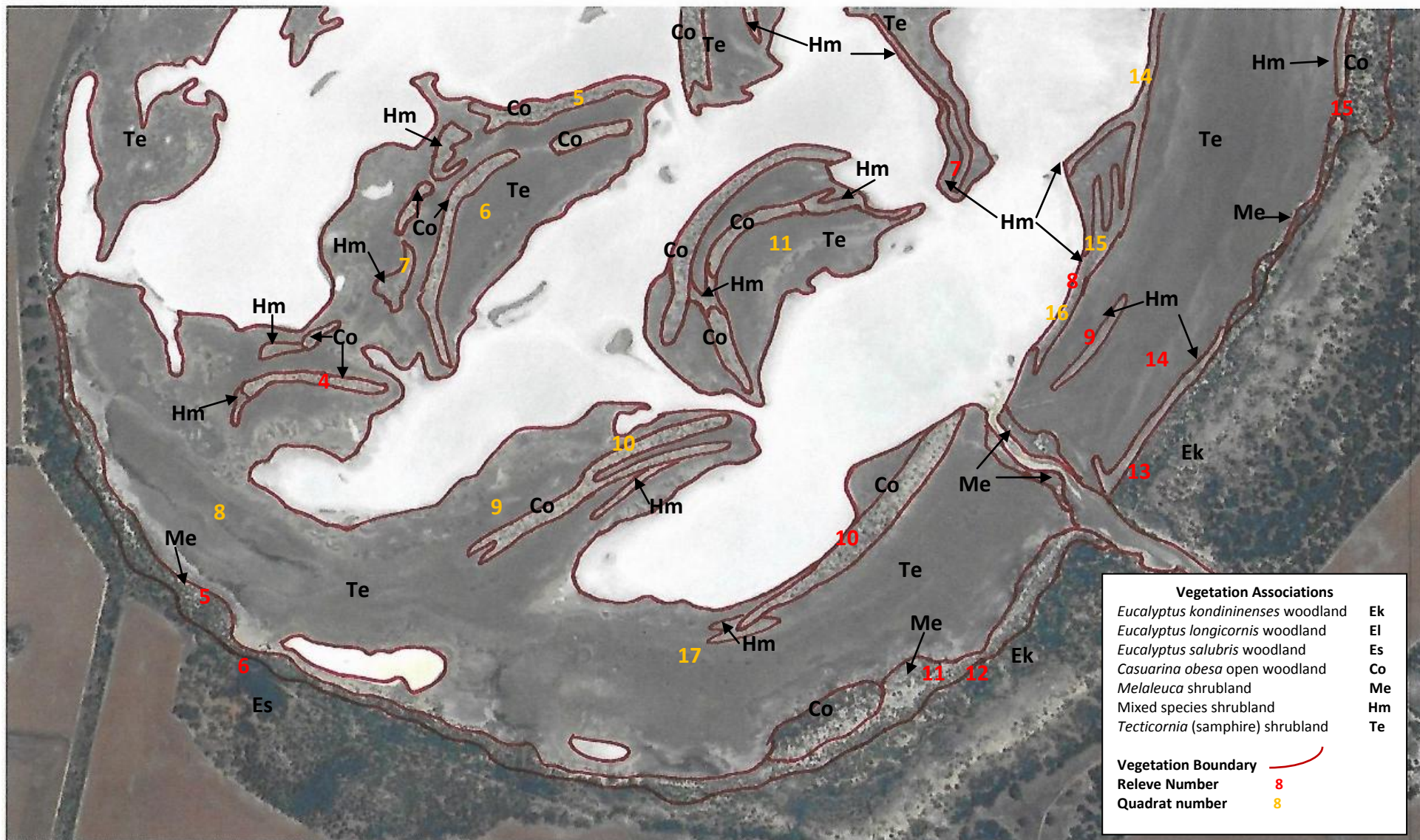


Figure 5: Vegetation map of Gypsum Mining Lease E70/4815 Lake Kathleen (South)



3.2 Vegetation Condition

The condition of the vegetation across the salt lake was Excellent with little disturbance noted and weed species in very low density. Weed species recorded include *Mesembryanthemum nodiflorum*, *Sonchus oleraceus*, *Ursinia anthemoides*, *Spergularia rubra*, *Avena* species, *Parapholis incurva* and *Pentameris airoides*.

Vegetation adjacent to Lake Newton Road which runs along the northern edge of the salt lake and vegetation adjacent to farmland on the western boundary of the UCL was in Very Good to Good condition with loss of understorey and invasion of weed grass species.

3.3 Threatened Ecological Communities

Threatened Ecological communities occurring on gypsiferous soils listed in section 1.4 were not found during the present survey. Eucalypt woodlands occurring in areas adjacent to the UCL surveyed, on privately owned land, could meet key diagnostic characteristics for Critically Endangered - Eucalypt Woodlands of the WA Wheatbelt and Red Morrel Woodland of the Wheatbelt (a component of the Eucalypt Woodlands of the WA Wheatbelt EPBC listed TEC) depending on the size and condition of these woodlands.

4.0 FLORA SURVEY

4.1 Flora of the Study Area.

A total of 87 plant species are recorded in Appendix 4 as occurring in the study area, 7 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 4 only represents part of the flora of the area. The spring is the best time of year for a flora survey and 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 lake Kathleen.

The families with the largest representatives of genera and species are listed in Table 5. The families Myrtaceae (*Melaleuca*, Eucalypts), Asteraceae (daisies), Chenopodiaceae (salt bush, samphire etc), Poaceae (grasses), Aizoaceae (pigface) and Frankeniaceae were the most strongly represented in the flora of the study area as would be expected in the salt lake areas.

Table 5: The number of species and genera represented within the major families in the study area.

Family	No. species	No. Genera	Introduced Weeds
Myrtaceae (<i>Melaleuca</i> , <i>Eucalyptus</i>)	14	4	
Asteraceae (daisies)	14	12	2
Chenopodiaceae (salt bush, samphire etc)	13	6	
Poaceae (grasses)	10	6	3
Frankeniaceae (<i>Frankenia</i>)	3	1	
Aizoaceae (pigface)	3	3	1

4.2 Threatened and Priority Flora

Appendix 6 lists Threatened and Priority Flora occurring in the Lake King Salt Lake System. Species that have been recorded on gypsum soils are in red. Species that have been recorded within a 5km, 10km and 20km radius of Lake Kathleen on NatureMap are also indicated. Appendix 7 includes Threatened and Priority Flora recorded on gypsum in the Lake Magenta, Lake King and Lake Grace salt lake chains

No Threatened (Declared Rare) species were found during the survey. Five priority species were found in the area of the UCL on Lake Kathleen including *Austrostipa geoffreyi* P1 (1 population), *Fitzwillia axilliflora* P2 (4 populations), *Angianthus halophilus* P3 (2 population), *Frankenia* sp. southern gypsum (M.N. Lyons 2864) P3 (extensive) and *Haegiela tatei* P4 (1 population).

Information on the locations and vegetation types in which *Frankenia* sp southern gypsum P3 was recorded are listed in Table 6 and information on the location and the vegetation types in which the populations and sub populations of the other priority species occur are listed in Table 7. Figure 6 maps the extent of the populations and sub populations of *Austrostipa geoffreyi* P1, *Fitzwillia axilliflora* P2, *Angianthus halophilus* P3 and *Haegiela tatei* P4. Guidelines from the Threatened and Priority Flora Report Form Field Manual (Department of Parks and Wildlife 2010) which were used to determine sub populations include

- Plants within 500m of a known population are considered to be part of that population
- Within a recognized population, plants that have considerable, recognizable separation between them are considered to be separate subpopulations (in this case the plants are separated by areas of samphire or bare salt lake but are within 500m of each other).

***Austrostipa geoffreyi* P1**

Austrostipa geoffreyi is a possible gypsophile (Rick 2011) ie mostly restricted to gypsum soils. It is a shortly rhizomatous, caespitose, perennial grass to 1.8m (FloraBase) and occurs on sandy gypsum rises in salt lakes at Lake Grace, Lake King and Lake Tay. The Lake Tay collection in 2013 was a 200km range extension to the east. It is similar to *Austrostipa juncifolia* which was also recorded during the present survey. Only one population occurring in mixed species shrubland was recorded and mapped in Figure 6 and a voucher specimen collected.

***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 is thought to be a gypsovag (gypsum tolerant) as it also grows in non-gypsum soils (Rick 2011). This species has been recorded in the shires of Kent, Lake Grace, Morawa and Wyalkatchem. Four populations and 5 sub populations are detailed in Table 7 and mapped in Figure 6 and occur in the mixed species shrubland. This species

has not been previously recorded in the Lake King salt lake system. The closest records are from the Newdegate/Lake Bryde area (Lake Magenta salt lake chain)



***Austrostipa geoffreyi* P1 on Lake Kathleen**



***Fitzwillia axilliflora* P2 on Lake Kathleen. Plants drying out at the end of their growing season**

***Angianthus halophilus* P3**

Angianthus halophilus P3 is an erect to spreading annual herb to 5cm high, flowering from October to November and growing on saline soils and gypsum rich dunes in salt lakes. This species is thought to be a gypsovag (gypsum tolerant) as it also grows in non-gypsum soils (Rick 2011). This priority plant has been previously recorded at Lake King, Lake Grace and Lake Cairlocup. Two populations and 3 sub populations were recorded during the present survey in mixed species shrubland. Details are listed in Table 7 and the extent of the populations mapped in Figure 6.



***Angianthus halophilus* P3 on Lake Kathleen**

***Frankenia* sp. southern gypsum (M.N. Lyons 2864) P3**

Frankenia sp. southern gypsum (M.N. Lyons 2864) P3 is a possible gypsophile (Rick 2011) ie mostly restricted to gypsum soils. This species was recorded at 23 localities on Lake Kathleen during the present survey including 9 quadrats, 6 releves and 8 opportunistic recordings (Table 6). The *Frankenia* was found in the mixed species shrublands and *Tecticornia* (samphire) shrublands.

This species 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. 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). *Frankenia* sp. southern gypsum has also been collected by the author at Lake Morris (2014), on

proposed Gypsum Mine M70/1342 south Lake King (2015), Lake Buchan (2016a) and Lake Carmody (2016b).

Previously *Frankenia* sp. southern gypsum was known only from Lake King, Lake Varley, Quarry Lake and Fisher Lake (Lyons et al 2004) with only three voucher collections present at the WA Herbarium. The genus *Frankenia* is at present being revised and confusion related to a number of species still remains. *Frankenia* sp. southern gypsum has previously been identified as *Frankenia sessilis*, *Frankenia* aff. *sessilis* and *Frankenia* sp 1 in previous reports (Rick 2011). The taxonomy of this species needs further clarification.



Frankenia sp. southern gypsum (M.N. Lyons 2864) P3 at lake Kathleen

Haegiela tatei P4

Haegiela tatei P4 is an ascending to erect annual herb, 2 to 8cm high with white and yellow flowers. This species flowers from August to November and has been recorded in clay, sandy loam and gypsum soils in saline habitats. *Haegiela tatei* is thought to be a gypsovag (gypsum tolerant) as it also grows in non-gypsum soils (Rick 2011). Plants have been recorded in the Coolgardie, Dundus, Esperance, Gnowangerup, Kent, Kondinin, Lake Grace and Yalgoo shires. Only 1 population was recorded during the present survey. Details are given in Table 7 and the extent of the population mapped in Figure 6.

4.3 Other flora of significance

***Kippistia suaedifolia* (gypsophile)**

Kippistia suaedifolia is a compact, dwarf shrub, 0.1 to 0.6 m high, with yellow flowers in August to November (FloraBase). This species is associated with salt lakes and claypans and has been recorded on gypsum, sand and clay soils according to information on herbarium labels which can sometimes be misleading (Rick 211). It has a wide distribution in WA recorded in the Shires of Cue, Dundas, Esperance, Kalgoorlie-Boulder, Kondinin, Lake Grace, Laverton, Meekatharra, Menzies, Ngaanyatjarraku, Wiluna, Wyalkatchem and Yalgoo.

It is thought that *Kippistia suaedifolia* is largely confined to gypsum soils and is possibly a gypsophile (Rick 2011). Because of its restricted habitat preference this species is more at risk than other plants which grow on a range of soil types. During the present survey *Kippistia suaedifolia* was found in the mixed species shrubland on low rises of gypsum. *Kippistia suaedifolia* is considered endangered in NSW



Kippistia suaedifolia at Lake Kathleen

***Cratystylis conocephala* (Range Extension)**

Cratystylis conocephala is a densely branched, spreading shrub, usually 0.5 to 1.5m high with white flowers. This species flowers from September to December and grows on calcareous sandy soils, clay, and loam on plains and rises (FloraBase). This species is common in the Coolgardie, Dundas, Esperance, Kalgoorlie-Boulder and Menzies shires. The closest collection to Lake Kathleen is from the Peak Charles/ Bremer Range area ~120kms to the east.

Cratystylis conocephala was recorded in the *Eucalyptus longicornis* woodland and is mostly confined to privately owned property to the east of Lake Kathleen.



Cratystylis conocephala in *Eucalyptus longicornis* woodland east of Lake Kathleen

Calandrinia sp.? Meckering (F. Obbens 42/02)

Frank Obbens is in the process of describing the species known as *Calandrinia* sp. Meckering. The specimen collected at Lake Kathleen is not typical of this species and it is yet to be determined whether the *Calandrinia* collected at Lake Kathleen is the same as the *Calandrinia* sp. Meckering found in the Meckering area. The species collected at Lake Kathleen commonly occurs on gypsiferous soils in the Magenta and Lake King salt lake chains.



Calandrinia sp.? Meckering (F. Obbens 42/02) at Lake Kathleen

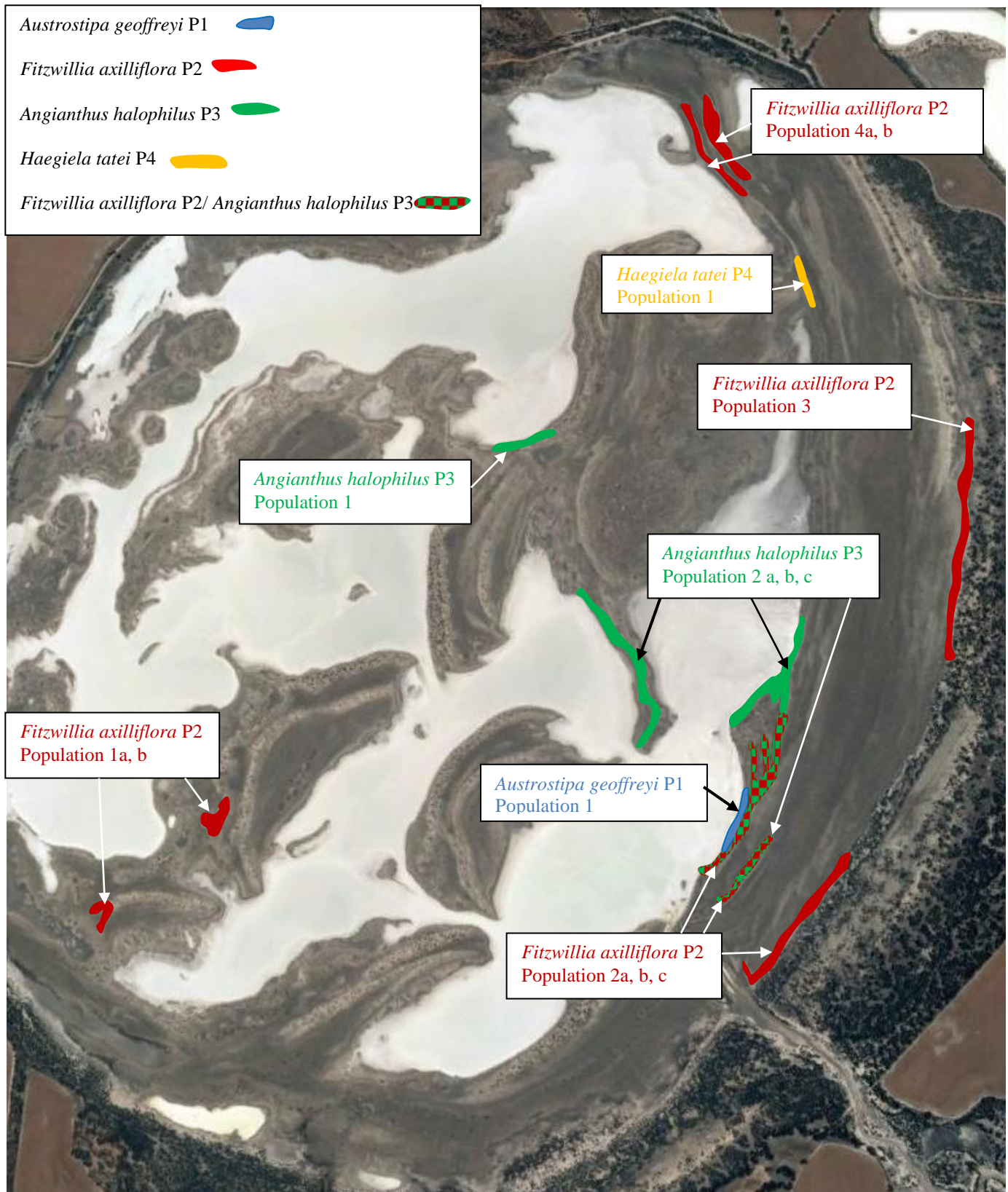
Table 6: Location of Frankenia sp. southern gypsum P3 plants on Lake Kathleen

Way points	Quadrat/releve	Voucher specimen	Vegetation type
004	Quadrat 1	7834	Mixed shrubland
012	Quadrat 2	7843, 7844	Mixed shrubland
017	Releve 2		Mixed shrubland
020	Releve 3		Mixed shrubland
029	Quadrat 7	7869	Mixed shrubland
038	Quadrat 9		Tecticornia shrubland
043	Quadrat 11	7895	Tecticornia shrubland
045			Tecticornia shrubland
046	Releve 7		Mixed shrubland
050	Quadrat 12	7901	Tecticornia shrubland
051			Tecticornia shrubland
058			Mixed shrubland
059			Mixed shrubland
061	Quadrat 15	7923	Mixed shrubland
062	Releve 8		Mixed shrubland
063	Quadrat 16		Mixed shrubland
064	Releve 9		Mixed shrubland
079	Releve 14		Tecticornia shrubland
083			Mixed shrubland
094			Mixed shrubland
099			Mixed shrubland
100			Mixed shrubland
104	Quadrat 19		Mixed shrubland

Table 7: Location of Priority flora on Lake Kathleen

Population /sub population No.	Species	Cons Code	Way Points	Releve /quadrat included	Voucher Specimen	Vegetation Type
1	<i>Austrostipa geoffreyi</i>	1	062-063	Quadrat 16 Releve 8	7956	Mixed species shrubland
1	<i>Angianthus halophilus</i>	3	014-015	Releve 1	7854	Mixed species shrubland
2a	<i>Angianthus halophilus</i>	3	046-048	Releve 7	7899	Mixed species shrubland
2b	<i>Angianthus halophilus</i>	3	056-057-058 061	Quadrat 14, 15	7915 7921	Mixed species shrubland
2c	<i>Angianthus halophilus</i>	3	064	Releve 9		Mixed species shrubland
1a	<i>Fitzwillia axilliflora</i>	2	029	Quadrat 7	7868	Mixed species shrubland
1b	<i>Fitzwillia axilliflora</i>	2	032			Mixed species shrubland
2a	<i>Fitzwillia axilliflora</i>	2	060-061	Quadrat 15	7920	Mixed species shrubland
2b	<i>Fitzwillia axilliflora</i>	2	064	Releve 9		Mixed species shrubland
2c	<i>Fitzwillia axilliflora</i>	2	077			Mixed species shrubland
3	<i>Fitzwillia axilliflora</i>	2	082, 083, 085, 087			Mixed species shrubland
4a	<i>Fitzwillia axilliflora</i>	2	100-101-102			Mixed species shrubland
4b	<i>Fitzwillia axilliflora</i>	2	104	Quad 19	7948	Mixed species shrubland
1	<i>Haegiela tatei</i>	4	004	Quadrat 1	7841	Mixed species shrubland

Figure 6: location of populations of Priority Flora on Lake Kathleen



5.0 CONSERVATION SIGNIFICANCE

5.1 Conservation Significance of Vegetation associations

In assessing the conservation significance of the vegetation on Lake Kathleen factors such as the condition of the vegetation, rarity and connectivity need to be taken into account.

Remnant vegetation on Lake Kathleen is in excellent condition except areas adjacent to Lake Newton road to the north of the lake and the western boundary of the UCL adjacent to farm land where loss of biodiversity occurs due to weeds, altered hydrology and past road maintenance activity.

The area surrounding Lake Kathleen has been extensively cleared. Lake Kathleen is to the east of Lake Camm (UCL) and Lake Newton (UCL) and vegetation on Lake Kathleen is poorly connected to vegetation in the rest of the Lake King salt lake chain by strips along roads and paddock divides some of which is degraded. Chains of salt lakes such as the Lake King system are important vegetation corridors in an already extensively cleared landscape.

In general salt lake chains and gypsum dune systems constitute a relatively small portion of the overall native vegetation of the Western Mallee sub region and therefore have a high conservation value. In the Lake King salt lake chain there are extensive areas of salt lake vegetation including areas of gypsum conserved in the Lake King Nature Reserve ~ 10 kms SW of lake Kathleen. Salt lake country is also conserved in the Lake Varley Nature Reserve, Lake Gulson Nature Reserve and Lake Pallerup Nature Reserves. However a number of the other lakes in the chain are UCL and are not protected for nature conservation and a number of these lakes are already mined for gypsum. Large areas of the salt lake country in the region have yet to be surveyed and it is therefore difficult to assess the extent of the vegetation types that are confined to gypsum in the sub region.

No Threatened Ecological communities occurring on gypsiferous soils listed in section 1.4 were found during the present survey. However woodlands adjacent to the Lake Kathleen salt lake on privately owned land may meet key diagnostic characteristics for the “Eucalypt Woodlands of the WA Wheatbelt” which have been classified as Critically Endangered and Priority 1: Red Morrell Woodland of the Wheatbelt (a component of the Eucalypt Woodlands of the WA Wheatbelt EPBC listed TEC). The presence of these adjacent woodlands needs to be taken into consideration when planning operations involving clearing operations.

5.2 Conservation Significance of Flora

No Threatened Flora were found in the area of the UCL on Lake Kathleen during the present survey. Five priority species were recorded including *Austrostipa geoffreyi* P1 (1 population), *Fitzwillia axilliflora* P2 (4 populations), *Angianthus halophilus* P3 (2 population), *Frankenia* sp. southern gypsum (M.N. Lyons 2864) P3 (extensive) and *Haegiela tatei* P4 (1 population).

Fitzwillia axilliflora P2 has not been previously recorded in the Lake King salt lake chain. *Austrostipa geoffreyi* P1, *Angianthus halophilus* P3 and *Haegiela tatei* P4 have been recorded from areas adjacent to the causeway in the Lake King Nature Reserve. The extent

of these species within this Nature Reserve is not known and further survey work is needed. These species need to be taken into consideration when planning mining activities.

Other significant flora include *Kippistia suaedifolia* (possible gypsophile), *Cratystylis conocephala* (range extension) and *Calendrinia* sp ?Meckering a possible new species. *Kippistia suaedifolia* has a wide distribution in WA, *Cratystylis conocephala* is mainly in areas adjacent to the UCL surveyed and *Calendrinia* sp ?Meckering is not uncommon in the Magenta and Lake King salt lake chains on gypsum. Mining activities should not affect the overall conservation of these species.

Frankenia sp. southern gypsum (M.N. Lyons 2864) P3 was recorded in the *Tecticornia* (samphire) shrublands and mixed species shrublands on the lake bed. This species has now been collected by the author from a number of salt lakes in the Magenta and Lake King salt lake chains Rick (2010), Rick (2011), Rick (2014), Rick (2015), Rick (2016a) and Rick (2016b). The genus *Frankenia* is at present being revised and confusion relating to a number of species still remains. *Frankenia* sp. southern gypsum has previously been identified as *Frankenia sessilis*, *Frankenia* aff. *sessilis* and *Frankenia* sp 1 in previous reports (Rick 2011). The taxonomy of this species needs further clarification. Recent surveys have therefore found *Frankenia* sp. southern gypsum to be more common than previously thought and the proposed mine should not impact on the overall conservation of this species.

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