OCTOBER 2015

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TORO ENERGY LIMITED

EXTENSION TO THE WILUNA URANIUM PROJECT

FLORA AND VEGETATION CONSOLIDATION AND CONSERVATION ASSESSMENT

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Document Status						
Rev.	**Author**	**Reviewer**	**Date**	**Approved for Issue**		
				Name	**Distributed To**	**Date**
0	M. Hay	M. Macdonald	15/07/2015	M. Macdonald	A. Tandy	24/07/2015
1	M. Macdonald	M. Hay	23/10/2015	M. Macdonald	A. Worland L. Chandler	30/10/2015

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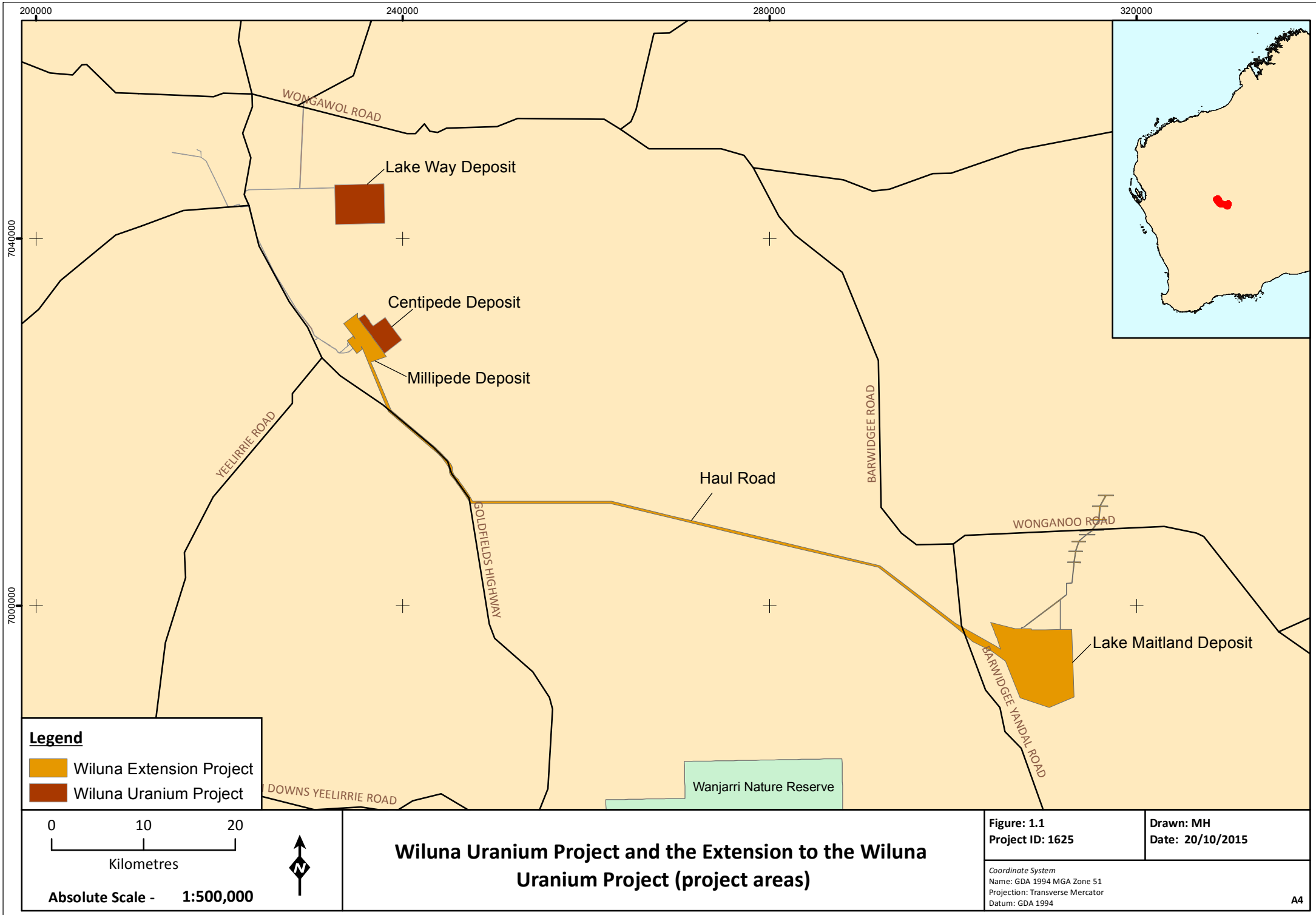
1 INTRODUCTION

1.1 PROJECT OVERVIEW

Toro Energy Limited (Toro) has recently been granted approval of the Wiluna Uranium Project which is based on mining Uranium at two locations, the Centipede and Lake Way deposits. Toro have recently acquired a further two more deposits, Millipede and Lake Maitland, and plans to seek environmental approvals for these, as well as a haul road that connects the two. This is known as the Extension to the Wiluna Uranium Project.

Based on comments received from the Office of the Environmental Protection Authority (OEPA) on the draft Environmental Scoping Document for the extension to the Wiluna Uranium Project, Toro has commissioned *ecologia* Environment (*ecologia*) to undertake an analysis of the flora and vegetation communities occurring at the Extension to the Wiluna Uranium Project by consolidating the results of the flora and vegetation assessments conducted in the area. The Wiluna Uranium Project and Extension to the Wiluna Uranium Project (project areas) are shown in Figure 1.1.



Wiluna Uranium Project and the Extension to the Wiluna Uranium Project (project areas)

Figure: 1.1
Project ID: 1625

Drawn: MH
Date: 20/10/2015

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

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2 LITERATURE REVIEW

2.1 PREVIOUS FLORA AND VEGETATION SURVEYS

2.1.1 Lake Way and Centipede (Outback Ecology 2007)

A Level 2 flora and a vegetation assessment was undertaken in October 2007 for the Lake Way and Centipede deposits as part of the Toro Wiluna Uranium Project (Outback Ecology 2007). The survey included 108 quadrats (each 30 x 30 m) and sampled 132 vascular flora taxa with no significant flora reported (Table 2.1). The introduced **Lysimachia arvensis* was recorded (as **Anagallis arvensis*) from one location at the Lake Way deposit. Twenty-two vegetation units were described, including significant vegetation units: Me1 (*Melaleuca xerophila* mid density low forest) which is generally restricted to a narrow band along the lake edge; and halophytic vegetation which is considered significant due to unique community assemblages, implying that the following vegetation units are considered to be of conservation significance:

- Ha1 (*Halosarcia indica* subsp. *leiostachya* and *Halosarcia auriculata* dense low heath over *Eragrostis* spp. very sparse grass). Ha1 was recorded at eight quadrats at Centipede deposit and one quadrat at the Lake Way deposit.
- Ha2 (*Halosarcia indica* subsp. *bidens*, *Atriplex bunburyana* and *Frankenia* sp1 mid density low heath). Ha2 was recorded at a single quadrat associated with a drainage channel flowing into Lake Way at the Lake Way deposit.
- Ha3 (*Halosarcia* spp., *Frankenia* spp. mid density low heath over *Eragrostis* spp. and *Aristida contorta* sparse open grass). Ha3 was recorded at six quadrats at the Lake Way deposit and one quadrat at Centipede deposit.
- Te1 (*Tecticornia tenuis* and *Halosarcia auriculata* mid density low heath over *Eragrostis* spp. very sparse grass). Te1 was recorded at two quadrats at Centipede deposit and two quadrats at the Lake Way deposit.
- Te2 (*Tecticornia arbuscula*, *Maireana amoena* and mixed species sparse dwarf scrub over *Triodia melvillei* sparse hummock grass and *Eragrostis* spp. sparse grass). Te2 was recorded at three quadrats from a chain of claypans to the east of the Lake Way deposit.
- Fr1 (*Frankenia* spp. and *Muellerolimon salicorniaceum* and mixed species low density heath over *Aristida contorta* sparse grass). Fr1 was recorded at one quadrat at the Lake Way Deposit.
- Fr2 (*Frankenia* spp. and *Halosarcia calyptrata* mid density low heath over *Eragrostis* spp. very sparse grass). Fr2 was recorded from one quadrat at Centipede deposit
- La1 (*Lawrencia helmsii* and *Halosarcia indica* subsp. *leiostachya* very sparse dwarf scrub over *Ptilotus obovatus* var. *obovatus* very sparse herbs over *Eragrostis* spp. very open grass). La1 was recorded at one quadrat associated with a claypan at the Centipede deposit and two quadrats from claypans at the Lake Way deposit.
- Ly1 (*Lycium australe*, *Cratystylis spinescens* and mixed species mid density heath over *Eragrostis* spp. mid density grass). Ly1 was recorded from one quadrat from a claypan at the Lake Way deposit.

2.1.2 Lake Maitland (Outback Ecology 2009)

A Level 2 flora and a vegetation assessment was undertaken in May 2007, November 2007 and May 2009 for the Mega Uranium Lake Maitland project (Outback Ecology 2009). The survey included 91 quadrats (each 30 x 30 m) and sampled 244 vascular flora taxa with one potential Priority 3 flora taxon (*Maireana ?prosthecochaeta*) and five range extensions (*Acacia aneura* var. cf. *major*, *Acacia*

brumalis, *Acacia maxwellii*, *Acacia scleroclada* and *Sida kingii*). The introduced **Tribulus terrestris* was recorded from one location at Lake Maitland. Thirty-one vegetation units were described, including significant vegetation unit KRE (Low woodland of *Eucalyptus striaticalyx* and *Grevillea sarissa* subsp. *bicolor* over low scrub of *Lawrencia helmsii*, *Sclerolaena fimbriolata* and *Tecticornia* aff. *undulata.*) which is restricted to several areas to the south of Lake Maitland (Table 2.1).

2.1.3 Lake Way, Centipede and West Creek Borefield (Niche 2011)

A Level 2 flora and a vegetation assessment was undertaken in April 2010, June 2010 and September/October 2010 for Lake Way, Centipede and West Creek Borefield deposits as part of the Toro Wiluna Uranium Project (Niche 2011). The survey included 264 (30 x 30 m) quadrats (including resampling of the Lake Way and Centipede quadrats from the Outback Ecology (2007) survey) and sampled 428 vascular flora taxa, including six Priority flora taxa (two Priority 1 taxa: *Eremophila congesta* and *Tecticornia* sp. Lake Way, and four Priority 3 taxa: *Eremophila arachnoides* subsp. *arachnoides*, *Stackhousia clementii*, *Homalocalyx echinulatus* and *Mirbelia stipitata*), twenty-four range extensions (*Brachyscome iberidifolia*, **Centaurea melitensis*, *Cratystylis subspinescens*, *Cynanchum floribundum*, *Dicrastylis doranii*, *Disphyma crassifolium* subsp. *clavellatum*, *Dysphania truncata*, *Euphorbia biconvexa*, *Frankenia interioris*, *Frankenia* sp. cf. *glomerata*, *Gnephosis angianthoides*, ?*Gompholobium simplicifolium* (as ?*Otion simplicifolium*), *Gunniopsis rodwayi*, *Gunniopsis septifraga*, *Isoetopsis graminifolia, Maireana amoena*, *Maireana appressa*, *Murchisonia volubilis*, *Nicotiana rotundifolia*, *Polygala isingii*, *Ptilotus murrayi*, *Scaevola tomentosa*, *Senna manicula*, and *Trachymene ceratocarpa*) and four atypical variants (*Frankenia* ?*interioris* and *Frankenia* sp. cf. *glomerata*, which are also listed above as range extensions, and *Scaevola spinescens* and *Rhagodia drummondii*). Four introduced flora species (**Acetosa vesicaria*, **Brassica tournefortii*, **Centaurea melitensis* and **Sonchus oleraceus*) were also recorded.

Thirty-four vegetation units were described, including the following seven potentially significant vegetation units:

- BIF (Open low woodland of *Acacia aneura* var. *aneura*) occurs in the West Creek Borefield and is considered potentially significant as it is restricted to banded ironstone formation and is suitable habitat for the Priority 1 *Eremophila congesta*. No BIF vegetation was anticipated to be impacted by the Wiluna Uranium Project.
- Ca1 (Open low woodland of *Eucalyptus gypsophila*) is considered significant as it provides habitat for the Priority 3 *Eremophila arachnoides* subsp. *arachnoides* and as calcrete vegetation of the north-eastern goldfields is considered at risk from grazing, feral animals (goats) or changed fire regimes (Cowan 2001). Ca1 was mapped over 26 ha at the Lake Way deposit, all of which was located outside potential impacts of the Wiluna Uranium Project.
- Ca2 (Low woodland of *Acacia* species) is considered significant as it provides habitat for the Priority 3 *Eremophila arachnoides* subsp. *arachnoides* and as calcrete vegetation of the north-eastern goldfields is considered at risk from grazing, feral animals (goats) and changed fire regimes (Cowan 2001). Ca2 was mapped over 378 ha at the Lake Way deposit, with 9.4 ha to be impacted and 5.7 ha at the Centipede deposit, with all 5.7 ha to be impacted.
- Cr (Woodland of *Eucalyptus camaldulensis* subsp. *obtusa*) is associated with West Creek in the West Creek Borefield. Cr is considered potentially significant as it is restricted to an area of 32 ha associated with West Creek.
- Fr1 (Fringing closed low forest of *Melaleuca xerophila*) occurs along the margin of Lake Way at both the Lake Way and Centipede deposits. Fr1 is considered at risk from changed fire regimes (Cowan 2001). Fr1 was mapped over 71 ha at the Lake Way deposit, with 59.3 ha (83.5%) to be impacted and 36 ha at the Centipede deposit, with 32.3 ha (89.7%) to be impacted.

- Sh complex (includes vegetation units: Sh1: Open low woodland of *Acacia* species; Sh2: Low woodland of *Acacia aneura* var. *aneura*; Sh3: Low forest of *Acacia rhodophloia*; Sh4: Low woodland of *Acacia ayersiana*; Sh5: Low open woodland of *Acacia aneura* var. *aneura*; and Shdl: Low woodland of *Acacia aneura* var. *aneura*). Sh complex is associated with sandstone hills and is considered significant as habitat for the Priority 1 *Eremophila congesta*.
- Sl1 (Low heath of *Tecticornia* species) occurs around the edges of Lake Way and is considered to consist of a potentially unique assemblage of species. Sl1 was mapped over 396 ha at the Lake Way deposit, with 216.2 ha (54.6%) to be impacted and 304 ha at the Centipede deposit, with 277.5 ha (91.2%) to be impacted.

2.1.4 *Tecticornia* review (Actis 2012)

The *Tecticornia* specimens collected during the surveys supporting the Lake Way, Centipede and West Creek Borefield flora and vegetation assessment (Niche 2011) were identified by Dr. Kelly Shepherd (Senior Research Scientist at the Western Australian Herbarium, Department of Parks and Wildlife, WA) and reports and data reviewed by samphire specialist Bindy Datsun (Actis 2012). A total of 231 specimens were collected from the salt lakes, including 168 *Tecticornia* specimens. These specimens represented 21 *Tecticornia* taxa, including 16 recognised taxa (species, subspecies or phrase name taxa), two of which are Priority flora:

- *Tecticornia* sp. Lake Way (P. Armstrong 05/961) (Priority 1); and
- *Tecticornia cymbiformis* (now Priority 3).

An additional five unrecognised (potentially new) taxa were also recorded:

- *Tecticornia* sp. aff. *laevigata*;
- *Tecticornia* sp. aff. *pruinosa*;
- *Tecticornia* sp. aff. *undulata*;
- *Tecticornia* sp. *halocnemoides* beaked seed aggregate; and
- *Tecticornia* sp. nov.

Three vegetation units described in Niche (2011) were identified in Actis (2012) as being potentially groundwater dependent:

- Fr1 (Fringing *Melaleuca xerophila*);
- Cp2 (Dwarf scrub *Cratystylis subspinescens*); and
- Sl1 (Low Heath D *Tecticornia* spp.)

2.1.5 Millipede (Niche 2014)

A Level 2 flora and a vegetation assessment was undertaken in April 2010, June 2010 and September/October 2010 and October 2013 for Millipede deposit as part of the Toro Wiluna Uranium Project (Niche 2014). The survey included 30 quadrats (each 30 x 30 m) and sampled 185 vascular flora taxa with two Priority flora taxa recorded (both Priority 3 taxa: *Eremophila arachnoides* subsp*. arachnoides* and *Stackhousia clementii*). No introduced flora species were recorded. Ten vegetation units were described, including two significant vegetation units: Ca1 (Low woodland of *Acacia* species) which is considered to be of significance due to the presence of the Priority 3 *Eremophila arachnoides* subsp. *arachnoides*; and Sl (Low heath of *Tecticornia* species) which is considered to be of significance due to the presence of potentially new (undescribed) species and the presence of the Priority 3 *Stackhousia clementii* (Table 2.1).

2.1.6 Millipede to Lake Maitland Haul Road (*ecologia* 2015c)

A Level 2 flora and a vegetation assessment was undertaken in June 2014, October 2014, January 2015 and March 2015 of the haul road alignment between the Millipede and Lake Maitland deposits as part of the Toro Extension to the Wiluna Uranium Project (*ecologia* 2015c). The survey included 130 quadrats (each 30 x 30 m) and sampled 223 vascular flora taxa with five Priority flora taxa recorded (three Priority 3 taxa: *Cratystylis centralis*, *Stackhousia clementii* and *Tecticornia cymbiformis*, and two Priority 4 taxa: *Eremophila pungens* and *Frankenia confusa*). Three introduced flora species were recorded (**Bidens bipinnata*, **Cucumis* ?*lanatus* and **Tribulus terrestris*).

Twelve vegetation units were described, including two significant *Tecticornia* vegetation units: S (*Tecticornia* spp., *Frankenia cinerea, Maireana villosa* and *Atriplex amnicola* sparse low shrubland) and V (*Tecticornia* spp., *Cratystylis subspinescens*, *Maireana amoena* and *Sclerolaena diacantha* sparse mid shrubland, over *Eragrostis falcata* sparse tussock grassland) which are considered to be of significance due to the presence of potentially new (undescribed) species and restricted distribution (Table 2.1). All *Tecticornia* specimens from this assessment were provided to Dr. Kelly Shepherd (Senior Research Scientist at the Western Australian Herbarium, Department of Parks and Wildlife, WA) for identification however they were not available at the time of analysis and are further discussed in *ecologia's* (2015a) *Tecticornia* assessment (see section 2.1.7).

2.1.7 Assessment of *Tecticornia* Communities of Lake Way and Lake Maitland (*ecologia* 2015a)

A *Tecticornia* assessment was undertaken at Lake Way and Lake Maitland in November 2014 and January 2015 as part of the Toro Extension to the Wiluna Uranium Project (*ecologia* 2015a). The survey included the identification of 134 specimens from 162 quadrats (3 x 3 m) as well as 77 specimens for the haul road survey (*ecologia* 2015c). All *Tecticornia* specimens were provided to Dr. Kelly Shepherd (Senior Research Scientist at the Western Australian Herbarium, Department of Parks and Wildlife, WA) for identification. In addition, the Actis (2012) review of *Tecticornia* for the Wiluna Uranium Project was also incorporated.

In addition to the sixteen known *Tecticornia* taxa, three Priority flora were identified:

- *Tecticornia sp. Lake Way* (P. Armstrong 05/961) (Priority 1);
- *Tecticornia sp. Sunshine Lake* (K.A. Shepherd et al. KS 867) (Priority 1); and
- *Tecticornia cymbiformis* (Priority 3).

Seven novel *Tecticornia* species were identified:

- *Tecticornia* aff. *halocnemoides* s.l. 'large ovate seed aggregate';
- *Tecticornia* aff. *halocnemoides* s.l. 'tuberculate seed'
- *Tecticornia* sp. aff *globulifera* (small);
- *Tecticornia* sp. aff *laevigata* (non-rotated fruitlets);
- *Tecticornia* sp. aff *pruinosa* (inflated bracts);
- *Tecticornia* sp. aff. Burnerbinmah (inflated fruit); and
- *Tecticornia* sp. aff. *undulata* (broad articles).

Six potentially novel taxa were identified:

- *Tecticornia* aff. *halocnemoides* (unusual epidermis);
- *?Tecticornia* sp. aff. *globulifera* (small);
- *Tecticornia* sp. *halocnemoides* beaked seed aggregate;
- *Tecticornia* sp. aff. *laevigata*;

- *Tecticornia* sp. aff. *pruinosa*; and
- *Tecticornia* sp. aff*. undulata*.

Four range extensions were identified:

- *Tecticornia halocnemoides* subsp*. catenulata*
- *Tecticornia moniliformis*
- *Tecticornia pterygosperma* subsp*. pterygosperma*
- *Tecticornia tenuis*

Nine *Tecticornia* complexes were described, which are considered to be of significance due to the presence of potentially new (undescribed) species and/or restricted distribution (Table 2.1).

- T1: *Tecticornia laevigata, T.* sp. aff *globulifera* (small) and *T.* sp. aff. *undulata* (broad articles) sparse low shrubland;
- T2: *Tecticornia peltata*, *T.* sp. aff *globulifera* (small), *T.* sp. aff. *undulata* (broad articles) and *T.* sp. Sunshine Lake (K.A. Shepherd et al. KS 867) sparse low shrubland;
- T3: *Tecticornia* sp. Dennys Crossing (K.A. Shepherd & J. English KS 552) (+/-*T. indica*, *T.* sp. aff. *undulata* (broad articles), *T.* sp. aff globulifera (small) and *Tecticornia* sp. Sunshine Lake (K.A. Shepherd et al. KS 867)) sparse low shrubland;
- T4: *Tecticornia* sp. Burnerbinmah (D. Edinger et al. 101) and *Tecticornia* sp. aff *globulifera* (small) (+/-*T. indica* subsp. *leiostachya* and *Tecticornia* aff *halocnemoides* s.l. 'large ovate seed aggregate') sparse low shrubland;
- T5: *Melaleuca xerophila* tall sparse shrubland, over *Tecticornia cymbiformis, Dissocarpus paradoxus,* and *Frankenia laxiflora* low shrubland, over *Enneapogon caerulescens* and *Eragrostis dielsii* sparse tussock grassland;
- T6: *Frankenia fecunda* (glabrous leaf variant) and *Tecticornia disarticulata* (+/- *Tecticornia indica* subsp*. bidens*) low sparse shrubland, over *Aristida holathera* and *Eragrostis falcata* sparse tussock grassland;
- T7: *Cratystylis subspinescens*, *Maireana amoena* and *Sclerolaena diacantha* (+/-*Tecticornia laevigata* and *Tecticornia indica*) sparse mid shrubland, over *Eragrostis falcata* sparse tussock grassland;
- T8: *Tecticornia* spp. (*Tecticornia indica* subsp. *bidens, Tecticornia* sp. aff *pruinosa*, *Tecticornia laevigata, Tecticornia* sp. aff. *undulata, Tecticornia peltata* and *Tecticornia* sp. (*halocnemoides* beaked seed aggregate) sparse low shrubland; and
- T9: *Acacia victoriae* and *Melaleuca xerophila* scattered tall shrubs, over *Lycium australe* and *Cratystylis subspinescens* sparse mid shrubland, over *Tecticornia* spp. (*Tecticornia indica* subsp. *bidens, Tecticornia* sp. aff *pruinosa*, *Tecticornia laevigata*, *Tecticornia* sp. aff. *undulata*, *Tecticornia peltata* and *Tecticornia* sp. (*halocnemoides* beaked seed aggregate) sparse low shrubland.

Table 2.1 – Summary of flora and vegetation assessments conducted in the area

Reference	Report	Timing	Quadrats (size)	Taxa (Genera/ Families)	Significant Flora	Veg Units	Significant Vegetation	Significance	Introduced Flora
Outback Ecology (2007)	Lake Way and Centipede flora and vegetation	Oct 2007	108 (30x30m)	132 (65/32)	None reported	22	Me1 Halophytic vegetation	Restricted Distribution Restricted, New species	**Lysimachia arvensis* (as **Anagallis arvensis*)
Outback Ecology (2009)	Lake Maitland flora and vegetation	May 2007 Nov 2007 May 2009	91 (30x30m)	244 (78/36)	*Maireana* ?*prosthecochaeta* (P3) 5 range extensions	31	KRE	Restricted Distribution	**Tribulus terrestris* **Portulaca oleracea*
Niche (2011)	Lake Way, Centipede and West Creek Borefield flora and vegetation	Apr/Jun 10 Sep/Oct 10	264 (30x30m)	428 (161/57)	*Eremophila congesta* (P1) *Tecticornia* sp. Lake Way (P1) *Eremophila arachnoides* subsp. *arachnoides* (P3) *Stackhousia clementii* (P3) *Homalocalyx echinulatus* (P3) *Mirbelia stipitata* (P3) 24 range extensions and 4 atypical variants	34	BIF Ca1 Ca2 Cr Fr1 Sh complex Sl1	Priority flora Priority flora Priority flora Restricted At risk Priority flora Unique	**Acetosa vesicaria* **Brassica tournefortii* **Centaurea melitensis* **Sonchus oleraceus*
Actis (2012)	*Tecticornia* review	As for Niche (2011)			*Tecticornia* sp. Lake Way (P1) *Tecticornia cymbiformis* (P3) 5 potentially undescribed *Tecticornia* taxa	-	Fr1 Sl1 Cp2	Potential GDE Potential GDE Potential GDE	-
Niche (2014)	Millipede flora and vegetation	Apr/Jun 10 Sep/Oct 10 Oct 2013	30 (30x30m)	185 (100/40)	*Eremophila arachnoides* subsp. *arachnoides* (P3) *Stackhousia clementii* (P3)	10	Ca1 *Tecticornia* vegetation	Priority flora Restricted, Sig. Flora	None reported
ecologia (2015c)	Millipede to Lake Maitland Haul Road flora and vegetation	Jun 2014 Oct 2014 Jan 2015 Mar 2015	130 (30x30m)	223 (93/34)	*Cratystylis centralis* (P3) *Stackhousia clementii* (P3) *Tecticornia cymbiformis* (P3) *Eremophila pungens* (P4) *Frankenia confusa* (P4) 5 range extensions & 2 atypical variants	12	S/V (*Tecticornia* community)	Restricted Distribution Restricted Distribution	**Bidens bipinnata* **Cucumis* ?*lanatus* **Tribulus terrestris*
ecologia (2015a)	Lake Way and Lake Maitland *Tecticornia*	Nov 2014 Jan 2015	162 (3x3m) along 15 transects	65 (27/11)	*Tecticornia* sp. Lake Way (P1) *Tecticornia* sp. Sunshine Lake (P1) *Tecticornia cymbiformis* (P3) 7 potentially new *Tecticornia* taxa	9	All *Tecticornia* communities	Restricted, Sig. Flora, Unknown	None reported

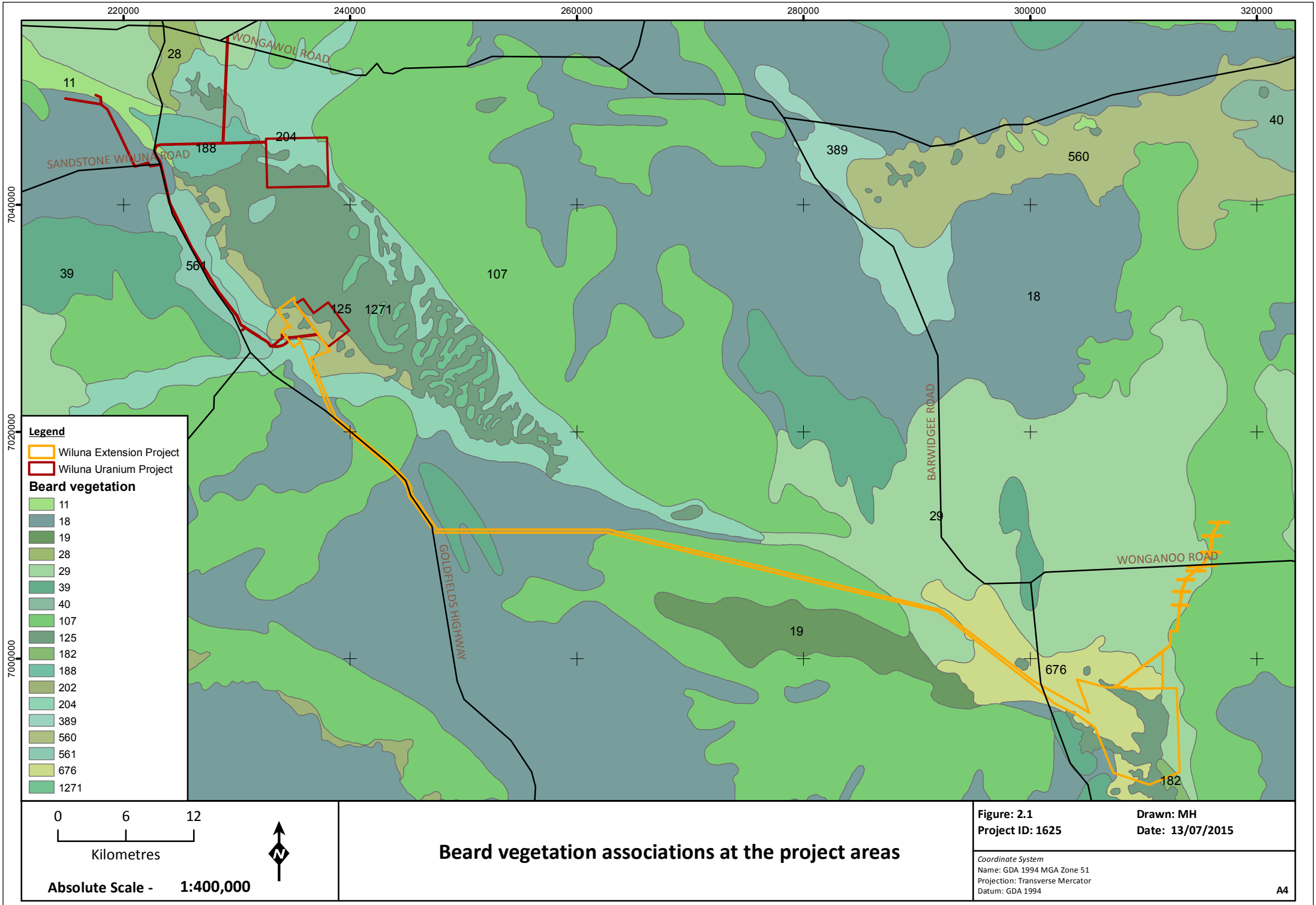
2.1.8 Beard vegetation mapping at the project areas

The vegetation of Western Australia was originally mapped at the 1:1,000,000 scale by Beard (1976), and was subsequently reinterpreted and updated to reflect the National Vegetation Information System (NVIS) standards (Shepherd *et al.* 2001).

Thirteen vegetation associations have been mapped at the project areas which are described in Table 2.2 and shown in Figure 2.1. Of these, unit 125 (Bare areas; salt lakes) and 560 (Mosaic: Shrublands; *Acacia ramulosa* scrub/succulent steppe; Samphire) were the most common at the project areas. Eight associations are considered restricted in the region, of which association 561: Succulent steppe with low woodland; mulga over saltbush is the most regionally restricted of those mapped at the study area with 8,966 ha mapped within the Murchison IBRA bioregion (Table 2.2).

Table 2.2 – Shepherd (Beard) vegetation associations at the study area

Vegetation code (Shepherd *et al.* 2001)	Vegetation association (Beard 1976)	Total area in project areas (ha)	Area mapped in the Murchison (ha)	% total area mapped in the Murchison & (% regional distribution)
11	Medium woodland; coolabah (*Eucalyptus microtheca*)	2.3	9,195	<0.1% (Restricted)
18	Low woodland; Mulga (*Acacia aneura*)	144.9	12,435,564	44.1% (Widespread)
29	Sparse low woodland; Mulga, discontinuous in scattered groups	94.0	2,974,137	10.5% (Widespread)
39	Shrublands; Mulga scrub	9.1	1,152,458	4.1% (Moderate)
40	Shrublands; *Acacia* scrub, various species	6.0	59,230	0.2% (Restricted)
107	Hummock grasslands, shrub steppe; Mulga and *Eucalyptus kingsmillii* over hard spinifex	105.9	2,794,374	9.9% (Widespread)
125	Bare areas; salt lakes	1,399.7	712,038	2.5% (Moderate)
182	Low woodland; Mulga & *Acacia ramulosa*	3.6	51,015	0.2% (Restricted)
188	Shrublands; mulga and *Acacia sclerosperma* scrub	21.6	11,990	<0.1% (Restricted)
204	Succulent steppe with open scrub; scattered Mulga & *Acacia sclerosperma* over saltbush & bluebush	439.9	186,550	0.7% (Restricted)
560	Mosaic: Shrublands; *Acacia ramulosa* scrub / succulent steppe; Samphire	693.6	84,797	0.3% (Restricted)
561	Succulent steppe with low woodland; mulga over saltbush	38.5	8,966	<0.1% (Restricted)
676	Succulent steppe; Samphire	152.6	383,163	1.4% (Restricted)



Beard vegetation associations at the project areas

Figure: 2.1 **Drawn: MH**
Project ID: 1625 **Date: 13/07/2015**

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

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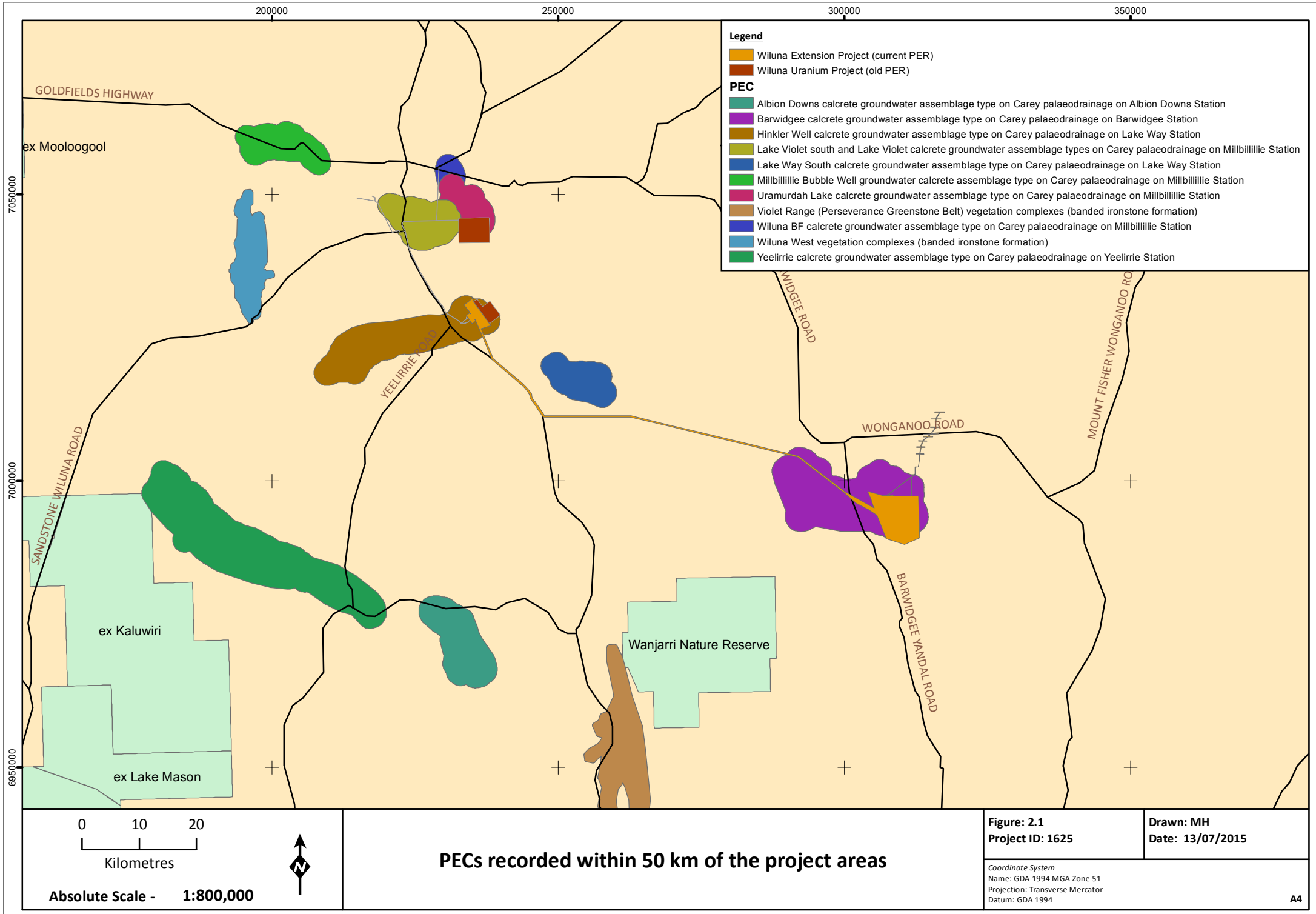
2.2 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

No Commonwealth or State listed TECs were recorded as occurring within 50 km of the project areas (Table 2.3, Figure 2.2).

The five PECs that occur in the project area are underground invertebrate assemblages and are not pertinent to the flora and vegetation of the project areas. The closest PECs that are relevant to the flora and vegetation are the Wiluna West vegetation complexes (Banded Ironstone Formation), approximately 20 km west of the project and the Violet Range vegetation complexes (Banded Ironstone Formation), approximately 40 km south.

Table 2.3 – PECs within 50 km of the project areas

Community	Category	Within project areas
Albion Downs calcrete groundwater assemblage type on Carey palaeodrainage on Albion Downs Station	Priority 1	No
Barwidgee calcrete groundwater assemblage type on Carey palaeodrainage on Barwidgee Station	Priority 1	Yes
Hinkler Well calcrete groundwater assemblage type on Carey palaeodrainage on Lake Way Station	Priority 1	Yes
Lake Violet south and Lake Violet calcrete groundwater assemblage types on Carey palaeodrainage on Millbillillie Station	Priority 1	Yes
Lake Way South calcrete groundwater assemblage type on Carey palaeodrainage on Lake Way Station	Priority 1	No
Millbillillie Bubble Well groundwater calcrete assemblage type on Carey palaeodrainage on Millbillillie Station	Priority 1	No
Uramurdah Lake calcrete groundwater assemblage type on Carey palaeodrainage on Millbillillie Station	Priority 1	Yes
Violet Range (Perseverance Greenstone Belt) vegetation complexes (banded ironstone formation)	Priority 1	No
Wiluna BF calcrete groundwater assemblage type on Carey palaeodrainage on Millbillillie Station	Priority 1	Yes
Wiluna West vegetation complexes (banded ironstone formation)	Priority 1	No
Yeelirrie calcrete groundwater assemblage type on Carey palaeodrainage on Yeelirrie Station	Priority 1	No


200000
250000
300000
350000
7050000
7000000
6950000
Legend
Wiluna Extension Project (current PER)
Wiluna Uranium Project (old PER)
PEC
Albion Downs calcrete groundwater assemblage type on Carey palaeodrainage on Albion Downs Station
Barwidgee calcrete groundwater assemblage type on Carey palaeodrainage on Barwidgee Station
Hinkler Well calcrete groundwater assemblage type on Carey palaeodrainage on Lake Way Station
Lake Violet south and Lake Violet calcrete groundwater assemblage types on Carey palaeodrainage on Millbillillie Station
Lake Way South calcrete groundwater assemblage type on Carey palaeodrainage on Lake Way Station
Millbillillie Bubble Well groundwater calcrete assemblage type on Carey palaeodrainage on Millbillillie Station
Uramurdah Lake calcrete groundwater assemblage type on Carey palaeodrainage on Millbillillie Station
Violet Range (Perseverance Greenstone Belt) vegetation complexes (banded ironstone formation)
Wiluna BF calcrete groundwater assemblage type on Carey palaeodrainage on Millbillillie Station
Wiluna West vegetation complexes (banded ironstone formation)
Yeelirrie calcrete groundwater assemblage type on Carey palaeodrainage on Yeelirrie Station
GOLDFIELDS HIGHWAY
ex Mooloogool
YEELIRRIE ROAD
WIDGEE ROAD
WONGANOO ROAD
MOUNT FISHER WONGANOO RO
SANDSTONE WILUNA ROAD
BARWIDGEE YANDAL ROAD
ex Kaluwiri
ex Lake Mason
Wanjarri Nature Reserve
0
10
20
Kilometres
N
Absolute Scale - 1:800,000
PECs recorded within 50 km of the project areas
Figure: 2.1
Project ID: 1625
Drawn: MH
Date: 13/07/2015
Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994
A4

3 METHODS

3.1 GUIDING PRINCIPLES

This survey was undertaken to supplement previous surveys that are undergoing an Environmental Impact Assessment process in WA and is required to address the following government legislation:

- EPAs Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002); and
- Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004).

Specifically, this report will provide:

- A review of background information used for the vegetation conservation assessment (including literature and database searches);
- Maps and details of any significant flora identified in the literature review;
- An inventory of vegetation types occurring at the project areas, incorporating recent published and unpublished records; and
- A map and detailed description of vegetation types (to NVIS Level V: Association) occurring in the project areas and an assessment of which vegetation units represent Threatened or Priority Ecological Communities.

3.2 DATABASE SEARCHES

Using the shapefile of the Extension to the Wiluna Uranium Project area a search of the DPaW Threatened and Priority Ecological Communities Database (Search reference 25-0514EC) with a 50 km buffer was undertaken in September 2014, to locate TECs and PECs previously recorded in the vicinity of the project areas.

Nationally Listed Threatened Ecological Communities

Ecological communities are naturally occurring biological assemblages associated with a particular type of habitat (DEC 2010). At a national level, flora and Threatened Ecological Communities (TECs) are protected under the Commonwealth EPBC Act.

A search of the EPBC protected matters search tool was undertaken to locate matters of national environmental significance.

State Listed Threatened Ecological Communities

DPaW also maintains a list of state listed TECs which are further categorised into three subcategories, much like those of the EPBC Act. Within the Western Australian classification, an ecological community will be listed as Vulnerable "when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future".

A search of the DPaW state listed TEC Database for the project areas was conducted using a 50 km buffer.

State Listed Priority Ecological Communities

DPaW maintains a list of Priority Ecological Communities (PEC). PECs include potential TECs that do not meet survey criteria, or that are not adequately defined.

A search of the DPaW Threatened and Priority Ecological Communities Database for the project areas was conducted using a 50 km buffer.

3.3 CONSOLIDATION OF DATA

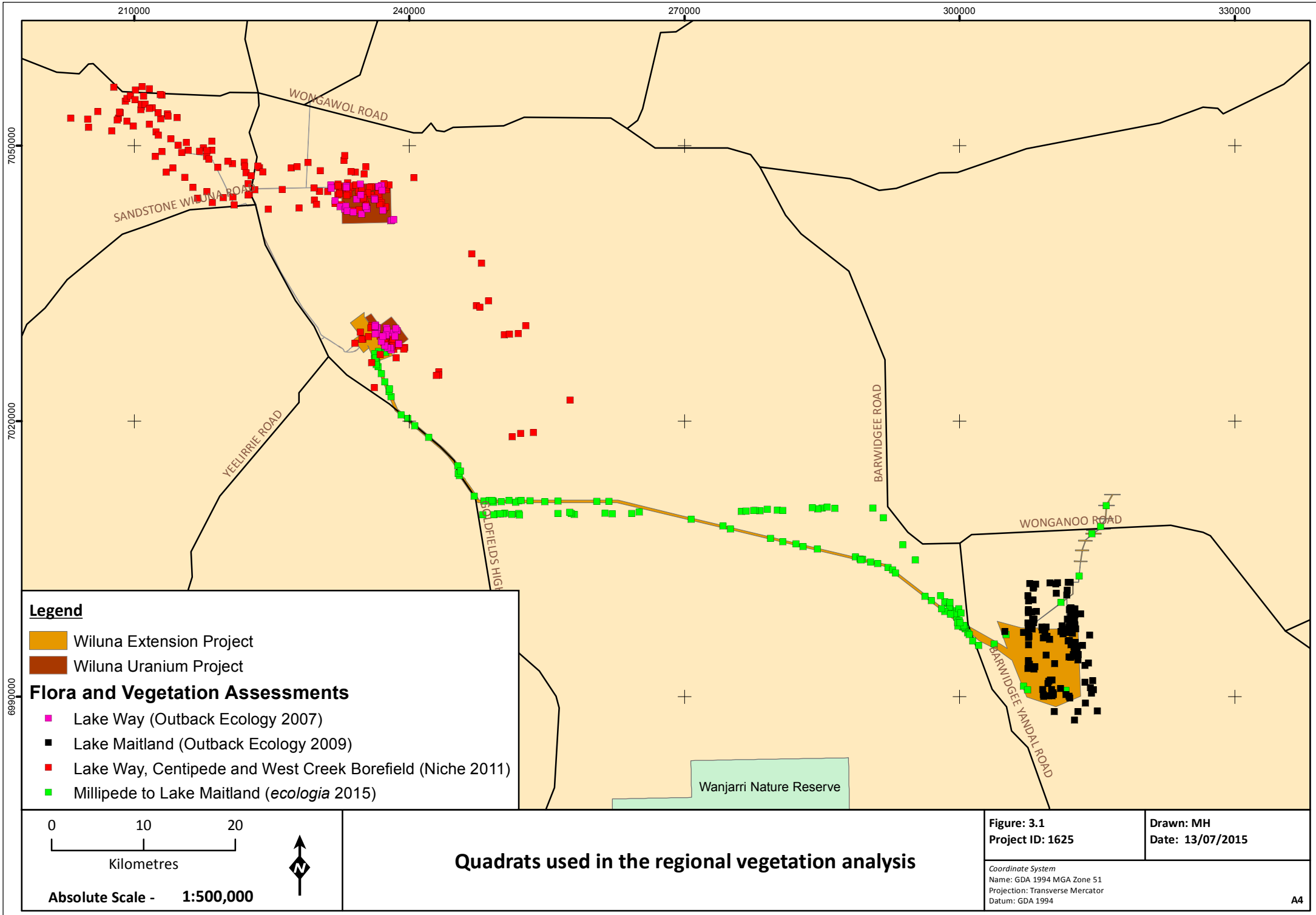
A number of finer scale surveys have been conducted for the Wiluna Uranium Project and the Extension to the Wiluna Uranium Project. These include:

- Outback Ecology (2007) - Lake Way and Centipede baseline vegetation and flora survey;
- Outback Ecology (2009) - Lake Maitland: baseline vegetation and flora surveys;
- Niche (2011) - Assessment of the flora and vegetation of: Lake Way, Centipede and West Creek Borefield;
- Niche (2014) - Assessment of the flora and vegetation of: Millipede;
- *ecologia* (2015c) - Millipede to Lake Maitland Haul Road Level 2 flora and vegetation assessment; and
- *ecologia* (2015a) – Assessment of *Tecticornia* associated with Lake Way and Lake Maitland.

Data from the flora and vegetation surveys listed above was used to conduct the flora and vegetation consolidation. There have been 10 separate phases of flora and vegetation assessments conducted at or in the vicinity of the project areas which will be included (Table 3.1). Five-hundred and six quadrats (all 30 x 30 m) were surveyed at and in the vicinity of the project areas during these assessments. These are shown in Figure 3.1.

Table 3.1 – Reports conducted at or in the vicinity of the project areas

Report	Survey Phases	Reference
Lake Way and Centipede baseline vegetation and flora survey	1: October 2007	Outback Ecology (2007)
Lake Maitland: baseline vegetation and flora surveys	1: May 2007 2: October 2009	Outback Ecology (2009)
Assessment of the flora and vegetation of: Lake Way, Centipede and West Creek Borefield	1: April-June 2010 2: Sept-Oct 2010	Niche (2011)
Assessment of the flora and vegetation of: Millipede	1: October 2013	Niche (2014)
Millipede to Lake Maitland Haul Road Level 2 Flora and vegetation assessment	1: June 2014 2: October 2014 3: January 2015 4: March 2015	*ecologia* (2015c)


210000
240000
270000
300000
330000
7050000
7020000
6990000
WONGAWOL ROAD
SANDSTONE WILUNA ROAD
YEELIRRIE ROAD
BARWIDGEE ROAD
WONGANOO ROAD
BARWIDGEE YANDAL ROAD
Wanjarri Nature Reserve
Legend
Wiluna Extension Project
Wiluna Uranium Project
Flora and Vegetation Assessments
Lake Way (Outback Ecology 2007)
Lake Maitland (Outback Ecology 2009)
Lake Way, Centipede and West Creek Borefield (Niche 2011)
Millipede to Lake Maitland (ecologia 2015)
0
10
20
Kilometres
N
Absolute Scale - 1:500,000
Quadrats used in the regional vegetation analysis
Figure: 3.1
Project ID: 1625
Drawn: MH
Date: 13/07/2015
Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994
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3.4 VEGETATION UNIT DELINEATION AND MAPPING

Vegetation units are delineated based on shared characteristics such as the vegetation structure, dominant species and species composition. A combination of aerial photography, clustering patterns observed from hierarchical cluster analysis (Section 3.4.1), and ground truthing was used to interpret the vegetation patterns of the project areas and allow for the vegetation mapping.

Vegetation units are described based on the National Vegetation Information System (NVIS) methodology (ESCAVI 2003) and are described to association level (level V) where the dominant growth form, height and crown cover for three species are described for three strata (upper, middle and ground).

3.4.1 Statistical Analysis

Statistical analysis provides an objective means of defining vegetation units and provides insight into the hierarchical relationship between communities based on the degree of similarity in species composition and abundance.

Multivariate analysis was conducted using the site by species matrix from the quadrats completed during all the surveys listed in Table 3.1. The species by site matrix was treated in the following manner:

- Data was transformed to presence/absence, rather than cover weighted to reduce observer bias;
- Taxa were removed from the data or in some cases grouped together if they could not be confidently identified to species level and there was a possibility of confusion with other similar taxa;
- All *Tecticornia* species were consolidated into one '*Tecticornia* sp.' entity as they were either not provided in the data or identifications were inconsistent between projects.
- Annual taxa were removed; and
- Subspecies and varieties of the same species were combined.

An association matrix was calculated from the site by species data using the Bray-Curtis coefficient in PATN v3.11. This was then used to perform a hierarchical cluster analysis using the Unweighted Pair Group Method with Arithmetic mean (UPGMA). The clustering patterns from the resultant dendrogram were used to delineate vegetation units. Vegetation units were then described on the basis of the most prevalent species within the unit as a whole. The site by species matrix used for the analysis is provided electronically in Appendix A and the dendrogram in Appendix B.

A combination of aerial photography, clustering patterns observed from the dendrogram, and ground truthing was used to interpret the vegetation patterns of the project areas, which was subsequently used to inform vegetation mapping.

3.4.2 *Tecticornia* Identifications

Identifications of the *Tecticornia* specimens were not resolved at the time of the statistical analysis. A separate report detailing the *Tecticornia* flora and vegetation values of the project areas was completed by *ecologia* (2015a) following identification of *Tecticornia* specimens by Kellie Sheppard, Senior Research Scientist at the Western Australian Herbarium, and should be consulted for further information on the composition of *Tecticornia* communities within the Lake Maitland and Millipede project areas.

3.5 VEGETATION CONSERVATION SIGNIFICANCE ASSESSMENT

Vegetation communities were assessed for National, State, regional and local significance.

National significance refers to those features of the environment which are recognised under legislation as being of importance to the Australian community; in particular TECs listed under the *EPBC Act* are regarded as nationally significant.

State significance refers to those features of the environment that are recognised under State legislation as being of importance to the Western Australian community, in particular communities listed as TECs or PECs under the *WC Act* are of state significance.

Regional significance addresses the representation of species and habitats at a biogeographic regional level. Vegetation communities that are restricted to the Murchison bioregion and whose distributions are limited or unknown are considered regionally significant. Regional significance of vegetation was assessed using Beard vegetation mapping at the project areas and in the Murchison. As the Beard mapping was conducted at a large scale it does not always accurately represent the mapped communities at the project areas, especially the minor details including drainage channels, creeklines and hill slopes. If a vegetation unit mapped at the project area can be attributed to a Beard vegetation unit, it can be used to loosely determine the potential extent of this community in the region.

Three levels of regional significance are given to each vegetation unit recorded at the project areas. These are described in Table 3.2.

Table 3.2 – Levels of regional significance

Level	Description
High	Vegetation unit is likely to be limited to an uncommon habitat type and in a restricted Beard vegetation unit(s) in the IBRA region.
Moderate	Vegetation unit is likely to be associated with a common habitat type, within a restricted-moderately restricted Beard vegetation unit(s) in the IBRA region.
Low	Vegetation unit is associated with a common habitat type and widespread Beard vegetation unit(s) in the IBRA region.

Local significance is when a species or vegetation unit is confined to a specialised habitat type that is not common and potentially restricted to the local area and whose disturbance or removal may lead to local extinction. A local vegetation conservation assessment will be conducted based on regional distribution, presence of significant flora, vegetation condition, average species richness as well as whether or not it is part of a known significant community (i.e. TEC, PEC etc.) and significant flora taxa will be assessed based on if it is restricted locally.

3.6 STUDY TEAM AND LICENCES

This vegetation consolidation conducted by *ecologia* was planned, coordinated, executed and reported by those summarised below in Table 3.3.

Table 3.3 – Study team and licences

Project staff			
Name	**Qualification**	**Role**	**Project role**
Matthew Macdonald	PhD (Botany)	Principal Ecologist	Reporting, project management
Melissa Hay	B.Sc. (Hons)	Senior Botanist	Reporting

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4 CONSOLIDATED RESULTS

4.1 FLORA

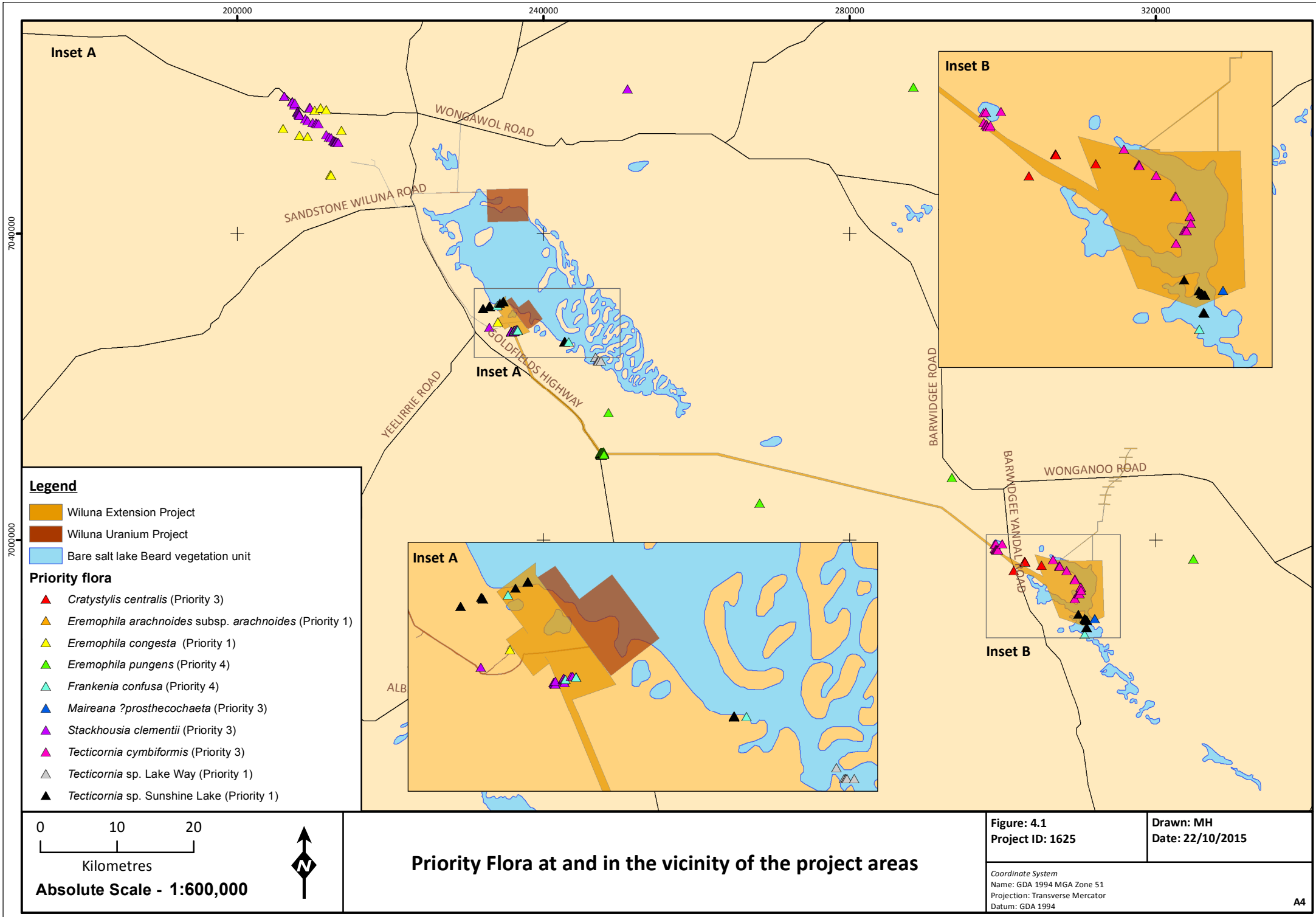
4.1.1 Priority flora

The Priority flora taxa identified from the flora and vegetation assessments included in this consolidation are listed in Table 4.1 and locations shown in Figure 4.1. Coordinates are provided electronically in Appendix A.

Table 4.1 – Priority flora

Flora taxon	Reference	Location and population description
Eremophila arachnoides subsp. *arachnoides* (P3)	Niche (2011)	Three large populations were described. One population at Centipede deposit (5,440 individuals) one population north of Lake Way deposit (18,500 individuals) and one population approximately 100 km north of Wiluna (18,000 individuals).
	Niche (2014)	
Eremophila congesta (P1)	Niche (2011)	Recorded extensively throughout the West Creek Borefield and one location west of the Millipede deposit.
Tecticornia sp. Lake Way (P1)	Niche (2011)	Recorded from previously known location approximately 10 km to the south of the Centipede/millipede deposits at Lake Way.
	Actis (2012)	
	ecologia (2015c)	
Tecticornia sp. Sunshine Lake (P1)	*ecologia* (2015c)	Recorded commonly at both Lake Maitland and Lake Way.
Cratystylis centralis (P3)	*ecologia* (2015c)	Two locations to the west of the Lake Maitland deposit.
Homalocalyx echinulatus (P3)^	Niche (2011)	Recorded from the West Creek Borefield. No abundance details or locations available.
Maireana ?*prosthecochaeta* (P3)	Outback Ecology (2007)	One record in the south-east of Lake Maitland. A targeted search by *ecologia* (November 2014 and January 2015) of approximately 23 km in and around the location of the original record, and areas of similar habitat (*ecologia* 2015b) suggests that this was an identification error and unlikely to occur here.
Mirbelia stipitata (P3)^	Niche (2011)	Collected from adjacent to Gunbarrel Highway during the regional survey. Not recorded at the project areas.
Stackhousia clementii (P3)	Niche (2011)	Two populations were reported, one at the West Creek Borefield (114 individuals) and one west of the Centipede deposit/Millipede deposit (500-1,000 individuals).
	Niche (2014)	One population of between 500 and 1,000 individuals in a minor tributary in the south of the Millipede deposit.
	ecologia (2015c)	One location with 5 individuals recorded in a minor tributary in the south of the Millipede deposit.
Tecticornia cymbiformis (P3)	Actis (2012)	Recorded at one quadrat at Lake Maitland. No coordinates available, so has not been included.
	ecologia (2015c)	Substantial population (5,480 individuals) at Lake Maitland, including fringing the main lake bed and a small salt pan to the west of Lake Maitland (intercepting the Haul Road alignment).
	ecologia (2015a)	
Eremophila pungens (P4)	*ecologia* (2015c)	A substantial population of over 2,000 individuals was recorded from the Millipede to Lake Maitland haul road.
Frankenia confusa (P4)	*ecologia* (2015c)	Scattered individuals on edge of Lake Way and Lake Maitland.

^ = no coordinates available



Priority Flora at and in the vicinity of the project areas

Figure: 4.1
Project ID: 1625

Drawn: MH
Date: 22/10/2015

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

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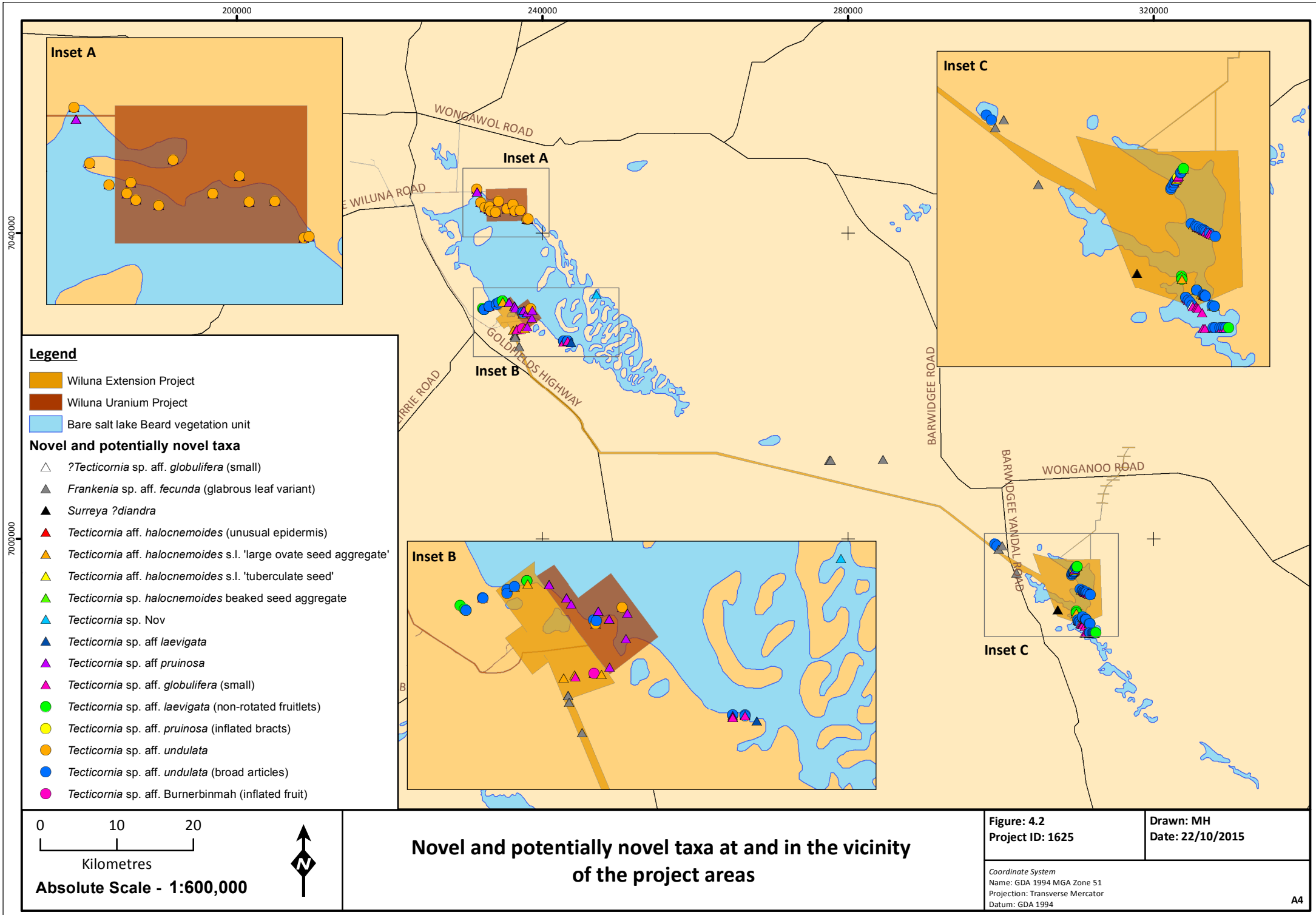
4.1.2 Novel and potentially novel flora taxa

The potentially new flora taxa identified from the flora and vegetation assessments included in this consolidation are listed in Table 4.2 and locations shown in Figure 4.2. Coordinates are provided electronically in Appendix A.

Table 4.2 – Potentially new flora taxa

Taxa	Location and population description
Novel taxa (*ecologia* 2015a)	
Tecticornia aff. *halocnemoides* s.l. 'large ovate seed aggregate'	Lake Way: Common on the edge of the main salt lake and minor tributary to the south of millipede/centipede. Lake Maitland: Common on the main lake bed and trail of small salt pans that run to the south.
Tecticornia aff. *halocnemoides* s.l. 'tuberculate seed'	Lake Maitland: Common on the main lake bed and trail of small salt pans that run to the south.
Tecticornia sp. aff. *globulifera* (small)	Lake Way: Very common on the edge of the main lake bed and minor tributaries. Lake Maitland: Very common on the main lake bed and on the trail of small salt pans to the south.
Tecticornia sp. aff. *laevigata* (non-rotated fruitlets)	Lake Way: Common on the main lake bed and minor tributaries. Lake Maitland: Common on the main lake bed and the small salt pan trail that runs south.
Tecticornia sp. aff. *pruinosa* (inflated bracts)	Lake Maitland: Scattered in the main lake bed.
Tecticornia sp. aff. Burnerbinmah (inflated fruit)	Lake Way: Recorded scattered on the minor tributary in the south of millipede.
Tecticornia sp. aff. *undulata* (broad articles)	Lake Way: Common on the main lake bed and minor tributaries. Lake Maitland: Very common on the main lake bed and on the trail of small salt pans to the south.
Potentially novel taxa (*ecologia* 2015a)	
Tecticornia aff. *halocnemoides* (unusual epidermis)	Lake Maitland: Scattered at one location in the trail of small salt pans that run to the south.
?Tecticornia sp. aff. *globulifera* (small)	Lake Way: Scattered on the main lake bed. Lake Maitland: Scattered on the trail of small salt pans that run to the south.
Frankenia sp. aff. *fecunda* (glabrous leaf variant)	Scattered at the southern end of Millipede and the haul road.
Surreya ?*diandra*	One location in the south-western section of the Millipede deposit.
Potentially novel taxa (Niche 2011)	
Tecticornia sp. *halocnemoides* beaked seed aggregate	Lake Way: Common on the main lake bed and the minor tributary running north from the Lake Way deposit.
Tecticornia sp. aff. *laevigata*	Lake Way: Common on the main lake bed of the centipede and millipede deposits and on the main tributary that runs north from the Lake Way deposit.
Tecticornia sp. aff. *pruinosa*	Lake Way: Very common on the main lake bed of the centipede/Millipede deposits and Lake Way deposits. Also recorded on the minor tributaries of both areas.
Tecticornia sp. aff. *undulata*	Lake Way: Very common on the main lake bed of the centipede/Millipede deposits and Lake Way deposits. Also recorded on the minor tributaries of the Lake Way deposit.
Frankenia ?*interioris*^	Recorded in the Centipede and Lake Way project areas.
Frankenia sp. cf. *glomerata*^	Recorded at the West Creek Borefield area.
Rhagodia drummondii sens. lat.^	Scattered in the Lake Way deposit and regionally neat Lake King.
Scaevola spinescens^	Common across Centipede and Lake Way deposits and the West Creek Borefield.
Tecticornia sp. nov	One location in a regional quadrat. No coordinates available.

^ = no coordinates available



Novel and potentially novel taxa at and in the vicinity of the project areas

Figure: 4.2
Project ID: 1625

Drawn: MH
Date: 22/10/2015

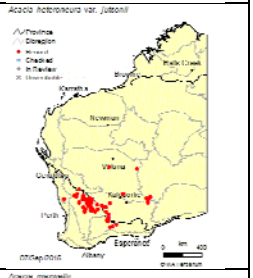
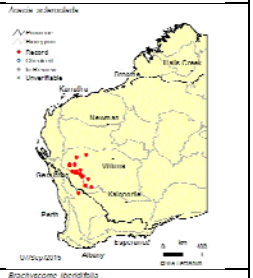
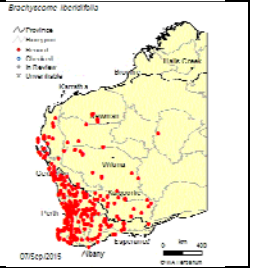
Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

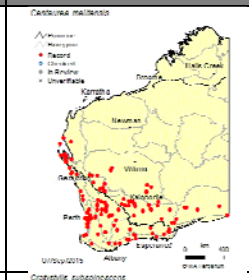
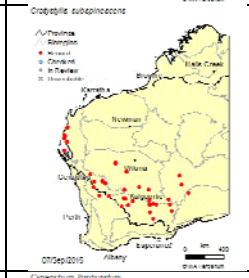
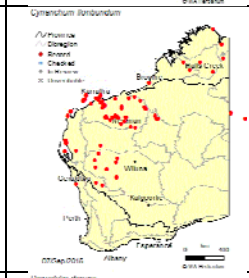
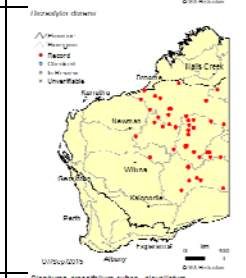
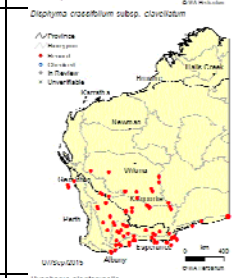
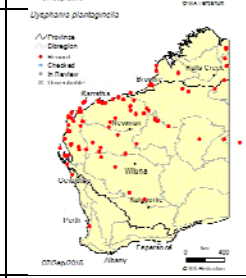
A4

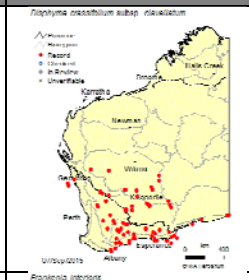
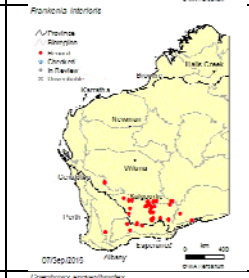
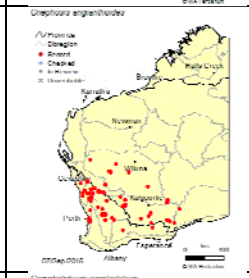
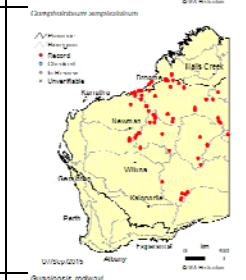
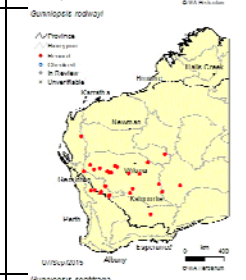
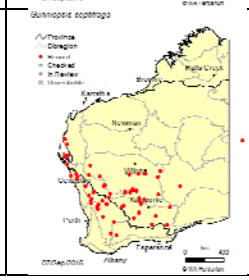
4.1.3 Range extensions

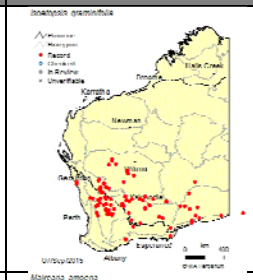
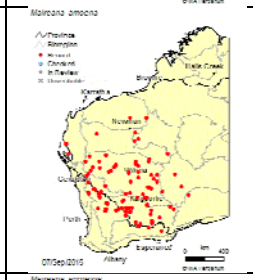
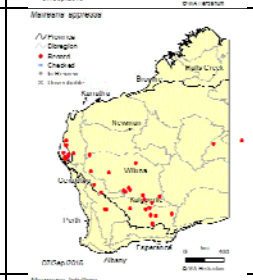
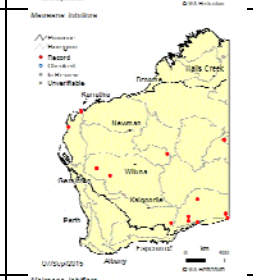
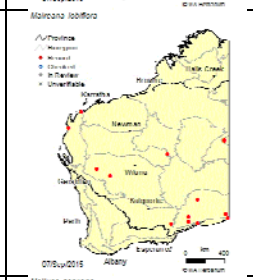
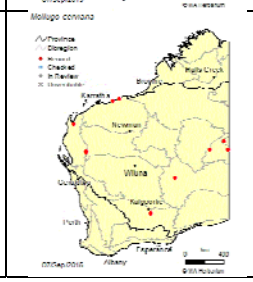
The range extensions identified from the flora and vegetation assessments included in this consolidation are listed in Table 4.3 and locations shown in Figure 4.3. Coordinates are provided electronically in Appendix A.

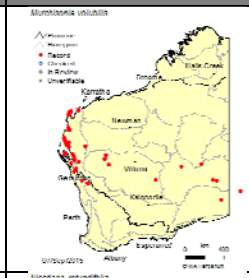
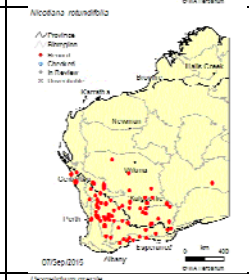
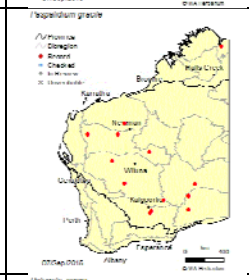
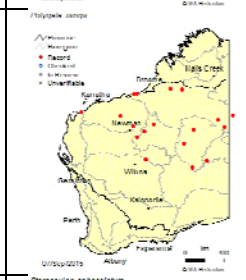
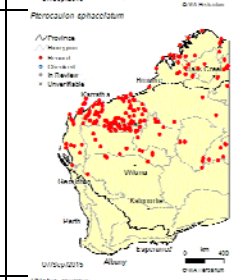
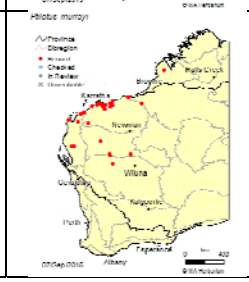
Table 4.3 – Range extensions of the Wiluna Uranium Project

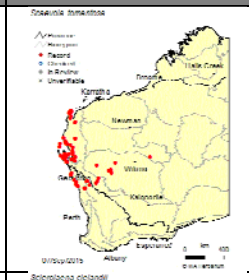
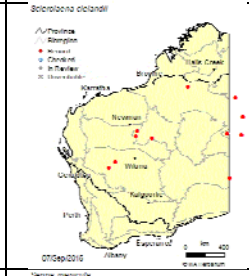
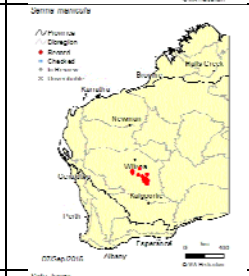
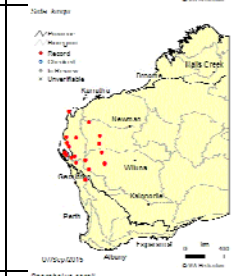
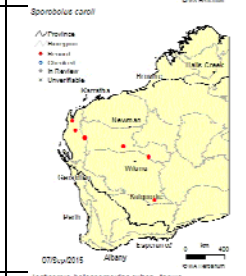
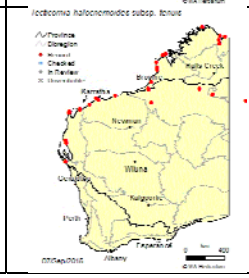
Flora taxon (reference)	Comment	Distribution
Acacia aneura var. cf *major* (Outback Ecology 2009)	This taxon was recorded from two locations north of Lake Maitland. Without a reference specimen, the identity of these specimens is difficult to establish given the recent taxonomic changes within the *Acacia aneura* complex.	Not recorded from WA
Acacia brumalis (Outback Ecology 2009)	Without a reference specimen, the identity of these specimens is difficult to establish. Recorded at the southern end of the Lake Maitland deposit.	
Acacia heteroneura var. *jutsonii* (*ecologia* 2015c)	Recorded from one location on sandplain on the haul road. Nearest record approximately 150 km west of the project.	
Acacia maxwellii (Outback Ecology 2009)	Without a reference specimen, the identity of these specimens is difficult to establish. Recorded at the southern end of the Lake Maitland deposit.	
Acacia scleroclada (Outback Ecology 2009)	Without a reference specimen, the identity of these specimens is difficult to establish. Recorded to the south-east of the Lake Maitland deposit.	
Brachyscome iberidifolia^ (Niche 2011)	This record is not considered to represent the limit of the range of this species, given that there are collections from further into the arid zone than the project location.	

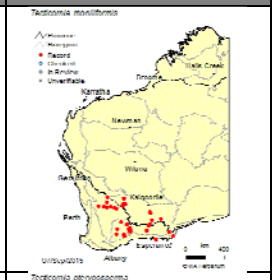
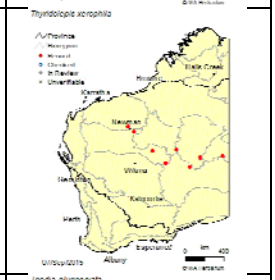
Flora taxon (reference)	Comment	Distribution
**Centaurea melitensis*^ (Niche 2011)	Recognition of a range extension for an introduced species may have management implications, but is not relevant to impact assessments. Recorded from the West Creek Borefield, but specific location information is available for this record.	
Cratystylis subspinescens^ (Niche 2011)	No information available.	
Cynanchum floribundum (Niche 2011)	Recorded scattered in two locations at the West Creek Borefield.	
Dicrastylis doranii^ (Niche 2011)	No information available.	
Disphyma crassifolium subsp. *clavellatum*^ (Niche 2011)	No information available.	
Dysphania plantaginella (*ecologia* 2015c)	Two locations recorded just outside the haul road near Lake Maitland.	
Dysphania truncata^ (Niche 2011)	Possible misidentification. Without a reference specimen, the identity of these specimens is difficult to establish.	Not recorded from WA

Flora taxon (reference)	Comment	Distribution
Euphorbia biconvexa^ (Niche 2011)	No information available.	
Frankenia interioris^ (Niche 2011)	No information available.	
Gnephosis angianthoides^ (Niche 2011)	No information available.	
?*Gompholobium simplicifolium* (as ?*Otion simplicifolium*)^ (Niche 2011)	No information available.	
Gunniopsis rodwayi^ (Niche 2011)	No information available.	
Gunniopsis septifraga^ (Niche 2011)	No information available.	

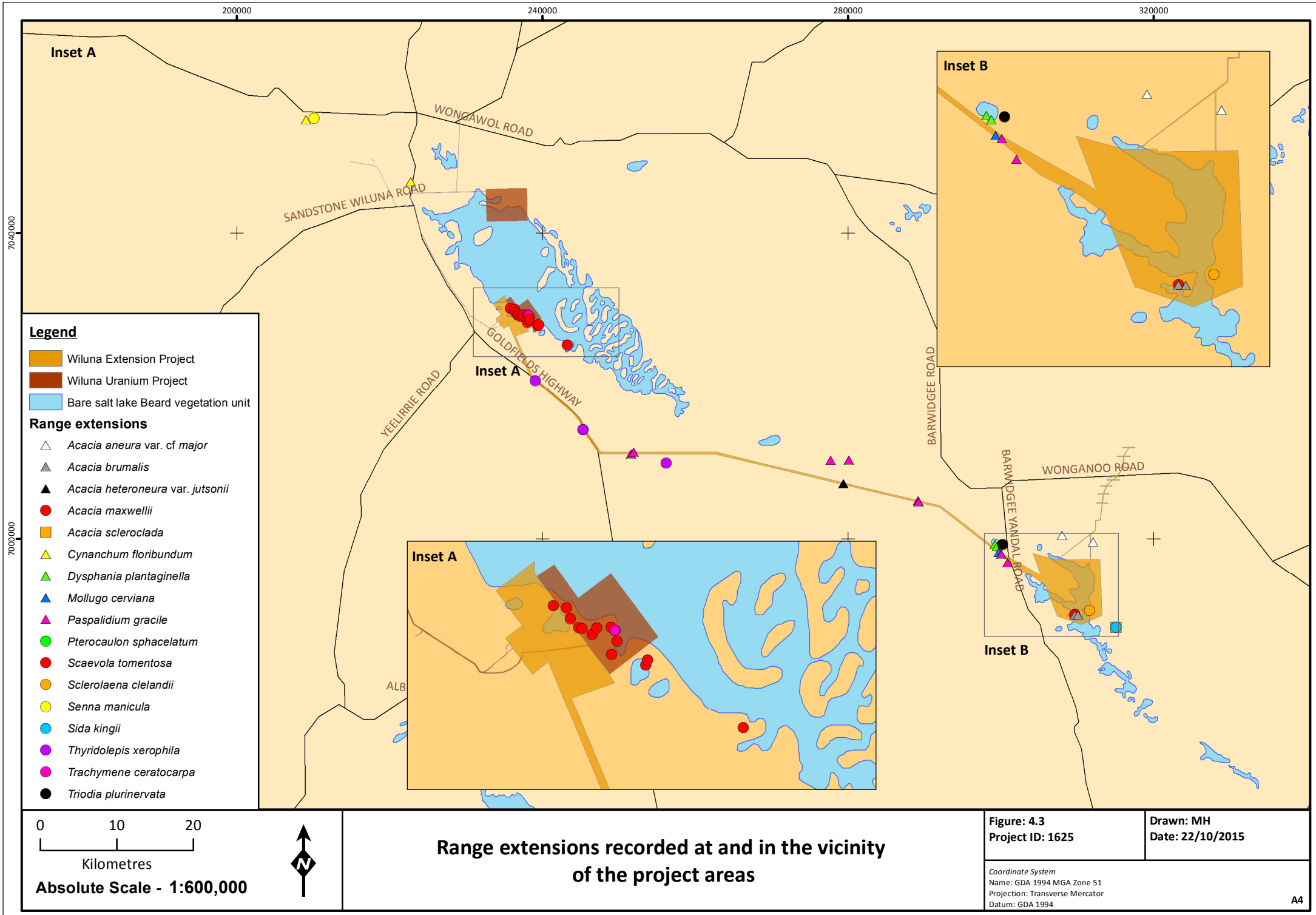
Flora taxon (reference)	Comment	Distribution
Isoetopsis graminifolia^ (Niche 2011)	No information available.	
Maireana amoena^ (Niche 2011)	No information available.	
Maireana appressa^ (Niche 2011)	No information available.	
Maireana lobiflora (*ecologia* 2015c)	Scattered individuals to the south-east of Lake Maitland.	
Maireana luehmannii (*ecologia* 2015c)	Recorded towards the southern end of the Millipede deposit and just outside the haul road near Lake Maitland.	
Mollugo cerviana^ (*ecologia* 2015c)	One large population (approximately 1,000 plants on a floodplain between salt pans, west of lake Maitland. Nearest previous record is approximately 300 km west of Lake Maitland.	

Flora taxon (reference)	Comment	Distribution
Murchisonia volubilis^ (Niche 2011)	No information available.	
Nicotiana rotundifolia^ (Niche 2011)	No information available.	
Paspalidium gracile (*ecologia* 2015c)	Widespread across the project area, but uncommonly recorded from drainage lines, floodplains and salt pans. Nearest previous record is approximately 150 km south-west of project area.	
Polygala isingii^ (Niche 2011)	No information available.	
Pterocaulon sphacelatum (*ecologia* 2015c)	Uncommon along a minor draining line. Nearest previous record is approximately 150 north-east of project area.	
Ptilotus murrayi^ (Niche 2011)	No information available.	

Flora taxon (reference)	Comment	Distribution
Scaevola tomentosa (Niche 2011)	Common within the Millipede and Centipede deposits.	
Sclerolaena clelandii (*ecologia* 2015a)	Scattered at one location in the south of the Lake Maitland deposit.	
Senna manicula (Niche 2011)	Scattered in the south-eastern section of the Lake Maitland deposit.	
Sida kingii (Outback Ecology 2009)	One location to the east of Lake Maitland deposit.	
Sporobolus caroli (*ecologia* 2015c)	One location in the southern end of the Millipede deposit.	
Tecticornia halocnemoides subsp. *catenulata* (Niche 2011)	Recorded at 11 locations at the Centipede and Lake Way deposits.	

Flora taxon (reference)	Comment	Distribution
Tecticornia moniliformis (Niche 2011)	Recorded commonly at the Centipede and Lake Way deposits on the main lake bed and minor tributaries.	
Tecticornia pterygosperma subsp. *pterygosperma* (*ecologia* 2015 a, c)	Recorded at one location at Lake Maitland, on a small salt pan to the south of the main lake bed.	
Tecticornia tenuis (*ecologia* 2015 a, c)	Recorded at three locations from Lake Way on the floodplain to the south of Millipede.	
Trachymene ceratocarpa (Niche 2011)	One location within the Centipede deposit.	
Thyridolepis xerophila (*ecologia* 2015c)	Scattered along draining lines at the northern end of the haul road. Nearest previous record is approximately 200 km north-east of the project.	
Triodia plurinervata (*ecologia* 2015c)	Recorded at one location to the east of Lake Maitland and north of the haul road.	

^ = no coordinates available. Note: Images used with the permission of the Western Australian Herbarium, Department of Parks and Wildlife (https://florabase.dpaw.wa.gov.au/help/copyright). Accessed on Friday, 23 October 2015.



Range extensions recorded at and in the vicinity of the project areas

Figure: 4.3
Project ID: 1625

Drawn: MH
Date: 22/10/2015

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

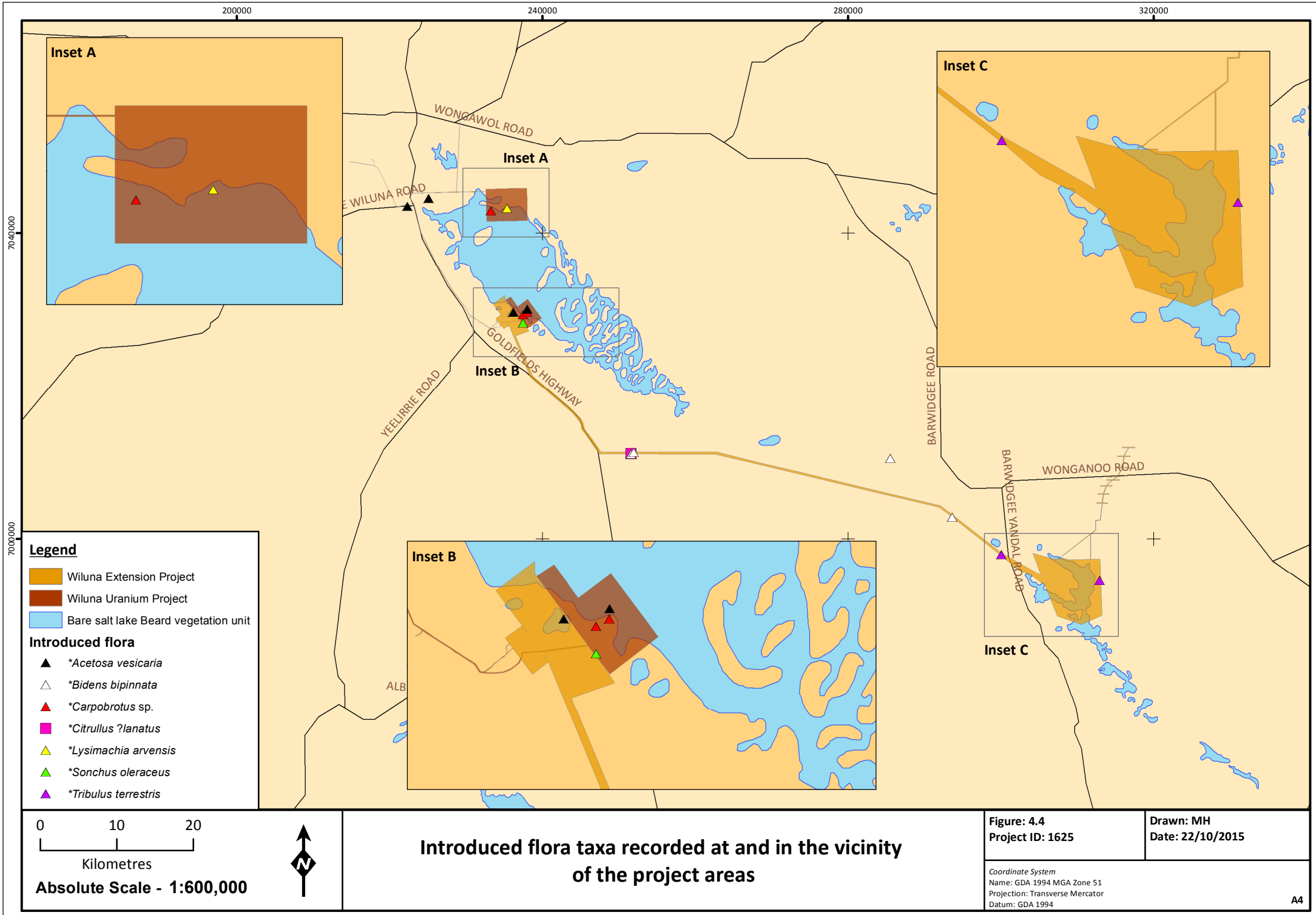
A4

4.1.4 Introduced flora

The introduced flora taxa identified from the flora and vegetation assessments included in this consolidation are listed in Table 4.4 and locations shown in Figure 4.4. Coordinates are provided electronically in Appendix A.

Table 4.4 – Introduced flora taxa of the Wiluna Uranium Project

Taxon	Reference	Comment
**Acetosa vesicaria*	Niche (2011)	Recorded at the Centipede and Millipede deposits and the West Creek borefields. Four locations totalling approximately 90 individuals.
**Bidens bipinnata*	*ecologia* (2015c)	Recorded along the haul road in large numbers along drainage lines. Four records representing an estimated 1,301 individuals.
**Brassica tournefortii*^	Niche (2011)	No information available.
**Carpobrotus* sp.	Outback Ecology (2007)	Recorded from three locations, two at Centipede deposit and one at Lake Way deposit.
**Centaurea melitensis*^	Niche (2011)	Recorded from one location in the West Creek Borefield. No specific location data is available.
**Citrullus ?lanatus*	*ecologia* (2015c)	Scattered at one location in a drainage line along the haul road.
**Lysimachia arvensis* (as **Anagallis arvensis*)	Outback Ecology (2007)	Recorded from one location at the Lake Way deposit.
**Sonchus oleraceus*	Niche (2011)	Recorded from one location at the Centipede deposit.
**Tribulus terrestris*	Outback Ecology (2009)	Recorded along the eastern edge of the lake Maitland deposit and along the haul road to the west of Lake Maitland.
	ecologia (2015c)	



Introduced flora taxa recorded at and in the vicinity of the project areas

Figure: 4.4
Project ID: 1625

Drawn: MH
Date: 22/10/2015

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

A4

4.2 VEGETATION

A total of 31 vegetation units were delineated based on all quadrats surveyed for the Wiluna Uranium Project and the Extension to the Uranium Project. These vegetation units and bare salt lake bed (with no vegetation cover) were mapped across a total area of 33,272.0 ha, incorporating all areas mapped from the flora and vegetation assessments for the Wiluna Uranium Project and the Extension to the Uranium Project.

Of these vegetation units, 21 were recorded at the Wiluna Uranium Project and 25 were recorded at the Extension to the Wiluna Uranium Project. These are described in Table 4.5, an overview map is shown in Figure 4.5 and more detailed vegetation mapping is presented in Figure 4.6 to Figure 4.8. The dendrogram showing the delineated vegetation communities used in this report is presented in Appendix B.

Table 4.5 – Vegetation units at the project areas

Code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Associated species	Photograph
AA	*Acacia tetragonophylla* sparse tall shrubland, over *Senna artemisioides* and *Ptilotus obovatus* sparse low shrubland.	Extent: 2,560.0 ha Average species richness: 8.8 ± 3.4 Landform: Plain Number of quadrats: 24	*Acacia aneura/aptaneura* *Acacia burkittii* *Acacia pteraneura/macraneura* *Eremophila longifolia* *Hakea francisiana* *Rhagodia eremaea* *Scaevola spinescens*	
AB	*Acacia tetragonophylla, Acacia victoriae* and *Ptilotus obovatus* sparse low shrubland.	Extent: 465.0 ha Average species richness: 5.8 ± 1.9 Landform: Plain Number of quadrats: 5	*Acacia aneura/aptaneura* *Acacia burkittii* *Eremophila arachnoides* subsp. *arachnoides* *Grevillea nematophylla* *Senna artemisioides*	
AC	*Eucalyptus camaldulensis* subsp. *obtusa* sparse low woodland, over *Acacia aptaneura* and *Acacia tetragonophylla* sparse tall shrubland, over *Eremophila longifolia, Senna artemisioides* and *Scaevola spinescens* sparse mid shrubland.	Extent: 3,009.2 ha Average species richness: 10.5 ± 3.5 Landform: Plain Number of quadrats: 15	*Acacia aneura/aptaneura* *Acacia victoriae* *Eragrostis eriopoda* *Grevillea nematophylla* *Hakea francisiana/minyma* *Ptilotus obovatus* *Rhagodia eremaea* *Santalum lanceolatum*	

Code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Associated species	Photograph
BA	*Acacia aneura/aptaneura* sparse low woodland, over *Acacia tetragonophylla* (+/- *Melaleuca hamata*) sparse tall shrubland, over *Senna artemisioides*, *Scaevola spinescens* and *Rhagodia drummondii* sparse mid shrubland, over Ptilotus obovatus, *Maireana villosa, Sclerolaena diacantha* and *Cratystylis subspinescens* sparse low shrubland.	Extent: 92.3 ha Average species richness: 14.5 ± 3.1 Landform: Plain Number of quadrats: 13	*Acacia pteraneura/macraneura* *Atriplex amnicola* *Enchylaena tomentosa var. tomentosa* *Enteropogon ramosus* *Eremophila galeata* *Exocarpos aphyllus* *Maireana triptera* *Melaleuca xerophila* *Pittosporum phylliraeoides* *Sclerolaena densiflora* *Solanum lasiophyllum* *Solanum nummularium*	
BB	*Casuarina pauper* open low woodland, over *Eremophila pantonii, Eremophila longifolia* and *Eremophila latrobei* sparse mid shrubland, over *Scaevola spinescens, Exocarpos aphyllus*, *Rhagodia drummondii* and *Ptilotus obovatus* sparse low shrubland.	Extent: 1,105.6 ha Average species richness: 15.7 ± 2.3 Landform: Plain Number of quadrats: 7	*Acacia nyssophylla* *Eremophea spinosa* *Eremophila forrestii* *Eriochiton sclerolaenoides* *Hakea preissii* *Sclerolaena diacantha* *Sclerolaena obliquicuspis* *Senna artemisioides* *Sida* sp. dark green fruits (S. van Leeuwen 2260) *Solanum lasiophyllum*	
BC	*Scaevola spinescens, Eremophila malacoides, Rhagodia drummondii, Maireana villosa* and *Eremophila glabra* sparse low shrubland, over *Enteropogon ramosus* sparse tussock grassland.	Extent: 59.7 ha Average species richness: 11.3 ± 2.3 Landform: Plain Number of quadrats: 3	*Enchylaena tomentosa* var. *tomentosa* *Eremophila forrestii* *Eremophila glandulifera* *Eremophila longifolia* *Exocarpos aphyllus* *Grevillea extorris* *Sclerolaena diacantha* *Triodia basedowii*	

Code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Associated species	Photograph
BD	*Acacia aneura/aptaneura* sparse low woodland, over *Maireana pyramidata, Maireana triptera* and *Atriplex bunburyana* open low shrubland.	Extent: 180.3 ha Average species richness: 10.7 ± 3.8 Landform: Plain Number of quadrats: 6	*Enchylaena tomentosa* var. *tomentosa* *Enteropogon ramosus* *Eremophila forrestii* *Eremophila longifolia* *Maireana georgei* *Rhagodia drummondii* *Sclerolaena cuneata* *Sida fibulifera* *Solanum lasiophyllum*	
CA	*Acacia aneura/aptaneura* sparse low woodland, over *Acacia burkittii* open tall shrubland, over *Eremophila galeata, Eremophila compacta, Senna sp. Meekatharra (E. Bailey 1-26), Senna artemisioides and Sida ectogama* sparse mid shrubland, over *Monachather paradoxus* open tussock grassland.	Extent: 34.6 ha Average species richness: 16 ± 4.5 Landform: Undulating plain and rocky hillslope Number of quadrats: 6	*Solanum lasiophyllum* *Acacia tetragonophylla* *Indigofera monophylla* *Scaevola spinescens* *Eragrostis eriopoda* *Eremophila oldfieldii* *Ptilotus obovatus* *Maireana thesioides* *Hibiscus burtonii* *Senna glaucifolia* *Eremophila pantonii*	
CB	*Acacia aneura/aptaneura* open low woodland, over *Acacia burkittii* and *Acacia tetragonophylla* sparse tall shrubland, over *Senna artemisioides x artemisioides*, *Senna glaucifolia* and *Eremophila galeata* open mid shrubland, over *Aristida contorta* open tussock grassland.	Extent: 6.6 ha Average species richness: 27.5 ± 2.1 Landform: Drainage line Number of quadrats: 2	*Abutilon otocarpum* *Acacia craspedocarpa* *Cheilanthes sieberi* subsp. *sieberi* *Cyperus betchei* subsp. *commiscens* *Digitaria brownii* *Eremophila clarkei* *Eremophila compacta* *Indigofera monophylla* *Paspalidium gracile* *Pluchea dentex* *Sclerolaena diacantha* *Themeda triandra*	

Code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Associated species	Photograph
CC	*Acacia pteraneura/macraneura* isolated low trees, over *Eremophila galeata, Senna artemisioides* and *Sida ectogama* sparse mid shrubland, over *Eragrostis eriopoda* and *Monachather paradoxus* open tussock grassland.	Extent: 122.2 ha Average species richness: 13.5 ± 4.1 Landform: Plain Number of quadrats: 13	*Acacia aneura/aptaneura* *Acacia burkittii/quadrimarginea* *Acacia craspedocarpa* *Acacia tetragonophylla* *Eremophila latrobei* *Maireana thesioides* *Psydrax rigidula* *Ptilotus obovatus* *Solanum lasiophyllum*	
CD	*Acacia aneura/aptaneura, Acacia pteraneura/macraneura* and *Acacia craspedocarpa* low woodland, over *Eremophila gilesii*, *Eremophila galeata* and *Senna artemisioides* sparse mid shrubland, over *Sida* sp. verrucose glands (F.H. Mollemans 2423), *Solanum lasiophyllum* and *Abutilon cryptopetalum* sparse low shrubland, over *Digitaria brownii, Eragrostis eriopoda* and *Monachather paradoxus* sparse tussock grassland.	Extent: 25.4 ha Average species richness: 19.1 ± 3.6 Landform: Plain, floodplain, drainage lines Number of quadrats: 8	*Acacia ayersiana/caesaneura* *Acacia tetragonophylla* *Duperreya commixta* *Eremophila latrobei* *Eremophila margarethae* *Maireana thesioides* *Psydrax rigidula* *Psydrax suaveolens* *Rhyncharrhena linearis* *Santalum spicatum* *Sida ectogama* *Spartothamnella teucriiflora*	
D	*Acacia aneura/aptaneura* and *Acacia ayersiana/caesaneura* open low woodland (+/- *Acacia tetragonophylla* and *Acacia pruinocarpa*), over *Eremophila forrestii, Eremophila latrobei, Eremophila foliosissima* sparse mid shrubland, over *Eragrostis eriopoda* sparse tussock grassland and *Triodia melvillei* sparse hummock grassland.	Extent: 9,226.8 ha Average species richness: 9.3 ± 2.7 Landform: Plain, floodplain, drainage lines Number of quadrats: 41	*Acacia craspedocarpa* *Acacia rhodophloia* *Cheilanthes sieberi* subsp. *sieberi* *Eremophila congesta* *Psydrax rigidula* *Psydrax suaveolens* *Ptilotus schwartzii* *Rhagodia drummondii* *Rhagodia eremaea* *Senna glaucifolia* *Spartothamnella teucriiflora*	

Code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Associated species	Photograph
E	*Acacia aneura/aptaneura/ayersiana/caesaneura* (+/- *Eucalyptus gypsophila*) sparse low woodland, over *Acacia nyssophylla*, *Eremophila arachnoides* subsp. *arachnoides* and *Acacia victoriae* sparse mid to tall shrubland, over *Ptilotus obovatus, Sclerolaena obliquicuspis* and *Rhagodia eremaea* sparse low shrubland, over *Eragrostis eriopoda* sparse tussock grassland.	Extent: 630.3 ha Average species richness: 6.5 ± 3.4 Landform: Plain Number of quadrats: 17	*Acacia burkittii* *Acacia ligulata* *Acacia oswaldii* *Casuarina pauper* *Dodonaea viscosa* *Eremophila latrobei* *Maireana pyramidata* *Scaevola spinescens* *Senna artemisioides* *Solanum lasiophyllum*	
F	+/- *Acacia victoriae* and/or *Melaleuca interioris* sparse tall shrubland, over *Eremophila glabra, Scaevola spinescens*, *Rhagodia eremaea* and *Lycium australe* sparse low shrubland.	Extent: 86.9 ha Average species richness: 6 ± 2.3 Landform: Plain Number of quadrats: 12	*Acacia burkittii* *Acacia nyssophylla* *Atriplex amnicola* *Eragrostis eriopoda* *Eremophila arachnoides* subsp. *arachnoides* *Maireana pyramidata* *Muellerolimon salicorniaceum* *Sclerolaena fimbriolata* *Sclerolaena obliquicuspis*	
G	*Acacia incurvaneura* woodland (+/-*Acacia craspedocarpa* and *Acacia ramulosa* var. *linophylla*), over *Eremophila maculata* and *Scaevola spinescens* shrubland over *Triodia melvillei* open hummock grassland.	Extent: 32.6 ha Average species richness: 6 ± 2.3 Landform: Plain Number of quadrats: 12	*Acacia pruinocarpa* *Eremophila latrobei*	

Code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Associated species	Photograph
H	+/- *Eucalyptus striaticalyx* and *Acacia aneura/aptaneura* sparse low woodland, over *Eremophila glabra* and *Senna artemisioides* sparse mid shrubland, over *Dissocarpus paradoxus, Eremophila oppositifolia* and *Sclerolaena bicornis* sparse low shrubland.	Extent: 6.2 ha Average species richness: 5.8 ± 1.9 Landform: Plain Number of quadrats: 4	*Acacia victoriae* *Acacia xanthocarpa* *Amyema maidenii* *Atriplex bunburyana* *Maireana villosa* *Rhyncharrhena linearis* *Santalum spicatum*	
I	+/- *Acacia aneura/aptaneura* isolated low trees, over *Lycium australe, Rhagodia drummondii*, *Frankenia pauciflora* sens. lat. and *Lawrencia squamata* open low shrubland.	Extent: 1,121.0 ha Average species richness: 5.7 ± 2.9 Landform: Plain, floodplain Number of quadrats: 4	*Acacia ayersiana/caesaneura* *Atriplex amnicola* *Cratystylis subspinescens* *Eragrostis eriopoda* *Exocarpos aphyllus* *Frankenia setosa* *Maireana amoena* *Scaevola spinescens* *Sclerolaena cornishiana* *Sclerolaena parviflora* *Triodia basedowii*	
J	+/- *Casuarina pauper* sparse low woodland, over *Atriplex bunburyana, Lycium australe, Lawrencia squamata* and *Ptilotus obovatus* sparse low to mid shrubland, over *Eragrostis setifolia* sparse tussock grassland.	Extent: 548.5 ha Average species richness: 9.7 ± 2.5 Landform: Plain, floodplain, near salt lakes Number of quadrats: 15	*Acacia tetragonophylla* *Eragrostis eriopoda* *Hakea preissii* *Rhagodia eremaea* *Sclerolaena cornishiana* *Senna artemisioides* *Solanum lasiophyllum*	

Code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Associated species	Photograph
K	*Casuarina obesa* open low woodland, over *Acacia nyssophylla* sparse tall shrubland, over *Lycium australe* and *Sclerolaena fimbriolata* sparse low shrubland.	Extent: 19.7 ha Average species richness: 5.3 ± 0.6 Landform: Plain Number of quadrats: 3	*Eremophea spinosa* *Eremophila falcata* *Ptilotus obovatus* *Senna artemisioides* *Senna glutinosa*	No photograph available
L	+/- *Acacia aneura/aptaneura* and *Hakea lorea* subsp. *lorea* isolated low trees, over *Alyogyne pinoniana, Androcalva loxophylla*, *Solanum coactiliferum* and *Leptosema chambersii* sparse low shrubland, over *Triodia basedowii* open hummock grassland and *Eragrostis eriopoda* sparse tussock grassland.	Extent: 283.4 ha Average species richness: 8 ± 3.6 Landform: Sandy plain Number of quadrats: 27	*Dicrastylis exsuccosa* *Dicrastylis flexuosa* *Eremophila forrestii* *Eremophila longifolia* *Eremophila platythamnos* *Eucalyptus eremicola* subsp. *peeneri* *Melaleuca eleuterostachya* *Monachather paradoxus* *Ptilotus obovatus*	
M	*Acacia aneura/aptaneura* (+/-*Acacia ayersiana/caesaneura*) open low woodland, over *Eremophila forrestii, Eremophila spectabilis* subsp. *brevis* open mid shrubland, over *Triodia basedowii* open hummock grassland and *Eragrostis eriopoda* and *Monachather paradoxus* sparse tussock grassland.	Extent: 1,562.7 ha Average species richness: 12.8 ± 3.5 Landform: Plain, sandy plain Number of quadrats: 37	*Acacia minyura* *Acacia pruinocarpa* *Acacia pteraneura/macraneura* *Acacia tetragonophylla* *Eremophila gilesii* *Eremophila latrobei* *Maireana villosa* *Psydrax rigidula* *Psydrax suaveolens* *Ptilotus obovatus* *Sida fibulifera* *Sida* sp. dark green fruits	

Code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Associated species	Photograph
N	*Acacia ayersiana/caesaneura* open low woodland (+/-*Acacia aneura/aptaneura* and *Eucalyptus eremicola* subsp. *peeneri*) open low woodland, over +/- *Melaleuca interioris* sparse tall shrubland, over *Triodia basedowii* open hummock grassland and *Eragrostis eriopoda* sparse tussock grassland.	Extent: 800.5 ha Average species richness: 14.7 ± 5.2 Landform: Plain, sandy plain Number of quadrats: 46	*Acacia tetragonophylla* *Cratystylis subspinescens* *Enchylaena tomentosa* var. *tomentosa* *Enteropogon ramosus* *Eremophila forrestii* *Grevillea sarissa* *Ptilotus obovatus* *Rhagodia drummondii* *Scaevola spinescens* *Senna artemisioides* *Solanum lasiophyllum*	
O	*Acacia ayersiana/caesaneura* open low woodland (+/- *Eucalyptus eremicola* subsp. *peeneri*) open low woodland, over *Triodia melvillei* open hummock grassland.	Extent: 3,987.8 ha Average species richness: 9 ± 3 Landform: Plain, sandy plain Number of quadrats: 55	*Acacia aneura/aptaneura* *Acacia ligulata* *Acacia oswaldii* *Eremophila forrestii* *Eremophila glabra* *Eremophila longifolia* *Grevillea sarissa* *Maireana pyramidata* *Ptilotus obovatus* *Rhagodia eremaea* *Scaevola spinescens* *Senna artemisioides*	
P	+/- *Acacia ayersiana/caesaneura* sparse low woodland, over *Acacia ligulata* and *Acacia jamesiana* sparse mid shrubland, over *Halgania cyanea* sparse low shrubs, over *Triodia basedowii* open hummock grassland.	Extent: 1,144.1 ha Average species richness: 11.6 ± 3.4 Landform: Plain, sandy plain Number of quadrats: 27	*Callitris columellaris* *Dodonaea viscosa* *Eragrostis eriopoda* *Eremophila miniata* *Eucalyptus eremicola* subsp. *peeneri* *Grevillea sarissa* *Monachather paradoxus* *Ptilotus obovatus* *Scaevola spinescens* *Scaevola tomentosa* *Senna artemisioides* *Solanum lasiophyllum*	

Code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Associated species	Photograph
Q	*Callitris columellaris* sparse tall shrubland, over *Triodia melvillii* open hummock grassland.	Extent: 288.5 ha Average species richness: 5.4 ± 1.5 Landform: Plain, sandy plain Number of quadrats: 7	*Acacia jennerae* *Acacia ligulata* *Acacia prainii* *Eragrostis eriopoda* *Eucalyptus eremicola* subsp. *peeneri* *Grevillea juncifolia* *Grevillea sarissa* *Halgania cyanea* *Scaevola tomentosa* *Solanum lasiophyllum*	
R	*Melaleuca xerophila* open tall shrubland, over *Muellerolimon salicorniaceum* sparse low shrubland, over *Eragrostis eriopoda* sparse tussock grassland.	Extent: 325.1 ha Average species richness: 5.4 ± 1.5 Landform: Plain, sandy plain Number of quadrats: 7	*Acacia ayersiana/caesaneura* *Amyema microphylla* *Enchylaena tomentosa* var. *tomentosa* *Eremophea spinosa* *Ptilotus obovatus* *Rhagodia drummondii* *Rhagodia eremaea* *Scaevola spinescens* *Sclerolaena bicornis* *Sclerolaena obliquicuspis* *Senna artemisioides* *Solanum lasiophyllum*	
S	*Tecticornia* spp., *Frankenia cinerea, Maireana villosa* and *Atriplex amnicola* sparse low shrubland.	Extent: 821.2 ha Average species richness: 4.2 ± 1.9 Landform: Salt lake, salt pan Number of quadrats: 24	*Atriplex bunburyana* *Disphyma crassifolium* *Eremophila glabra* *Frankenia pauciflora sens. lat.* *Maireana luehmannii* *Muellerolimon salicorniaceum* *Panicum effusum* *Rhagodia eremaea* *Sclerolaena fimbriolata* *Solanum lasiophyllum* *Zygophyllum aurantiacum*	

Code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Associated species	Photograph
T	*Tecticornia* spp., *Cratystylis subspinescens* and *Scaevola spinescens* sparse low shrubland.	Extent: 431.4 ha Average species richness: 2.1 ± 1.9 Landform: Salt lake, salt pan Number of quadrats: 11	*Acacia tetragonophylla* *Atriplex bunburyana* *Enteropogon ramosus* *Eremophila glabra*	
U	*Tecticornia* spp., *Maireana amoena* and *Scaevola collaris* sparse low shrubland, over *Eragrostis lanipes* sparse tussock grassland.	Extent: 1,984.1 ha Average species richness: 4.2 ± 1.2 Landform: Salt lake, salt pan Number of quadrats: 11	*Atriplex nana* *Frankenia cinerea* *Sclerolaena fimbriolata* *Lawrencia helmsii* *Lawrencia glomerata* *Maireana oppositifolia*	
V	*Tecticornia* spp., *Cratystylis subspinescens, Maireana amoena* and *Sclerolaena diacantha* sparse mid shrubland, over *Eragrostis falcata* sparse tussock grassland.	Extent: 324.0 ha Average species richness: 10.3 ± 3.6 Landform: Floodplain, salt pan, tributary Number of quadrats: 22	*Atriplex codonocarpa* *Enteropogon ramosus* *Eremophila malacoides* *Frankenia fecunda* *Frankenia laxiflora* *Melaleuca interioris* *Melaleuca xerophila* *Ptilotus obovatus* *Rhagodia drummondii* *Scaevola spinescens* *Sclerolaena cuneata* *Sclerolaena deserticola* *Solanum lasiophyllum*	

Code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Associated species	Photograph
W	*Eucalyptus striaticalyx* sparse low woodland, over *Grevillea sarissa* sparse tall shrubland, over *Lawrencia helmsii* sparse low shrubland.	Extent: 172.9 ha Average species richness: 5.6 ± 3.2 Landform: Floodplain, salt pan, tributary Number of quadrats: 8	*Acacia oswaldii* *Atriplex amnicola* *Atriplex nana* *Enchylaena tomentosa* var. *tomentosa* *Eragrostis falcata* *Eragrostis lanipes* *Eragrostis setifolia* *Eremophila latrobei* *Eremophila margarethae* *Frankenia pauciflora sens. lat.* *Maireana pentatropis* *Sclerolaena fimbriolata*	

220000 240000 260000 280000 300000

7060000 7040000 7020000 7000000

Legend

- Wiluna Uranium Project
- Wiluna Extension Project

Unit

- AA
- AB
- AC
- BA
- BB
- BC
- BD
- CA
- CB
- CC
- CD
- D
- E
- F
- G
- H
- I
- J
- K
- L
- M
- N
- O
- P
- Q
- R
- S
- T
- U
- V
- W
- Salt

0 10 20

Kilometres

Absolute Scale - 1:300,000

N

Vegetation mapping consolidation overview

Figure: 5.1
Project ID: 1625

Drawn: MH
Date: 14/07/2015

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

A3

200000 210000 220000 230000 240000 250000

7060000 7050000 7040000 7030000

Map 1

Map 2

Map 3

Legend

Wiluna Extension Project

Wiluna Uranium Project

Unit

AA AB AC BA BB BC BD CA CB CC CD D E F G H I J K L M N O P Q R S T U V W Salt

0 5 10

Kilometres

Absolute Scale - 1:150,000

N

Vegetation mapping consolidation - Map 1

Figure: 4.6
Project ID: 1625

Drawn: MH
Date: 14/07/2015

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

A3

240000 250000 260000 270000 280000 290000

7020000

7010000

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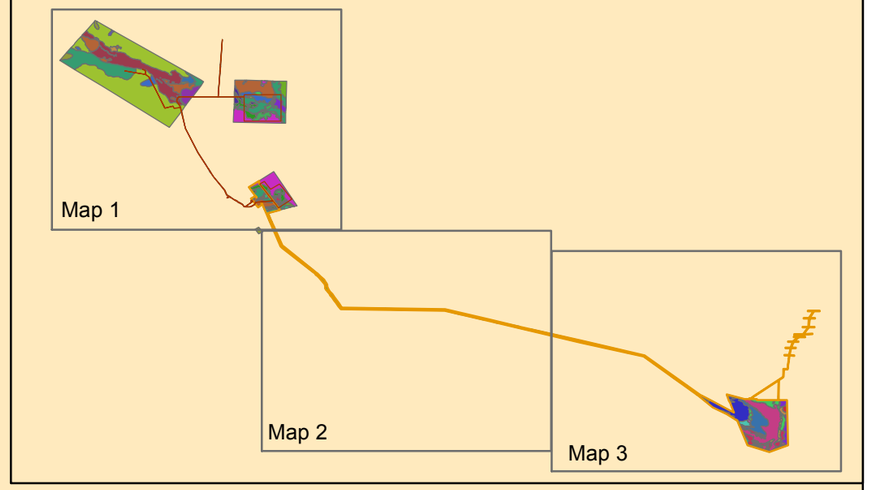

Legend

Wiluna Extension Project

Wiluna Uranium Project

Unit

AA
AB
AC
BA
BB
BC
BD
CA
CB
CC
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V
W
Salt

0 5 10

Kilometres

Absolute Scale - 1:150,000

N

Vegetation mapping consolidation - Map 2

Figure: 4.7
Project ID: 1625

Drawn: MH
Date: 14/07/2015

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

A3

270000 280000 290000 300000 310000 320000

7020000

7010000

7000000

6990000

Map 1

Map 2

Map 3

Legend

Wiluna Extension Project

Wiluna Uranium Project

Unit

AA AB AC BA BB BC BD CA CB CC CD D E F G

H I J K L M N O P Q R S T U V W Salt

0 5 10

Kilometres

Absolute Scale - 1:150,000

N

Vegetation mapping consolidation - Map 3

Figure: 4.8
Project ID: 1625

Drawn: MH
Date: 14/07/2015

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

A3

5 DISCUSSION

5.1 VEGETATION CONSERVATION SIGNIFICANCE ASSESSMENT

The vegetation conservation significance assessment has been conducted for vegetation units recorded within the project areas.

5.1.1 Vegetation of National Significance

No TECs, or vegetation units likely to be TECs, were located at the project areas and therefore no vegetation units of National significance were recorded.

5.1.2 Vegetation of State Significance

No State listed TECs, or vegetation units likely to be TECs were recorded at the project areas. Eleven PECs were recorded as occurring within 50 km of the project areas, of which five occur within the project areas:

- Barwidgee calcrete groundwater assemblage type on Carey palaeodrainage on Barwidgee Station;
- Hinkler Well calcrete groundwater assemblage type on Carey palaeodrainage on Lake Way Station;
- Lake Violet south and lake Violet calcrete groundwater assemblage types on Carey palaeodrainage on Millbillillie Station; and
- Uramurdah Lake calcrete groundwater assemblage type on Carey palaeodrainage on Millbillillie Station; and
- Wiluna BF calcrete groundwater assemblage type on Carey palaeodrainage on Millbillillie Station.

The five PECs that occur at the project areas are underground invertebrate assemblages and are not pertinent to the flora and vegetation of the project areas. The closest PECs that are relevant to flora and vegetation are the Wiluna West vegetation complexes on BIF, 35 km west and the Violet Range vegetation complexes on BIF, 40 km south. There is no BIF habitat at the project areas and no vegetation units at the project areas that resemble these PECs. Therefore no vegetation units of State significance occur at the project areas.

5.1.3 Vegetation of Regional Significance

An assessment of the significance of the vegetation at the project areas at a regional level is constrained by the lack of mapping across the region at a scale comparable to the mapping during the current assessment. The only source of vegetation mapping available across the Murchison is that conducted by Beard (1976) (and digitised by Shepherd *et al.* (2001)), at a scale of 1:1,000,000. As it is completed at such a large scale it does not accurately represent the mapped communities at the project areas, especially the minor details including drainage channels, creeklines and low hill slopes. If a vegetation unit mapped at the project areas can be attributed to a Beard vegetation unit, it can be used to loosely determine the potential extent of this community in the region.

The thirteen Beard vegetation units mapped at the project areas have been compared to the vegetation units that have been consolidated for the current assessment in Table 5.1. Using the total mapped area of each Beard unit in the Murchison region, eight units; 11, 40, 182, 188, 204, 560, 561 and 676 have restricted distributions. These units are generally associated with salt lakes or saline depressions and often have a Chenopodiaceae understory.

Table 5.1 – Comparing Beard vegetation mapping and vegetation units for regional significance

Unit code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Corresponding Beard Unit	% total area mapped in the Murchison* & (regional distribution)	Regional significance
AA	*Acacia tetragonophylla* sparse tall shrubland, over *Senna artemisioides* and *Ptilotus obovatus* sparse low shrubland.	Extent: 2,560.0 ha Average species richness: 8.8 ± 3.4 Landform: Plain Number of quadrats: 24	204: Succulent steppe with open scrub; scattered Mulga & *Acacia sclerosperma* over saltbush & bluebush	0.9% (Restricted)	Low: also recorded at the borefields in other widespread units
			560: Mosaic: Shrublands; Bowgada scrub / succulent steppe; Samphire	0.4% (Restricted)	
			676: Succulent steppe; Samphire	1.8% (Restricted)	
AB	*Acacia tetragonophylla, Acacia victoriae* and *Ptilotus obovatus* sparse low shrubland.	Extent: 465.0 ha Average species richness: 5.8 ± 1.9 Landform: Plain Number of quadrats: 5	188: Shrublands; mulga and *Acacia sclerosperma* scrub	<0.1% (Restricted)	High
AC	*Eucalyptus camaldulensis* subsp. *obtusa* sparse low woodland, over *Acacia aptaneura* and *Acacia tetragonophylla* sparse tall shrubland, over *Eremophila longifolia, Senna artemisioides* and *Scaevola spinescens* sparse mid shrubland.	Extent: 3,009.2 ha Average species richness: 10.5 ± 3.5 Landform: Plain Number of quadrats: 15	11: Medium woodland; coolabah (*Eucalyptus microtheca*)	<0.1% (Restricted)	High
BA	*Acacia aneura/aptaneura* sparse low woodland, over *Acacia tetragonophylla* (+/- *Melaleuca hamata*) sparse tall shrubland, over *Senna artemisioides*, *Scaevola spinescens* and *Rhagodia drummondii* sparse mid shrubland, over Ptilotus obovatus, *Maireana villosa, Sclerolaena diacantha* and *Cratystylis subspinescens* sparse low shrubland.	Extent: 92.3 ha Average species richness: 14.5 ± 3.1 Landform: Plain Number of quadrats: 13	676: Succulent steppe; Samphire	1.8% (Restricted)	High
BB	*Casuarina pauper* open low woodland, over *Eremophila pantonii, Eremophila longifolia* and *Eremophila latrobei* sparse mid shrubland, over *Scaevola spinescens, Exocarpos aphyllus*, *Rhagodia drummondii* and *Ptilotus obovatus* sparse low shrubland.	Extent: 1,105.6 ha Average species richness: 15.7 ± 2.3 Landform: Plain Number of quadrats: 7	676: Succulent steppe; Samphire	1.8% (Restricted)	High
BC	*Scaevola spinescens, Eremophila malacoides, Rhagodia drummondii, Maireana villosa* and *Eremophila glabra* sparse low shrubland, over *Enteropogon ramosus* sparse tussock grassland.	Extent: 59.7 ha Average species richness: 11.3 ± 2.3 Landform: Plain Number of quadrats: 3	29: Sparse low woodland; Mulga, discontinuous in scattered groups	14.3% (Widespread)	Low

Unit code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Corresponding Beard Unit	% total area mapped in the Murchison* & (regional distribution)	Regional significance
BD	*Acacia aneura/aptaneura* sparse low woodland, over *Maireana pyramidata, Maireana triptera* and *Atriplex bunburyana* open low shrubland.	Extent: 180.3 ha Average species richness: 10.7 ± 3.8 Landform: Plain Number of quadrats: 6	676: Succulent steppe; Samphire	1.8% (Restricted)	High
CA	*Acacia aneura/aptaneura* sparse low woodland, over *Acacia burkittii* open tall shrubland*, over Eremophila galeata*, *Eremophila compacta, Senna sp. Meekatharra (E. Bailey 1-26), Senna artemisioides and Sida ectogama* sparse mid shrubland, over *Monachather paradoxus* open tussock grassland.	Extent: 34.6 ha Average species richness: 16 ± 4.5 Landform: Undulating plain and rocky hillslope Number of quadrats: 6	39: Shrublands; Mulga scrub	5.5% (Moderate)	Moderate: restricted to hill slopes
CB	*Acacia aneura/aptaneura* open low woodland, over *Acacia burkittii* and *Acacia tetragonophylla* sparse tall shrubland, over *Senna artemisioides x artemisioides*, *Senna glaucifolia* and *Eremophila galeata* open mid shrubland, over *Aristida contorta* open tussock grassland.	Extent: 6.6 ha Average species richness: 27.5 ± 2.1 Landform: Drainage line Number of quadrats: 2	39: Shrublands; Mulga scrub	5.5% (Moderate)	Moderate: restricted to drainage lines
CC	*Acacia pteraneura/macraneura* isolated low trees, over *Eremophila galeata, Senna artemisioides* and *Sida ectogama* sparse mid shrubland, over *Eragrostis eriopoda* and *Monachather paradoxus* open tussock grassland.	Extent: 122.2 ha Average species richness: 13.5 ± 4.1 Landform: Plain Number of quadrats: 13	39: Shrublands; Mulga scrub	5.5% (Moderate)	Low
CD	*Acacia aneura/aptaneura, Acacia pteraneura/macraneura* and *Acacia craspedocarpa* low woodland, over *Eremophila gilesii*, *Eremophila galeata* and *Senna artemisioides* sparse mid shrubland, over *Sida* sp. verrucose glands (F.H. Mollemans 2423), *Solanum lasiophyllum* and *Abutilon cryptopetalum* sparse low shrubland, over *Digitaria brownii, Eragrostis eriopoda* and *Monachather paradoxus* sparse tussock grassland.	Extent: 25.4 ha Average species richness: 19.1 ± 3.6 Landform: Plain, floodplain, drainage lines Number of quadrats: 8	18: Low woodland; Mulga (*Acacia aneura*)	59.9% (Widespread)	Low
			29: Sparse low woodland; Mulga, discontinuous in scattered groups	14.3% (Widespread)	

Unit code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Corresponding Beard Unit	% total area mapped in the Murchison* & (regional distribution)	Regional significance
D	*Acacia aneura/aptaneura* and *Acacia ayersiana/caesaneura* open low woodland (+/-*Acacia tetragonophylla* and *Acacia pruinocarpa*), over *Eremophila forrestii, Eremophila latrobei, Eremophila foliosissima* sparse mid shrubland, over *Eragrostis eriopoda* sparse tussock grassland and *Triodia melvillei* sparse hummock grassland.	Extent: 9,226.8 ha Average species richness: 9.3 ± 2.7 Landform: Plain, floodplain, drainage lines Number of quadrats: 41	18: Low woodland; Mulga (*Acacia aneura*)	59.9% (Widespread)	Low
E	*Acacia aneura/aptaneura/ayersiana/caesaneura* (+/- *Eucalyptus gypsophila*) sparse low woodland, over *Acacia nyssophylla*, *Eremophila arachnoides* subsp. *arachnoides* and *Acacia victoriae* sparse mid to tall shrubland, over *Ptilotus obovatus, Sclerolaena obliquicuspis* and *Rhagodia eremaea* sparse low shrubland, over *Eragrostis eriopoda* sparse tussock grassland.	Extent: 630.3 ha Average species richness: 6.5 ± 3.4 Landform: Plain Number of quadrats: 17	560: Mosaic: Shrublands; Bowgada scrub / succulent steppe; Samphire	0.4% (Restricted)	High
F	+/- *Acacia victoriae* and/or *Melaleuca interioris* sparse tall shrubland, over *Eremophila glabra, Scaevola spinescens*, *Rhagodia eremaea* and *Lycium australe* sparse low shrubland.	Extent: 86.9 ha Average species richness: 6 ± 2.3 Landform: Plain Number of quadrats: 12	204: Succulent steppe with open scrub; scattered Mulga & *Acacia sclerosperma* over saltbush & bluebush	0.7% (Restricted)	High
G	*Acacia incurvaneura* woodland (+/-*Acacia craspedocarpa* and *Acacia ramulosa* var. *linophylla*), over *Eremophila maculata* and *Scaevola spinescens* shrubland over *Triodia melvillei* open hummock grassland.	Extent: 32.6 ha Average species richness: 6 ± 2.3 Landform: Plain Number of quadrats: 12	107: Hummock grasslands, shrub steppe; Mulga and *Eucalyptus kingsmillii* over hard spinifex	13.5% (Widespread)	Low
H	+/- *Eucalyptus striaticalyx* and *Acacia aneura/aptaneura* sparse low woodland, over *Eremophila glabra* and *Senna artemisioides* sparse mid shrubland, over *Dissocarpus paradoxus, Eremophila oppositifolia* and *Sclerolaena bicornis* sparse low shrubland.	Extent: 6.2 ha Average species richness: 5.8 ± 1.9 Landform: Plain Number of quadrats: 4	204: Succulent steppe with open scrub; scattered Mulga & *Acacia sclerosperma* over saltbush & bluebush	0.7% (Restricted)	High
I	+/- *Acacia aneura/aptaneura* isolated low trees, over *Lycium australe, Rhagodia drummondii*, *Frankenia pauciflora* sens. lat. and *Lawrencia squamata* open low shrubland.	Extent: 1,121.0 ha Average species richness: 5.7 ± 2.9 Landform: Plain, floodplain Number of quadrats: 4	676: Succulent steppe; Samphire	1.8% (Restricted)	Moderate: potentially restricted to near salt lakes

Unit code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Corresponding Beard Unit	% total area mapped in the Murchison* & (regional distribution)	Regional significance
J	+/- *Casuarina pauper* sparse low woodland, over *Atriplex bunburyana, Lycium australe, Lawrencia squamata* and *Ptilotus obovatus* sparse low to mid shrubland, over *Eragrostis setifolia* sparse tussock grassland.	Extent: 548.5 ha Average species richness: 9.7 ± 2.5 Landform: Plain, floodplain, near salt lakes Number of quadrats: 15	676: Succulent steppe; Samphire	1.8% (Restricted)	Moderate: potentially restricted to near salt lakes
K	*Casuarina obesa* open low woodland, over *Acacia nyssophylla* sparse tall shrubland, over *Lycium australe* and *Sclerolaena fimbriolata* sparse low shrubland.	Extent: 19.7 ha Average species richness: 5.3 ± 0.6 Landform: Plain Number of quadrats: 3	676: Succulent steppe; Samphire	1.8% (Restricted)	Moderate: potentially restricted to near salt lakes
L	+/- *Acacia aneura/aptaneura* and *Hakea lorea* subsp. *lorea* isolated low trees, over *Alyogyne pinoniana, Androcalva loxophylla*, *Solanum coactiliferum* and *Leptosema chambersii* sparse low shrubland, over *Triodia basedowii* open hummock grassland and *Eragrostis eriopoda* sparse tussock grassland.	Extent: 283.4 ha Average species richness: 8 ± 3.6 Landform: Sandy plain Number of quadrats: 27	29: Sparse low woodland; Mulga, discontinuous in scattered groups	14.3% (Widespread)	Low
			107: Hummock grasslands, shrub steppe; Mulga and *Eucalyptus kingsmillii* over hard spinifex	13.5% (Widespread)	
M	*Acacia aneura/aptaneura* (+/-*Acacia ayersiana/caesaneura*) open low woodland, over *Eremophila forrestii, Eremophila spectabilis* subsp. *brevis* open mid shrubland, over *Triodia basedowii* open hummock grassland and *Eragrostis eriopoda* and *Monachather paradoxus* sparse tussock grassland.	Extent: 1,562.7 ha Average species richness: 12.8 ± 3.5 Landform: Plain, sandy plain Number of quadrats: 37	18: Low woodland; Mulga (*Acacia aneura*)	59.9% (Widespread)	Low
			29: Sparse low woodland; Mulga, discontinuous in scattered groups	14.3% (Widespread)	
			107: Hummock grasslands, shrub steppe; Mulga and *Eucalyptus kingsmillii* over hard spinifex	13.5% (Widespread)	
N	*Acacia ayersiana/caesaneura* open low woodland (+/- *Acacia aneura/aptaneura* and *Eucalyptus eremicola* subsp. *peeneri*) open low woodland, over +/- *Melaleuca interioris* sparse tall shrubland, over *Triodia basedowii* open hummock grassland and *Eragrostis eriopoda* sparse tussock grassland.	Extent: 800.5 ha Average species richness: 14.7 ± 5.2 Landform: Plain, sandy plain Number of quadrats: 46	29: Sparse low woodland; Mulga, discontinuous in scattered groups	14.3% (Widespread)	Low
			204: Succulent steppe with open scrub; scattered Mulga & *Acacia sclerosperma* over saltbush & bluebush	0.9% (Restricted)	
			560: Mosaic: Shrublands; Bowgada scrub / succulent steppe; Samphire	0.4% (Restricted)	
			676: Succulent steppe; Samphire	1.8% (Restricted)	

Unit code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Corresponding Beard Unit	% total area mapped in the Murchison* & (regional distribution)	Regional significance
O	*Acacia ayersiana/caesaneura* open low woodland (+/- *Eucalyptus eremicola* subsp. *peeneri*) open low woodland, over *Triodia melvillei* open hummock grassland.	Extent: 3,987.8 ha Average species richness: 9 ± 3 Landform: Plain, sandy plain Number of quadrats: 55	560: Mosaic: Shrublands; Bowgada scrub / succulent steppe; Samphire	0.4% (Restricted)	Low: also recorded at the borefields in other widespread units
P	+/- *Acacia ayersiana/caesaneura* (+/-*Eucalyptus eremicola* subsp. *peeneri* and *Eucalyptus kingsmillii)* sparse low woodland, over *Acacia ligulata* and *Acacia jamesiana* sparse mid shrubland, over *Halgania cyanea* sparse low shrubs, over *Triodia basedowii* open hummock grassland	Extent: 1,144.1 ha Average species richness: 11.6 ± 3.4 Landform: Plain, sandy plain Number of quadrats: 27	107: Hummock grasslands, shrub steppe; Mulga and *Eucalyptus kingsmillii* over hard spinifex	13.5% (Widespread)	Low
Q	*Callitris columellaris* sparse tall shrubland, over *Triodia melvillii* open hummock grassland.	Extent: 288.5 ha Average species richness: 5.4 ± 1.5 Landform: Plain, sandy plain Number of quadrats: 7	107: Hummock grasslands, shrub steppe; Mulga and *Eucalyptus kingsmillii* over hard spinifex	13.5% (Widespread)	Low
R	*Melaleuca xerophila* open tall shrubland, over *Muellerolimon salicorniaceum* sparse low shrubland, over *Eragrostis eriopoda* sparse tussock grassland.	Extent: 325.1 ha Average species richness: 5.4 ± 1.5 Landform: Plain, sandy plain Number of quadrats: 7	125: Bare areas; salt lakes	3.4% (Moderate)	High: restricted to the edges of salt lakes
S	*Tecticornia* spp., *Frankenia cinerea, Maireana villosa* and *Atriplex amnicola* sparse low shrubland.	Extent: 821.2 ha Average species richness: 4.2 ± 1.9 Landform: Salt lake, salt pan Number of quadrats: 24	125: Bare areas; salt lakes	3.4% (Moderate)	High: restricted to salt pans
			676: Succulent steppe; Samphire	1.8% (Restricted)	
T	*Tecticornia* spp., *Cratystylis subspinescens* and *Scaevola spinescens* sparse low shrubland.	Extent: 431.4 ha Average species richness: 2.1 ± 1.9 Landform: Salt lake, salt pan Number of quadrats: 11	125: Bare areas; salt lakes	3.4% (Moderate)	High: restricted to salt pans
U	*Tecticornia* spp., *Maireana amoena* and *Scaevola collaris* sparse low shrubland, over *Eragrostis lanipes* sparse tussock grassland.	Extent: 1,984.1 ha Average species richness: 4.2 ± 1.2 Landform: Salt lake, salt pan Number of quadrats: 11	125: Bare areas; salt lakes	3.4% (Moderate)	High: restricted to salt pans
V	*Tecticornia* spp., *Cratystylis subspinescens, Maireana amoena* and *Sclerolaena diacantha* sparse mid shrubland, over *Eragrostis falcata* sparse tussock grassland.	Extent: 324.0 ha Average species richness: 10.3 ± 3.6	125: Bare areas; salt lakes	3.4% (Moderate)	Moderate: restricted to near salt pans

Unit code	Vegetation unit description	Mapped extent, average species richness, landform and quadrats	Corresponding Beard Unit	% total area mapped in the Murchison* & (regional distribution)	Regional significance
		Landform: Floodplain, salt pan, tributary Number of quadrats: 22	204: Succulent steppe with open scrub; scattered Mulga & *Acacia sclerosperma* over saltbush & bluebush	0.9% (Restricted)	
			676: Succulent steppe; Samphire	1.8% (Restricted)	
W	*Eucalyptus striaticalyx* sparse low woodland, over *Grevillea sarissa* sparse tall shrubland, over *Lawrencia helmsii* sparse low shrubland.	Extent: 172.9 ha Average species richness: 5.6 ± 3.2 Landform: Floodplain, salt pan, tributary Number of quadrats: 8	125: Bare areas; salt lakes	3.4% (Moderate)	Moderate: restricted to edges of salt lakes on calcrete

* Based on sum of all Beard vegetation units mapped for the Murchison

5.1.4 Vegetation of Local Significance

The local conservation significance of the 31 vegetation units recorded at the project areas is assessed in Table 5.2. Of these, four are considered to have a high local significance, thirteen have a moderate local significance and 14 have a low local significance.

Vegetation units with a high local significance and which are equivalent to vegetation considered of potential significance in previous flora and vegetation assessments (Table 5.3) are discussed below:

AC: *Eucalyptus camaldulensis* subsp. *obtusa* sparse low woodland, over *Acacia aptaneura* and *Acacia tetragonophylla* sparse tall shrubland, over *Eremophila longifolia, Senna artemisioides* and *Scaevola spinescens* sparse mid shrubland, includes the Cr vegetation unit considered to be of potential significance in a previous flora and vegetation assessment (Niche 2011, Table 5.3).

D: *Acacia aneura/aptaneura/ayersiana/caesaneura* open low woodland (+/-*Acacia tetragonophylla* and *Acacia pruinocarpa*), over *Eremophila forrestii, Eremophila latrobei, Eremophila foliosissima* sparse mid shrubland, over *Eragrostis eriopoda* sparse tussock grassland and *Triodia melvillei* sparse hummock grassland, includes the BIF and Sh complex vegetation units considered to be of potential significance in a previous flora and vegetation assessment (Niche 2011, Table 5.3).

E: *Acacia aneura/aptaneura/ayersiana/caesaneura* (+/-*Eucalyptus gypsophila*) sparse low woodland, over *Acacia nyssophylla*, *Eremophila arachnoides* subsp. *arachnoides* and *Acacia victoriae* sparse mid to tall shrubland, over *Ptilotus obovatus, Sclerolaena obliquicuspis* and *Rhagodia eremaea* sparse low shrubland, over *Eragrostis eriopoda* sparse tussock grassland, includes the Ca1 vegetation unit considered to be of potential significance in previous flora and vegetation assessments (Niche 2011 and Niche 2014, Table 5.3).

R: *Melaleuca xerophila* open tall shrubland, over *Muellerolimon salicorniaceum* sparse low shrubland, over *Eragrostis eriopoda* sparse tussock grassland is associated with beard unit 125, a restricted unit mapped as only 3.4% of the Murchison. This unit is also restricted to areas fringing salt lakes, which is even more restricted and is therefore given high local significance. Equivalent vegetation was also considered to be potentially significant in previous flora and vegetation assessments (Outback Ecology 2007, Niche 2011 and Actis 2012, Table 5.3).

S: *Tecticornia* spp., *Frankenia cinerea, Maireana villosa* and *Atriplex amnicola* sparse low shrubland is associated with beard vegetation units 676 and 125, both restricted units mapped as occurring across 1.8% and 3.4%, respectively of the Murchison. It is restricted to saline depressions, a very restricted landform and is also is habitat for Priority flora including *Frankenia confusa* and *Tecticornia cymbiformis* and is therefore given high local significance. This vegetation unit also includes vegetation considered to be of potential significance in previous flora and vegetation assessments (Outback Ecology 2007, Niche 2011, Actis 2012 and Niche 2014, Table 5.3).

T: *Tecticornia* spp., *Cratystylis subspinescens* and *Scaevola spinescens* sparse low shrubland is associated with beard unit 125, a restricted unit mapped as only 3.4% of the Murchison. This unit is restricted to salt lakes and is therefore given high local significance. This vegetation unit also includes vegetation considered to be of potential significance in previous flora and vegetation assessments (Outback Ecology 2007, Niche 2011, Actis 2012 and Niche 2014, Table 5.3).

U: *Tecticornia* spp., *Maireana amoena* and *Scaevola collaris* sparse low shrubland, over *Eragrostis lanipes* sparse tussock grassland is associated with beard unit 125, a restricted unit mapped as only 3.4% of the Murchison. This unit is restricted to salt lakes and is therefore given high local significance. This vegetation unit also includes vegetation considered to be of potential significance in previous flora and vegetation assessments (Outback Ecology 2007, Niche 2011, Actis 2012 and Niche 2014, Table 5.3).

V: *Tecticornia* spp., *Cratystylis subspinescens, Maireana amoena* and *Sclerolaena diacantha* sparse mid shrubland, over *Eragrostis falcata* sparse tussock grassland is associated with beard vegetation unit 676, a restricted unit mapped as occurring across 1.9% of the Murchison. It is restricted to saline depressions and floodplains, a very restricted landform. It is also habitat for Priority flora including *Frankenia confusa, Stackhousia clementii* and *Tecticornia cymbiformis* and is therefore given high local significance. This vegetation unit also includes vegetation considered to be of potential significance in previous flora and vegetation assessments (Outback Ecology 2007 and Actis 2012, Table 5.3).

W: *Eucalyptus striaticalyx* sparse low woodland, over *Grevillea sarissa* sparse tall shrubland, over *Lawrencia helmsii* sparse low shrubland, is equivalent to the vegetation unit KRE considered to be of potential significance in a previous flora and vegetation assessment (Outback Ecology 2009, Table 5.3).

Table 5.2 – Local conservation significance of vegetation units at the project areas

Unit	Vegetation description	Total area (ha)	Landform & potential local distribution of landform	Regional significance ^	Species richness #	Priority species	Assigned local significance
AA	*Acacia tetragonophylla* sparse tall shrubland, over *Senna artemisioides* and *Ptilotus obovatus* sparse low shrubland.	2,560.0	Plain: widespread	Low	8.8	*Eremophila arachnoides* subsp. *arachnoides*	Low
AB	*Acacia tetragonophylla, Acacia victoriae* and *Ptilotus obovatus* sparse low shrubland.	465.0	Plain: widespread	High	5.8	-	Moderate
AC	*Eucalyptus camaldulensis* subsp. *obtusa* sparse low woodland, over *Acacia aptaneura* and *Acacia tetragonophylla* sparse tall shrubland, over *Eremophila longifolia, Senna artemisioides* and *Scaevola spinescens* sparse mid shrubland.	3,009.2	Plain: widespread	High	10.5	*Stackhousia clementii*	Moderate
BA	*Acacia aneura/aptaneura* sparse low woodland, over *Acacia tetragonophylla* (+/- *Melaleuca hamata*) sparse tall shrubland, over *Senna artemisioides*, *Scaevola spinescens* and *Rhagodia drummondii* sparse mid shrubland, over *Ptilotus obovatus*, *Maireana villosa, Sclerolaena diacantha* and *Cratystylis* subspinescens sparse low shrubland.	92.3	Plain near salt lakes: moderately widespread	High	14.5	*Tecticornia cymbiformis*	Moderate
BB	*Casuarina pauper* open low woodland, over *Eremophila pantonii, Eremophila longifolia* and *Eremophila latrobei* sparse mid shrubland, over *Scaevola spinescens, Exocarpos aphyllus*, *Rhagodia drummondii* and *Ptilotus obovatus* sparse low shrubland.	1,105.6	Floodplain: moderate	High	15.7	*Cratystylis centralis*	Moderate
BC	*Scaevola spinescens, Eremophila malacoides, Rhagodia drummondii, Maireana villosa* and *Eremophila glabra* sparse low shrubland, over *Enteropogon ramosus* sparse tussock grassland.	59.7	Plain: widespread	Low	11.3	-	Low
BD	*Acacia aneura/aptaneura* sparse low woodland, over *Maireana pyramidata, Maireana triptera* and *Atriplex bunburyana* open low shrubland.	180.3	Plain: widespread	High	10.7	-	Moderate
CA	*Acacia aneura/aptaneura* sparse low woodland, over *Acacia burkittii* open tall shrubland*, over Eremophila galeata*, *Eremophila compacta, Senna sp. Meekatharra (E. Bailey 1-26), Senna artemisioides* and *Sida ectogama* sparse mid shrubland, over *Monachather paradoxus* open tussock grassland.	34.6	Undulating plain, rocky hillslope: restricted	Moderate	16	-	Moderate
CB	*Acacia aneura/aptaneura* open low woodland, over *Acacia burkittii* and *Acacia tetragonophylla* sparse tall shrubland, over *Senna artemisioides x artemisioides*, *Senna glaucifolia* and *Eremophila galeata* open mid shrubland, over *Aristida contorta* open tussock grassland.	6.6	Drainage line: restricted	Moderate	27.5	-	Moderate
CC	*Acacia pteraneura/macraneura* isolated low trees, over *Eremophila galeata, Senna artemisioides* and *Sida ectogama* sparse mid shrubland, over *Eragrostis eriopoda* and *Monachather paradoxus* open tussock grassland.	122.2	Plain: widespread	Low	13.5	-	Low

Unit	Vegetation description	Total area (ha)	Landform & potential local distribution of landform	Regional significance ^	Species richness #	Priority species	Assigned local significance
CD	*Acacia aneura/aptaneura, Acacia pteraneura/macraneura* and *Acacia craspedocarpa* low woodland, over *Eremophila gilesii*, *Eremophila galeata* and *Senna artemisioides* sparse mid shrubland, over *Sida* sp. verrucose glands (F.H. Mollemans 2423), *Solanum lasiophyllum* and *Abutilon cryptopetalum* sparse low shrubland, over *Digitaria brownii, Eragrostis eriopoda* and *Monachather paradoxus* sparse tussock grassland.	25.4	Plain, floodplain, drainage line: widespread	Low	19.1	-	Low
D	*Acacia aneura/aptaneura/ayersiana/caesaneura* open low woodland (+/-*Acacia tetragonophylla* and *Acacia pruinocarpa*), over *Eremophila forrestii, Eremophila latrobei, Eremophila foliosissima* sparse mid shrubland, over *Eragrostis eriopoda* sparse tussock grassland and *Triodia melvillei* sparse hummock grassland.	9,226.8	Plain: widespread	Low	9.3	*Eremophila pungens*	Low
E	*Acacia aneura/aptaneura/ayersiana/caesaneura* (+/-*Eucalyptus gypsophila*) sparse low woodland, over *Acacia nyssophylla*, *Eremophila arachnoides* subsp. *arachnoides* and *Acacia victoriae* sparse mid to tall shrubland, over *Ptilotus obovatus, Sclerolaena obliquicuspis* and *Rhagodia eremaea* sparse low shrubland, over *Eragrostis eriopoda* sparse tussock grassland.	630.3	Plain: widespread	High	6.5	*Eremophila arachnoides* subsp. *arachnoides*	Low
F	+/- *Acacia victoriae* and/or *Melaleuca interioris* sparse tall shrubland, over *Eremophila glabra, Scaevola spinescens*, *Rhagodia eremaea* and *Lycium australe* sparse low shrubland.	86.9	Plain: widespread	High	2.3	-	Moderate
G	*Acacia incurvaneura* woodland (+/-*Acacia craspedocarpa* and *Acacia ramulosa* var. *linophylla*), over *Eremophila maculata* and *Scaevola spinescens* shrubland over *Triodia melvillei* open hummock grassland.	32.6	Plain: widespread	Low	6	-	Low
H	+/- *Eucalyptus striaticalyx* and *Acacia aneura/aptaneura* sparse low woodland, over *Eremophila glabra* and *Senna artemisioides* sparse mid shrubland, over *Dissocarpus paradoxus, Eremophila oppositifolia* and *Sclerolaena bicornis* sparse low shrubland.	6.2	Plain: widespread	High	6.2	-	Moderate
I	+/- *Acacia aneura/aptaneura* isolated low trees, over *Lycium australe, Rhagodia drummondii*, *Frankenia pauciflora* sens. lat. and *Lawrencia squamata* open low shrubland.	1,121.0	Plain and floodplain: widespread	Moderate	5.7	-	Low
J	+/- *Casuarina pauper* sparse low woodland, over *Atriplex bunburyana, Lycium australe, Lawrencia squamata* and *Ptilotus obovatus* sparse low to mid shrubland, over *Eragrostis setifolia* sparse tussock grassland.	548.5	Plain and floodplain: moderately widespread	Moderate	9.7	*Eremophila arachnoides* subsp. *arachnoides*	Moderate

Unit	Vegetation description	Total area (ha)	Landform & potential local distribution of landform	Regional significance ^	Species richness #	Priority species	Assigned local significance
K	*Casuarina obesa* open low woodland, over *Acacia nyssophylla* sparse tall shrubland, over *Lycium australe* and *Sclerolaena fimbriolata* sparse low shrubland.	19.7	Plain and floodplain: moderately widespread	Moderate	19.7	-	Moderate
L	+/- *Acacia aneura/aptaneura* and *Hakea lorea* subsp. *lorea* isolated low trees, over *Alyogyne pinoniana, Androcalva loxophylla*, *Solanum coactiliferum* and *Leptosema chambersii* sparse low shrubland, over *Triodia basedowii* open hummock grassland and *Eragrostis eriopoda* sparse tussock grassland.	283.4	Sandy plain: widespread	Low	8	-	Low
M	*Acacia aneura/aptaneura* (+/-*Acacia ayersiana/ caesaneura*) open low woodland, over *Eremophila forrestii, Eremophila spectabilis* subsp. *brevis* open mid shrubland, over *Triodia basedowii* open hummock grassland and *Eragrostis eriopoda* and *Monachather paradoxus* sparse tussock grassland.	1,562.7	Sandy plain: widespread	Low	12.8	*Eremophila pungens*	Low
N	*Acacia ayersiana/caesaneura* open low woodland (+/-*Acacia aneura/aptaneura* and *Eucalyptus eremicola* subsp. *peeneri*) open low woodland, over +/- *Melaleuca interioris* sparse tall shrubland, over *Triodia basedowii* open hummock grassland and *Eragrostis eriopoda* sparse tussock grassland.	800.5	Sandy plain: widespread	Low	14.7	*Eremophila arachnoides* subsp. *arachnoides*	Low
O	*Acacia ayersiana/caesaneura* open low woodland (+/- *Eucalyptus eremicola* subsp. *peeneri*) open low woodland, over *Triodia melvillei* open hummock grassland.	3,987.8	Sandy plain: widespread	Low	9	*Eremophila arachnoides* subsp. *arachnoides* *Eremophila pungens*	Low
P	+/- *Acacia ayersiana/caesaneura* (+/-*Eucalyptus eremicola* subsp. *peeneri* and *Eucalyptus kingsmillii)* sparse low woodland, over *Acacia ligulata* and *Acacia jamesiana* sparse mid shrubland, over *Halgania cyanea* sparse low shrubs, over *Triodia basedowii* open hummock grassland.	1,144.1	Sandy plain: widespread	Low	11.6	-	Low
Q	*Callitris columellaris* sparse tall shrubland, over *Triodia melvillii* open hummock grassland.	288.5	Sandy plain: widespread	Low	5.4	-	Low
R	*Melaleuca xerophila* open tall shrubland, over *Muellerolimon salicorniaceum* sparse low shrubland, over *Eragrostis eriopoda* sparse tussock grassland.	325.1	Fringing salt lakes: restricted	High	5.4	-	High
S	*Tecticornia* spp., *Frankenia cinerea, Maireana villosa* and *Atriplex amnicola* sparse low shrubland.	821.2	Salt pan: restricted	High	4.2	*Frankenia confusa* *Tecticornia cymbiformis*	High
T	*Tecticornia* spp., *Cratystylis subspinescens* and *Scaevola spinescens* sparse low shrubland.	431.4	Salt pan: restricted	High	2.1	-	High
U	*Tecticornia* spp., *Maireana amoena* and *Scaevola collaris* sparse low shrubland, over *Eragrostis lanipes* sparse tussock grassland.	1,984.1	Salt pan: restricted	High	4.2	-	High

Unit	Vegetation description	Total area (ha)	Landform & potential local distribution of landform	Regional significance ^	Species richness #	Priority species	Assigned local significance
V	*Tecticornia* spp., *Cratystylis subspinescens, Maireana amoena* and *Sclerolaena diacantha* sparse mid shrubland, over *Eragrostis falcata* sparse tussock grassland.	324	Floodplain, salt pan: moderate	Moderate	10.3	*Frankenia confusa* *Stackhousia clementii* *Tecticornia cymbiformis*	Moderate
W	*Eucalyptus striaticalyx* sparse low woodland, over *Grevillea sarissa* sparse tall shrubland, over *Lawrencia helmsii* sparse low shrubland.	172.9	Fringing salt lakes: restricted	Moderate	5.6	-	Moderate

^ Based on Table 5.1.

Table 5.3 – Comparison of significant vegetation from previous flora and vegetation assessments

ecologia (2015c)		Outback Ecology (2007)	Outback Ecology (2009)	Niche (2011)	Actis (2012)	Niche (2014)
Unit	Vegetation description					
AC	*Eucalyptus camaldulensis* subsp. *obtusa* sparse low woodland, over *Acacia aptaneura* and *Acacia tetragonophylla* sparse tall shrubland, over *Eremophila longifolia, Senna artemisioides* and *Scaevola spinescens* sparse mid shrubland.	-	-	Cr	-	-
D	*Acacia aneura/aptaneura/ayersiana/caesaneura* open low woodland (+/- *Acacia tetragonophylla* and *Acacia pruinocarpa*), over *Eremophila forrestii, Eremophila latrobei, Eremophila foliosissima* sparse mid shrubland, over *Eragrostis eriopoda* sparse tussock grassland and *Triodia melvillei* sparse hummock grassland.	-	-	BIF/ Sh complex	-	-
E	*Acacia aneura/aptaneura/ayersiana/caesaneura* (+/-*Eucalyptus gypsophila*) sparse low woodland, over *Acacia nyssophylla*, *Eremophila arachnoides* subsp. *arachnoides* and *Acacia victoriae* sparse mid to tall shrubland, over *Ptilotus obovatus, Sclerolaena obliquicuspis* and *Rhagodia eremaea* sparse low shrubland, over *Eragrostis eriopoda* sparse tussock grassland.	-	-	Ca1	-	Ca1
R	*Melaleuca xerophila* open tall shrubland, over *Muellerolimon salicorniaceum* sparse low shrubland, over *Eragrostis eriopoda* sparse tussock grassland.	Me1	-	Fr1	Fr1	-
S	*Tecticornia* spp., *Frankenia cinerea, Maireana villosa* and *Atriplex amnicola* sparse low shrubland.	Halophytic vegetation	-	Sl1	Sl1	Sl
T	*Tecticornia* spp., *Cratystylis subspinescens* and *Scaevola spinescens* sparse low shrubland.		-			
U	*Tecticornia* spp., *Maireana amoena* and *Scaevola collaris* sparse low shrubland, over *Eragrostis lanipes* sparse tussock grassland.		-			
V	*Tecticornia* spp., *Cratystylis subspinescens, Maireana amoena* and *Sclerolaena diacantha* sparse mid shrubland, over *Eragrostis falcata* sparse tussock grassland.		-		Cp2	-
W	*Eucalyptus striaticalyx* sparse low woodland, over *Grevillea sarissa* sparse tall shrubland, over *Lawrencia helmsii* sparse low shrubland.	-	KRE	-	-	-

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APPENDIX A ELECTRONIC APPENDICES

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Provided Electronically:

A.1: Regional site by species matrix
A.2 Significant flora location data

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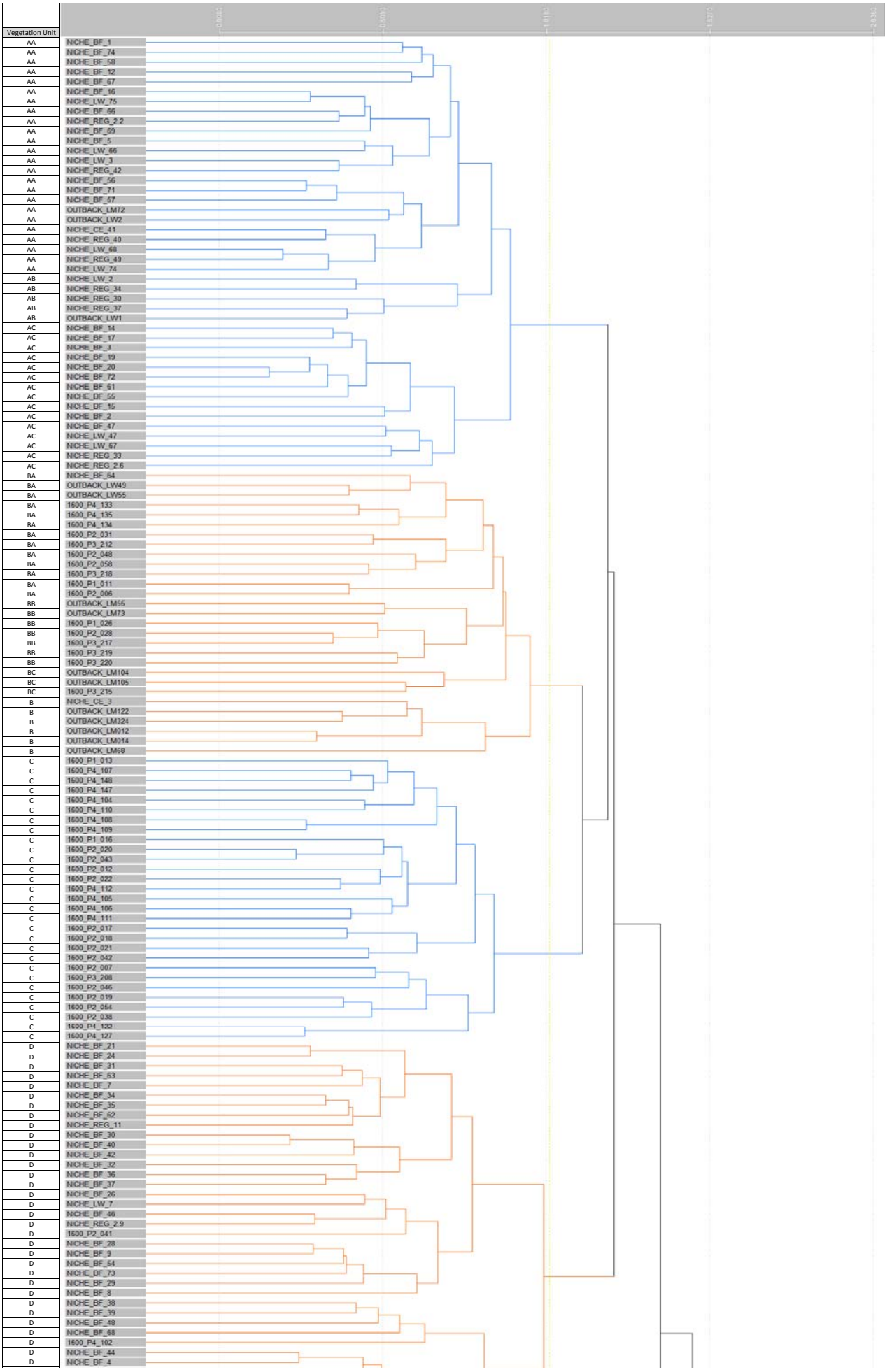
APPENDIX B DENDROGRAM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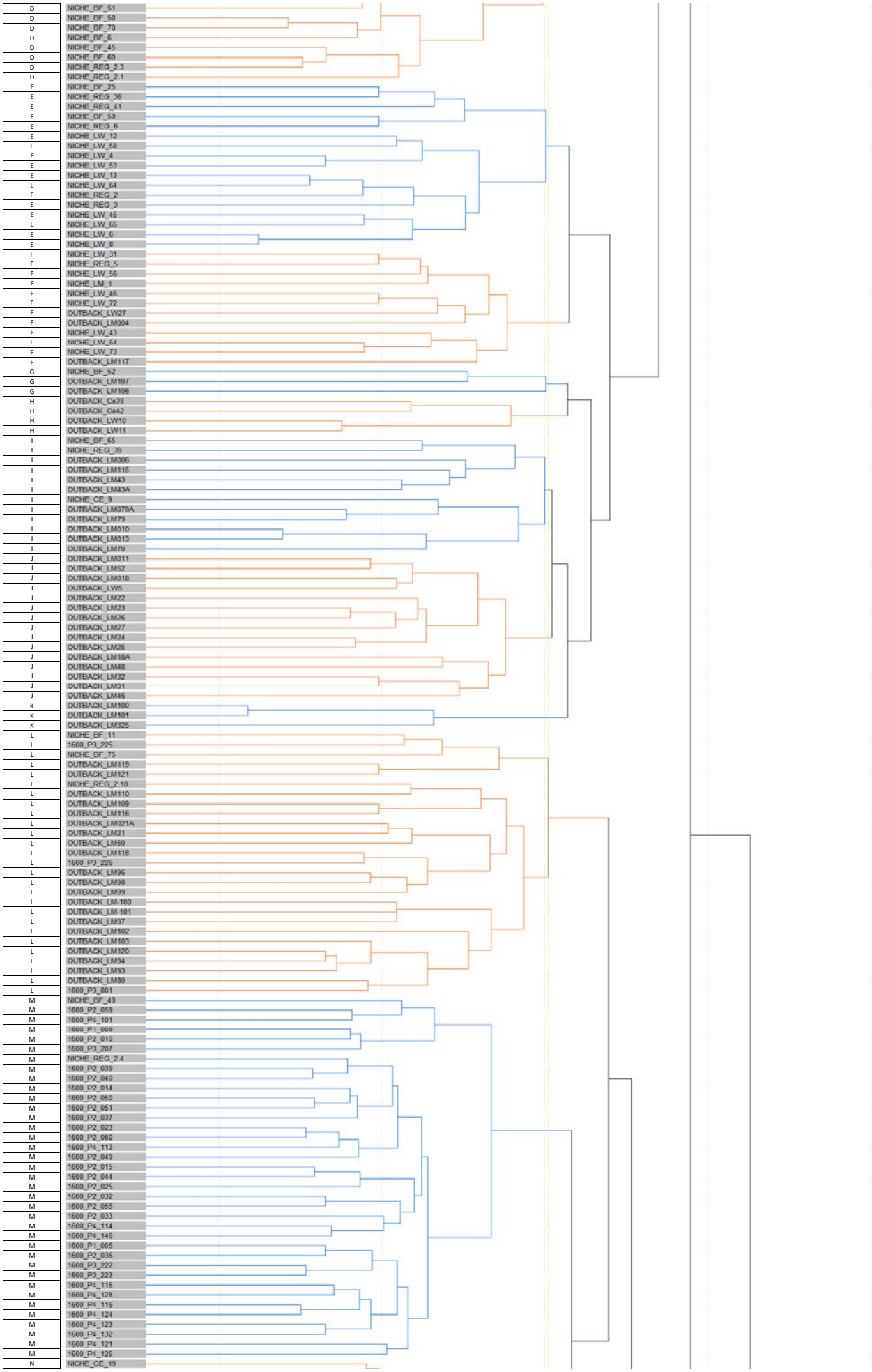
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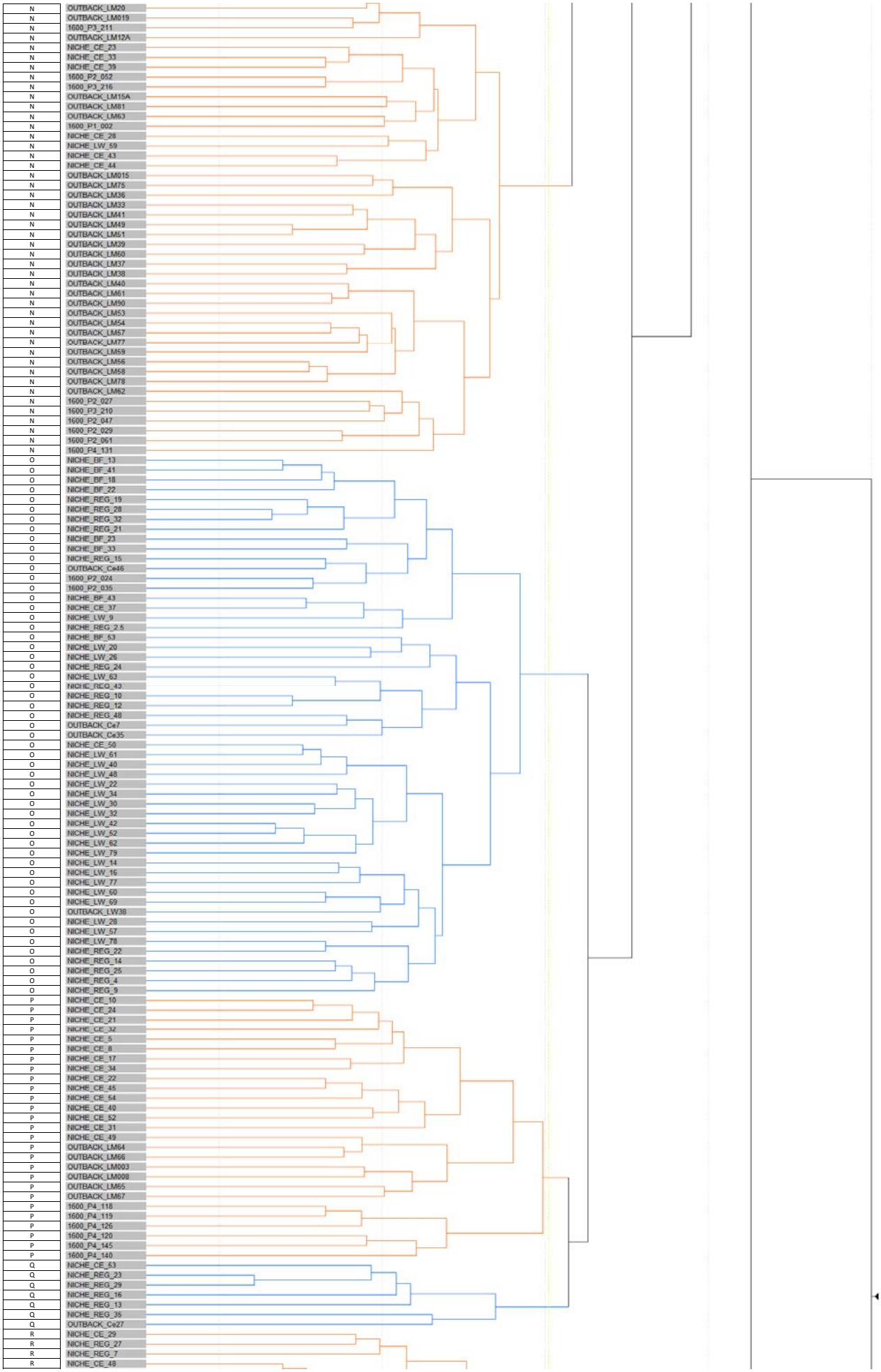
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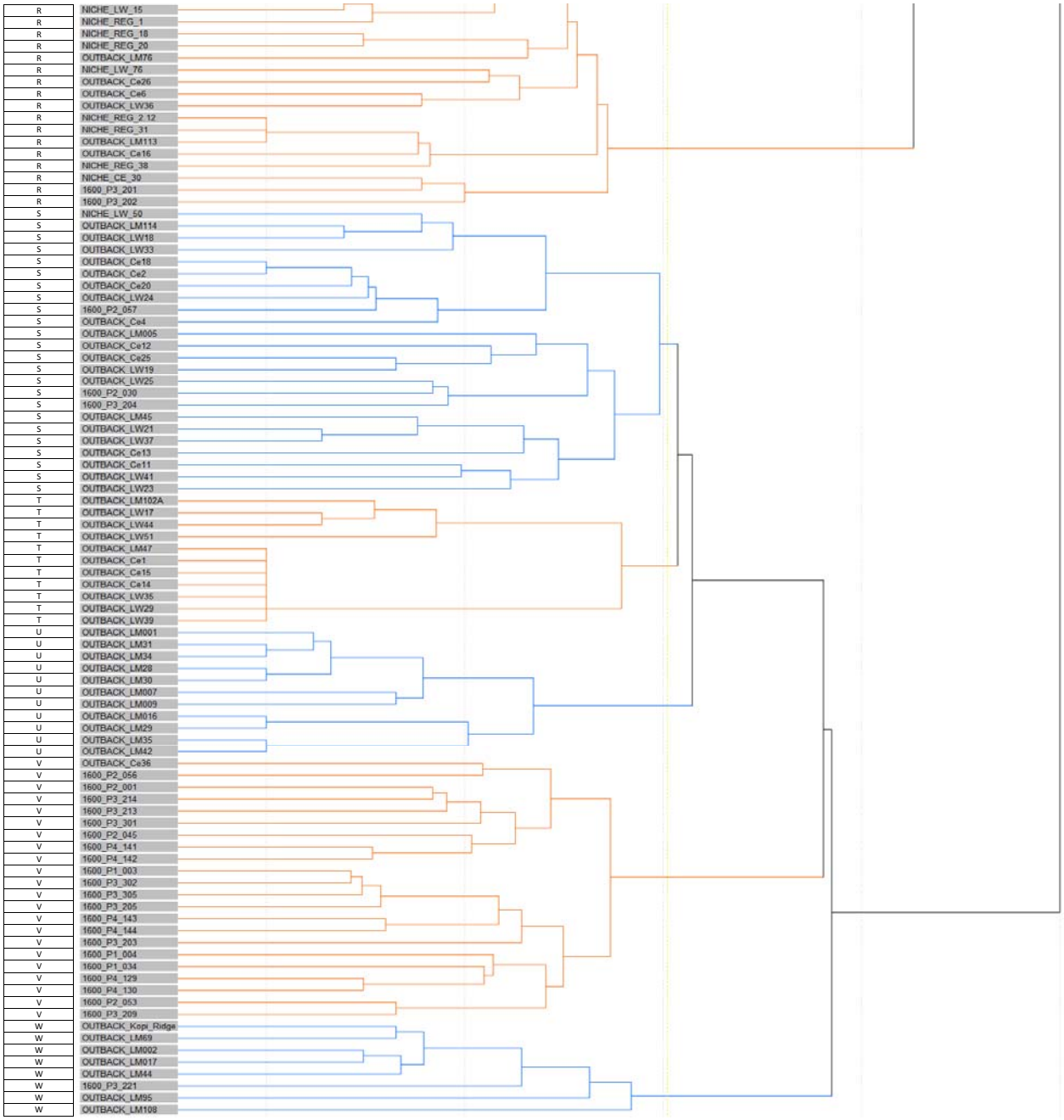
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