Providing sustainable environmental strategies, management and monitoring solutions to industry and government.

TORO ENERGY LIMITED
EXTENSION TO THE WILUNA URANIUM PROJECT
CUMULATIVE IMPACT ASSESSMENT
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Toro Energy Limited – Extension to the Wiluna Uranium Project
Cumulative Impact Assessment

Document Status

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FIGURES

Figure 1.1 – The Wiluna Uranium Project and the Extension to the Wiluna Uranium Project .............. 2
Figure 2.1 – Beard vegetation associations .......................................................................................... 7
Figure 2.2 – Land systems .................................................................................................................... 10
Figure 3.1 – Priority flora ..................................................................................................................... 14
Figure 3.2 – New taxa .......................................................................................................................... 15
Figure 3.3 – Potentially new taxa ......................................................................................................... 16
Figure 4.1 – Conservation significant fauna ......................................................................................... 37
Figure 4.2 – Low halophytic shrubland habitat type ........................................................................... 38
Figure 4.3 – Mallee/Mulga woodland over spinifex plain habitat type .............................................. 39
Figure 4.4 – Woodland/shrubland over calcrete habitat type ............................................................... 39
Figure 4.5 – Mulga over sandplain habitat type .................................................................................. 40
Figure 4.6 – Open plain habitat type .................................................................................................. 40
Figure 4.7 – Mulga over stony ground habitat type ........................................................................... 41
Figure 4.8 – Bare salt lake habitat type ............................................................................................... 41
Figure 4.9 – Spinifex sand dune habitat type ...................................................................................... 42
Figure 4.10 – Spinifex sandplain habitat type ..................................................................................... 42
Figure 4.11 – Kopi dune habitat type .................................................................................................. 43
Figure 4.12 – Stony hills and footslopes habitat type .......................................................................... 43
Figure 4.13 – Fauna habitats ............................................................................................................... 44
Figure 4.14 – Fauna habitats – Haul Road .......................................................................................... 45
Figure 5.1 – SRE records ...................................................................................................................... 53
Figure 5.2 – Confirmed SREs, SREs within the development envelope and fauna habitats ............... 56

APPENDICES

Appendix A Significant Flora Maps .................................................................................................... 60
Appendix B Vegetation Unit Mapping ................................................................................................. 123
1 INTRODUCTION

In 2012 and 2013 Toro Energy Limited (Toro) was granted State and Commonwealth approval for implementation of the “Wiluna Uranium Project” which is based on mining uranium at the Centipede and Lake Way deposits.

Toro has recently acquired two additional deposits, Millipede and Lake Maitland, and is seeking environmental approvals for mining of these deposits, as well as for the construction and operation of a haul road and a water supply borefield. The two satellite pits, together with the borefield and the haul road are known as the “Extension to the Wiluna Uranium Project”. The Wiluna Uranium Project and Extension to the Wiluna Uranium Project (project areas) are shown in Figure 1.1.

The Extension to the Wiluna Uranium Project is located on Barwidgee and Lake Way Stations, with the northern end (Millipede deposit) located approximately 25 km south-east of Wiluna and the southern end (Lake Maitland deposit), located approximately 100 km south-east of Wiluna, and an 80 km haul road connecting the two. The Wiluna Uranium Project is located on Lake Way Station, with the northern end (Lake Way deposit) located approximately 10 km south-east of Wiluna and the southern end (Centipede deposit) located directly east of the Millipede deposit, and includes a road connecting the two and the West Creek Borefield, located approximately 6 km south of Wiluna (Figure 1.1).

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 commissioned ecologia Environment (ecologia) to undertake a cumulative impact assessment by incorporating impacts from the original Wiluna Uranium Project and includes:

- Existing environment, including Beard vegetation communities and land systems;
- Significant flora;
- Vegetation;
- Vertebrate fauna habitats;
- Significant fauna; and
- Invertebrate short range endemics (SRE).

This report has been revised to address responses to public submissions to Toro’s Public Environmental Review for the Extension to the Wiluna Uranium Project. The revisions also include consideration of the EPA recent advice that the cumulative impact assessment report should only refer to the 254 vouchered Tecticornia taxa specimens identified by Dr Kelly Shepherd. The exceptions to this are records of Tecticornia cymbiformis that have been confirmed during the site visit by the peer reviewer as well as specimens of Tecticornia species lodged with the Western Australian Herbarium that do not represent conservation significant taxa, potentially new taxa or range extensions recorded within the project area. Additionally the revised impact assessment only considers significant flora that will be impacted as a result of the current proposal and impacts to more than 30% of the mapped extent of vegetation communities and known individuals of Priority listed, new species, potential new species or ranges extensions had the potential to result in a significant impact to those communities or flora species. No new field work was undertaken and most of the revision focuses on reorganisation, presentation and additional explanation of figures, tables and results provided in the previous version of the report.
The Wiluna Uranium Project and the Extension to the Wiluna Uranium Project

Legend

- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts

- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Re injection Area

Indirect Impacts

- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

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

Figure: 1.1
Project ID: 1631
Drawn: MH
Date: 29/03/2015
1.1 PROJECT IMPACT DEFINITIONS

A summary of direct and indirect impact areas are provided in Table 1.1 and Table 1.2 respectively (Figure 1.1). The cumulative project direct and indirect impact area is 36,537.2 ha.

Table 1.1 – Summary of direct impacts (ha)

<table>
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<tr>
<th>Development Envelope</th>
<th>Extension to the Wiluna Uranium Project</th>
<th>Direct Impact</th>
<th>Wiluna Uranium Project Total</th>
<th>Cumulative Direct Total</th>
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<tr>
<td>Millipede</td>
<td>739.0</td>
<td>2,824.0</td>
<td>23.6</td>
<td>537.9</td>
</tr>
<tr>
<td>Haul Road</td>
<td>304.2</td>
<td>23.6</td>
<td>243.9</td>
<td>23.6</td>
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<tr>
<td>Lake Maitland</td>
<td>2,824.0</td>
<td>23.6</td>
<td>243.9</td>
<td>23.6</td>
</tr>
<tr>
<td>West Creek Borefield</td>
<td>23.6</td>
<td>243.9</td>
<td>23.6</td>
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<td>Centipede Deposit</td>
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<td>243.9</td>
<td>23.6</td>
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<td>Millipede</td>
<td>739.0</td>
<td>2,824.0</td>
<td>23.6</td>
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<td>Haul Road</td>
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<td>23.6</td>
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<td>23.6</td>
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<tr>
<td>Lake Maitland</td>
<td>2,824.0</td>
<td>23.6</td>
<td>243.9</td>
<td>23.6</td>
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<tr>
<td>West Creek Borefield</td>
<td>23.6</td>
<td>243.9</td>
<td>23.6</td>
<td>23.6</td>
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<tr>
<td>Direct Impact Total</td>
<td>739.0</td>
<td>2,824.0</td>
<td>23.6</td>
<td>537.9</td>
</tr>
</tbody>
</table>

| Direct Impact        | 739.0                                  | 2,824.0       | 23.6                       | 537.9                  | 1,581.8                  | 1,530.0                  | 3,111.8                  |
| Direct Impact Total  | 739.0                                  | 2,824.0       | 23.6                       | 537.9                  | 1,581.8                  | 1,530.0                  | 3,111.8                  |

Table 1.2 – Summary of indirect impacts (ha)

<table>
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<tr>
<th>Extent within 0.5 m groundwater drawdown zone</th>
<th>Extent within 25 m Millipede Haul Road Dust Deposition Zone</th>
<th>Cumulative Indirect Total</th>
<th>Cumulative total</th>
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<td>Lake Way</td>
<td>32,958.9</td>
<td>466.5</td>
<td>33,425.4</td>
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<td>Millipede/ Centipede West Creek Borefield</td>
<td>5,352.6</td>
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<td>Lake Maitland</td>
<td>8,407.40</td>
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<tr>
<td>West Creek Borefield</td>
<td>5,282.4</td>
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<tr>
<td>Lake Maitland</td>
<td>11,644.9</td>
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1.1.1 Direct Impacts

Direct impacts are defined as areas to be cleared within the ‘disturbance footprint’ and include:

- Wiluna Uranium Project: West Creek Borefield, Accommodation Village, Lake Way Deposit, Centipede Deposit and various infrastructure areas (Figure 1.1).
- Extension to the Wiluna Uranium Project: Millipede Deposit, Haul Road, Lake Maitland Mine and Lake Maitland Borefield (Figure 1.1); and
- Extension to the Wiluna Uranium Project: 24.5 ha of a proposed 390 ha ‘re-injection area’ at the southern end of Lake Maitland. The location for direct impact is unknown and will be refined with further field trials, therefore direct impacts have been calculated based on:
  - Direct impacts to significant flora, fauna etc. has been calculated as nil as any known locations in this area will be avoided; and
  - Direct impacts to vegetation, fauna habitat etc. has been calculated as a proportion of each unit that occurs within the re-injection area, i.e. a unit which represents 50% of the reinjection area is assumed to incur 50% of the reinjection direct impact (Figure 1.1).

Direct impact is calculated, for example, using the numbers of individuals or area of vegetation that occur within the disturbance footprint that is going to be directly impacted. Impacts within the development envelope are also included as a worst case scenario.

1.1.2 Indirect Impacts

The indirect impacts are defined as areas that will potentially be impacted and include areas that are affected by:

- Groundwater drawdown (calculated using the 0.5 m drawdown contour at the West Creek and Lake Maitland Borefields and Centipede, Millipede, Lake Way and Lake Maitland Deposits) (Figure 1.1); and
- Dust deposition (calculated using 25 m either side of the Millipede to Lake Maitland Haul Road) (Figure 1.1).

Indirect impact totals are calculated, for example, by summing the extent of a vegetation unit within the predicted water draw down contour and subtracting vegetation that is already directly impacted within the disturbance footprint.
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2 EXISTING ENVIRONMENT

2.1 BEARD VEGETATION

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).

A total of 13 Beard vegetation associations fall within the disturbance footprint of the project areas. These are listed in Table 2.1 and mapped in Figure 2.1. Most of these units have greater than 99% of their pre-European extent remaining, except vegetation association 561 with 89.9% remaining (Government of Western Australia 2014). Association 561: Succulent steppe with low woodland; Mulga over saltbush is the most regionally restricted of those impacted with only 8,966 ha mapped within the Murchison bioregion.

None of the Beard vegetation associations will result in greater than 1% of their total occurrence in the Murchison IBRA directly impacted as a result of clearing proposed in connection with the Extension to the Wiluna Uranium Project.
## Table 2.1 – Beard vegetation association cumulative direct impacts

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<tr>
<th>#</th>
<th>Vegetation Association Description</th>
<th>Current Extent Mapped in the Murchison (^a)</th>
<th>Development Envelope</th>
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<th>Direct Impact</th>
<th>Wiluna Uranium Project Total</th>
<th>Cumulative Direct Total</th>
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<tr>
<td></td>
<td></td>
<td>ha</td>
<td>ha</td>
<td>ha</td>
<td>ha</td>
<td>ha</td>
<td>%</td>
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<td>11</td>
<td>Medium woodland; coolabah (Eucalyptus microtheca)</td>
<td>9,153</td>
<td>9,153</td>
<td>-</td>
<td>-</td>
<td>2.3</td>
<td>&lt;0.1%</td>
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<td>18</td>
<td>Low woodland; Mulga (Acacia aneura)</td>
<td>12,363,252</td>
<td>114.0</td>
<td>114.0</td>
<td>68.8</td>
<td>68.8</td>
<td>76.1</td>
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<td>29</td>
<td>Sparse low woodland; Mulga, discontinuous in scattered groups</td>
<td>2,955,695</td>
<td>24.5</td>
<td>24.5</td>
<td>19.7</td>
<td>55.3</td>
<td>89.3</td>
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<td>39</td>
<td>Shrublands; Mulga scrub</td>
<td>1,138,065</td>
<td>11.4</td>
<td>11.4</td>
<td>9.1</td>
<td>9.1</td>
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<td>40</td>
<td>Shrublands; Acacia scrub, various species</td>
<td>58,832</td>
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<td>-</td>
<td>6.0</td>
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<td>107</td>
<td>Hummock grasslands, shrub steppe; Mulga and Eucalyptus kingsmillii over hard spinifex</td>
<td>2,790,992</td>
<td>111.7</td>
<td>111.7</td>
<td>91.1</td>
<td>98.1</td>
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<td>126</td>
<td>Bare areas; salt lakes</td>
<td>710,255</td>
<td>98.3</td>
<td>98.3</td>
<td>-</td>
<td>-</td>
<td>0.2%</td>
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<td>182</td>
<td>Low woodland; Mulga &amp; Acacia ramulosa</td>
<td>50,888</td>
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<td>3.6</td>
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<td>188</td>
<td>Shrublands; Mulga and Acacia sclerosperma scrub</td>
<td>11,864</td>
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<td>21.6</td>
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<td>204</td>
<td>Succulent steppe with open scrub; scattered Mulga &amp; Acacia sclerosperma over saltbush &amp; bluebush</td>
<td>184,861</td>
<td>163.6</td>
<td>163.6</td>
<td>535.6</td>
<td>356.0</td>
<td>357.9</td>
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<td>560</td>
<td>Mosaic: Shrublands; Acacia ramulosa scrub / succulent steppe; Samphire</td>
<td>84,725</td>
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<td>561</td>
<td>Succulent steppe with low woodland; Mulga over saltbush</td>
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<td>-</td>
<td>38.5</td>
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<td>676</td>
<td>Succulent steppe; Samphire</td>
<td>382,704</td>
<td>56.2</td>
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<td>45.0</td>
<td>152.6</td>
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<td>2,024.0</td>
<td>537.0</td>
<td>1,581.8</td>
<td>1,530.0</td>
</tr>
</tbody>
</table>

\(^a\) from (Government of Western Australia 2014). Note there may be minor discrepancies in totals due to rounding and GIS calculations.
Legend

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope
Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Re injection Area

Indirect Impacts

Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

Direct Impacts

Figure: 2.1
Project ID: 1631
Drawn: MH
Date: 24/03/2016

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

Beard vegetation associations

Inset A: Lake Way Deposit
Inset B: Millipede/Centipede Deposits
Inset C: Lake Maitland Deposit

Absolute Scale - 1:440,000
Kilometres
0 10 20
2.2 LAND SYSTEMS

A regional survey of the Murchison was conducted by Curry et al. (1994) in an attempt to obtain an inventory and condition of land systems within the Murchison River catchment. The Murchison regional inventory covers approximately 88,360 km² of arid zone rangelands situated between Mt Magnet and Meekatharra in the east and the catchments of the Greenough and Wooramel Rivers in the west. This area includes most of the catchment of the Murchison River and its tributaries the Sanford, Roderick and Yalgar Rivers; as well as most of the catchment of Lake Austin. Lands within the area have been described and mapped into 19 broad land types composed of 74 land systems.

A total of 19 land systems fall within the disturbance footprint. These are listed in Table 2.2 and mapped in Figure 2.2. The Cyclops land system (alluvial plains with halophytic shrublands) is the most regionally restricted of those impacted with 25,534 ha mapped within the Murchison IBRA bioregion.

None of the land systems have greater than 1% of their total area mapped in the Murchison directly impacted as a result of clearing proposed in connection with the Extension to the Wiluna Uranium Project.
Table 2.2 – Land system cumulative direct impacts

<table>
<thead>
<tr>
<th>Land System</th>
<th>Description</th>
<th>Current Extent Mapped in the Murchison Development Envelope</th>
<th>Extension to the Wiluna Uranium Project</th>
<th>Direct Impact</th>
<th>Wiluna Uranium Project Total</th>
<th>Cumulative Direct Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Araarak</td>
<td>Sandy plains with acacia shrublands and wanderrie grasses</td>
<td>149,890</td>
<td>-</td>
<td>1.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bullimore</td>
<td>Sandplains and occasional dunes with spinifex grasslands</td>
<td>3,564,992</td>
<td>-</td>
<td>151.4</td>
<td>46.3</td>
<td>207.7</td>
</tr>
<tr>
<td>Carnegie</td>
<td>Salt lakes and fringing alluvial plains with halophytic shrublands</td>
<td>1,185,945</td>
<td>710.0</td>
<td>15.1</td>
<td>-</td>
<td>525.7</td>
</tr>
<tr>
<td>Calvina</td>
<td>Calcrete plains with acacia shrublands</td>
<td>290,394</td>
<td>29.0</td>
<td>25.9</td>
<td>44.9</td>
<td>122.2</td>
</tr>
<tr>
<td>Cyclops</td>
<td>Alluvial plains with halophytic shrublands</td>
<td>25,334</td>
<td>-</td>
<td>8.6</td>
<td>-</td>
<td>6.9</td>
</tr>
<tr>
<td>Delma</td>
<td>Salt lakes and fringing alluvial plains with halophytic shrublands</td>
<td>133,509</td>
<td>17.1</td>
<td>1967.4</td>
<td>0.0</td>
<td>13.7</td>
</tr>
<tr>
<td>Desdemona</td>
<td>Sandy plains with acacia shrublands and wanderrie grasses</td>
<td>255,706</td>
<td>-</td>
<td>9.2</td>
<td>0.3</td>
<td>7.4</td>
</tr>
<tr>
<td>Gabanintha</td>
<td>Hills and ranges with acacia shrublands</td>
<td>165,109</td>
<td>-</td>
<td>9.4</td>
<td>-</td>
<td>7.5</td>
</tr>
<tr>
<td>Kilara</td>
<td>Low hills and stony plains with acacia shrublands</td>
<td>133,194</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.8</td>
</tr>
<tr>
<td>Melaleuca</td>
<td>Calcrete plains with acacia shrublands</td>
<td>37,625</td>
<td>-</td>
<td>1.8</td>
<td>1.8</td>
<td>2.8</td>
</tr>
<tr>
<td>Miluna</td>
<td>Alluvial plains with halophytic shrublands</td>
<td>206,496</td>
<td>-</td>
<td>765.3</td>
<td>2.0</td>
<td>115.8</td>
</tr>
<tr>
<td>Mitchell</td>
<td>Wash plains and sandy banks on hardpan, with Mulga shrublands and wanderrie grasses or spinifex</td>
<td>26,622</td>
<td>8.1</td>
<td>-</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Monk</td>
<td>Wash plains and sandy banks on hardpan, with Mulga shrublands and wanderrie grasses or spinifex</td>
<td>996,801</td>
<td>11.0</td>
<td>-</td>
<td>8.8</td>
<td>8.8</td>
</tr>
<tr>
<td>Ranch</td>
<td>Wash plains on hardpan with Mulga shrublands</td>
<td>86,989</td>
<td>11.8</td>
<td>-</td>
<td>9.5</td>
<td>9.5</td>
</tr>
<tr>
<td>Trennaman</td>
<td>Wash plains and sandy banks on hardpan, with Mulga shrublands and wanderrie grasses or spinifex</td>
<td>61,752</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>9.6</td>
</tr>
<tr>
<td>Violet</td>
<td>Stony plains with acacia shrublands and halophytic shrublands</td>
<td>546,126</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>25.5</td>
</tr>
<tr>
<td>Wiluna</td>
<td>Low hills with eucalypt or acacia woodlands with halophytic undershrubs</td>
<td>252,598</td>
<td>16.6</td>
<td>-</td>
<td>13.3</td>
<td>13.3</td>
</tr>
<tr>
<td>Windarra</td>
<td>Low hills and stony plains with acacia shrublands</td>
<td>227,973</td>
<td>13.3</td>
<td>-</td>
<td>10.6</td>
<td>10.6</td>
</tr>
<tr>
<td>Yanganoo</td>
<td>Wash plains and sandy banks on hardpan, with Mulga shrublands and wanderrie grasses or spinifex</td>
<td>1,967,111</td>
<td>5.7</td>
<td>-</td>
<td>4.6</td>
<td>11.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>739.0</strong></td>
<td><strong>304.2</strong></td>
<td><strong>2,824.0</strong></td>
<td><strong>537.9</strong></td>
<td><strong>841.8</strong></td>
</tr>
</tbody>
</table>

Note there may be minor discrepancies in totals due to rounding and GIS calculations.
Legend

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area

Direct Impacts

Indirect Impacts

Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

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

Figure: 2.1  
Project ID: 1631
Drawn: MH  
Date: 24/03/2016

Land systems

Absolute Scale - 1:440,000
3 FLORA AND VEGETATION

3.1 SOURCES OF INFORMATION

The vegetation and flora of the project was consolidated by ecologia (2015b) and this has been used for the cumulative impact assessment of the non-\textit{Tecticornia} flora and vegetation communities. Surveys used in this consolidation included:

- Outback Ecology (2009b): 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; and

For \textit{Tecticornia} taxa and communities, the following report was utilised:


3.2 SIGNIFICANT FLORA

3.2.1 Background

The estimated abundance of significant flora, including total number of individuals provided in Table 3.2, has been calculated from a variety of sources, including the \textit{ecologia} (2015b) consolidated report, along with:

- FloraBase searches for all known records in Western Australia (for known Priority flora species only); and
- DPaW database searches, conducted for the haul road in September 2014 (search reference 32-0514FL, buffer of 50 km).

FloraBase and DPaW database records vary considerably in the amount of detail regarding abundance that is available ranging from accurate counts or general abundance descriptions to no detail at all. Where multiple records at the same location were available, the highest numeric estimate was applied. Where descriptions of abundance only were available, numbers were inferred according to Table 3.1. Where databases provided no estimate of species abundance, it was assumed only a single individual plant was present. In most instances these assumptions are likely to result in a significant underestimate, and hence the final estimates of total individuals of each species are likely to be extremely conservative.

Table 3.1 – Conversion table for abundance descriptions

<table>
<thead>
<tr>
<th>Cover or description</th>
<th># plants assumed for record</th>
</tr>
</thead>
<tbody>
<tr>
<td>No cover or number</td>
<td>1</td>
</tr>
<tr>
<td>Infrequent, not common, occasional, rare, scattered, sparse</td>
<td>1</td>
</tr>
<tr>
<td>Common, locally common, frequent</td>
<td>30</td>
</tr>
<tr>
<td>Abundant</td>
<td>50</td>
</tr>
<tr>
<td>&lt;1% cover</td>
<td>1</td>
</tr>
<tr>
<td>1-2% cover</td>
<td>5</td>
</tr>
<tr>
<td>2-10% cover</td>
<td>10</td>
</tr>
<tr>
<td>10-30% cover</td>
<td>20</td>
</tr>
<tr>
<td>30-70% cover</td>
<td>30</td>
</tr>
<tr>
<td>70-100% cover</td>
<td>40</td>
</tr>
</tbody>
</table>
3.2.1.1 Priority Flora

Seven Priority flora taxa were recorded during flora and vegetation assessments conducted for the Extension to the Wiluna Uranium Project (Table 3.2) and include:

- Priority 1: *Eremophila congesta* and *Tecticornia* sp. Sunshine Lake (K.A. Shepherd et al. KS 867).
- Priority 3 (^ = Niche 2011 record): *Eremophila arachnoides* subsp. *arachnoides*, *Stackhousia clementii* and *Tecticornia cymbiformis*.
- Priority 4: *Eremophila pungens* and *Frankenia confusa*.

Locations of Priority flora are shown on Figure 3.1 and maps showing the distribution of each Priority flora taxon are provided in Appendix A.

3.2.1.2 New and Potentially New Taxa

Seven new and one potentially new *Tecticornia* taxa have been identified from specimens collected from Extension to the Wiluna Uranium Project (Shepherd 2015) (Table 3.2) and include:

- Potentially new taxa: ?*Tecticornia* sp. aff. *globulifera* (small)

In addition to the taxa listed above, Shepherd (2015) concluded that in taxonomically problematic species, multiple entities have been included under the same identification and therefore the current number of *Tecticornia* taxa is likely to be an underestimate of the actual number of samphire in the project areas.

Locations of new and potentially new taxa are shown on Figure 3.2 and Figure 3.3 respectively and maps showing the distribution of each individual taxon are provided in Appendix A.

3.2.1.3 Other Significant Flora

Two atypical variants were recorded from the Project area: *Frankenia* sp. aff. *fecunda* (glabrous leaf variant) and *Surreya* ?*diandra* (Table 3.2).

Nineteen range extensions were recorded (Table 3.2) of which two are bioregional range extensions: *Acacia brumalis* and *Tecticornia tenuis* (Table 3.2).

Maps showing the distribution of each individual other significant flora taxa are provided in Appendix A.
3.2.1.4 *Tecticornia* Taxa

An assessment of *Tecticornia* associated with Extension to the Wiluna Uranium Project was conducted by *ecologia* (2015a) with the intention of better resolving the diversity of taxa present. Identification of specimens collected during this assessment, including those specimens collected during the Millipede to Lake Maitland Haul Road assessment by *ecologia* (2015f), were undertaken by Senior Research Scientist at the Western Australian Herbarium, Dr Kelly Shepherd (Shepherd 2015). Due to the difficulties associated with accurate field identification and lack of taxonomic clarification of *Tecticornia* taxa (Shepherd 2015), for the purpose of this assessment all *Tecticornia* taxa have been treated as significant for the project areas.

As instructed by the OPEA, only the 254 vouchered *Tecticornia* specimens that were provided to Dr Shepherd have been considered in the impact assessment of conservation significant, new, potentially new, and range extension taxa. The exceptions to this are the records of *Tecticornia cymbiformis*, which have been confirmed during the site visit by the peer reviewer. Of the 254 vouchered specimens only 209 were fully identified by Dr Shepherd as the remaining 43 specimens were either sterile or could not be identified for other reasons. Two specimens in addition to those 209, identified as *?Tecticornia sp. aff. globulifera* (small), are also included here as a separate entity.

For the 13 known *Tecticornia* taxa that do not represent conservation significant taxa, potentially new taxa, or range extensions (included in Table 3.2 under ‘Other *Tecticornia* taxa’), specimens lodged at the Western Australian Herbarium (where each record was assumed to represent a single individual) have been included in the impact assessment together with the *ecologia* specimens confirmed by Dr Shepherd.

It should be noted that the 209 specimens are not representative of the total number of individuals of each of the 26 *Tecticornia* taxa identified by Dr Shepherd from the project areas, which is significantly greater based on percentage cover estimates, but represent collected, vouchered and formally identified specimens only.

*Tecticornia* taxa referred to in Niche (2011) could not be verified by Dr Shepherd, and have not included in this assessment.

Figures showing the distribution of each significant taxon are provided in Appendix A.
Legend

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area

Indirect Impacts
Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

Priority Flora

- Priority 1: Eremophila congesta
- Priority 1: Tecticornia sp. Sunshine Lake (K.A. Shepherd et al. KS 867)
- Priority 3: Stackhousia clementii
- Priority 3: Tecticornia cymbiformis
- Priority 4: Eremophila pungens
- Priority 4: Frankenia confusa

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994
Legend
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

New Taxa
- Tecticornia aff. haloconoides s.l. 'large ovate seed aggregate'
- Tecticornia aff. haloconoides s.l. 'tuberculate seed'
- Tecticornia sp. aff. globulifera (small)
- Tecticornia sp. aff. laevigata (non-rotated fruitlets)
- Tecticornia sp. aff. prunosa (infared bracts)
- Tecticornia sp. aff. undulata (broad articles)
- Tecticornia sp. aff. Burnerbinmah (inflated fruit)

Kilometres

Absolute Scale - 1:750,000

Figure: 3.2
Project ID: 1631
Drawn: MH
Date: 29/03/2015

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994
3.2.2 Discussion of Impacts

The cumulative direct and indirect impacts to significant flora are outlined in Table 3.2. As a precautionary approach, all taxa that are located within the 0.5 m groundwater drawdown contour have been listed. However, none of the recorded significant taxa, including Tecticornia, are considered likely to be groundwater dependent (see discussion in ecologia (2016)), and as a consequence the cumulative direct and indirect impact has been provided for only known potential groundwater dependent species.

3.2.2.1 Priority Flora

None of the seven Priority listed taxa impacted are expected to be impacted by more than 30% of the known number of individuals. Additionally, of the 7 novel taxa identified, only one, Tecticornia sp. aff. Burnerbinmah (inflated fruit), is predicted to experience more than 30% direct impact to the known number of individuals. This single record is in close proximity to the southern boundary of the proposed impact area at the Millipede Deposit. However Toro proposes a temporary 50 m exclusion zone around this known individual until further survey work for the species is undertaken.

- *Eremophila congesta* (Priority 1) has only been recorded in the Murchison IBRA bioregion and is typically recorded on lateritic outcrops in greenstone hills, or stony quartzite slopes, which are generally locally restricted habitat types. *Eremophila congesta* has been recorded in the vicinity of the project area at the West Creek Borefield on small rocky outcrops and at one location to the west of Millipede deposit which does not fall within the disturbance footprint. Additionally, this record near the Millipede deposit is likely to be a data error as suitable habitat does not exist at this location. No existing records of *Eremophila congesta* will be directly impacted by the project. While three individuals (30% of the estimated local population) are within the predicted 0.5 m groundwater drawdown contour, this species is not considered to be groundwater dependent and there is not expected to be any impact from groundwater drawdown associated with the project.

- *Tecticornia* sp. Sunshine Lake (K.A. Shepherd et al. KS 867) (Priority 1) is known from the Murchison and Little Sandy Desert IBRA bioregions. *Tecticornia* sp. Sunshine Lake has previously been recorded at Lake Way and two other salt lakes, which are approximately 200 km and 600 km to the north. During assessments for this project, *Tecticornia* sp. Sunshine Lake has been recorded frequently at both Lake Way and Lake Maitland. At Lake Way it was recorded mainly along the very edge of the bare salt lake at multiple locations and at Lake Maitland it was recorded in the smaller salt pans towards the southern end of the lake. Because of its association with locally common habitats and regional records, there is a high likelihood of additional habitat outside the project area at both Lake Way and Lake Maitland as well as elsewhere in the region. Of the 15 confirmed specimens collected and identified from the project areas, none fall within the disturbance footprint. However, although 4 individuals (26.7% of the confirmed individuals) are within the predicted 0.5 m groundwater drawdown contour associated with the Millipede/Centipede and Lake Maitland deposits, *Tecticornia* taxa are not considered to be groundwater dependent and therefore are not expected to be impacted by groundwater drawdown.
Table 3.2 – Significant flora cumulative direct and indirect impacts

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Total Known Individuals</th>
<th>Development Envelope</th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Direct and Indirect Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Aggregate</td>
<td>Dust</td>
<td>Dust</td>
</tr>
<tr>
<td>Priority 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eremophila congesta</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia sp. Sunshine Lake (R.A. Shepherd et al, 1967)</td>
<td>15</td>
<td>3</td>
<td>-</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>Priority 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eremophila aarachnomoides subsp. aarachnomoides*</td>
<td>32,966</td>
<td>5,440</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stenocactus elementi</td>
<td>1,531</td>
<td>81</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia cymophorum</td>
<td>5,578</td>
<td>-</td>
<td>50</td>
<td>120</td>
<td>-</td>
</tr>
<tr>
<td>Priority 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eremophila pungens</td>
<td>2,302</td>
<td>-</td>
<td>1,981</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Frankenia confusa</td>
<td>685</td>
<td>36</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>*New taxa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tecticornia aff. halocnemoides s.l. ‘large ovate seed aggregate*</td>
<td>12</td>
<td>4</td>
<td>-</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia aff. halocnemoides s.l. ‘tuberculate seed*</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia sp. Burnerbrinna (inflated fruit)</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia sp. globulifera (small)</td>
<td>13</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia sp. aff. navajite (non-rotated fruitlets)</td>
<td>12</td>
<td>1</td>
<td>-</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia sp. aff. pruinose (inflated bracts)</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia sp. aff. undulata (broad articles)</td>
<td>25</td>
<td>-</td>
<td>11</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>*Potential new taxa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>?Tecticornia sp. aff. globulifera (small)</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Atypical taxa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frankenia sp. aff. eucnuda (glabrous leaf variant)</td>
<td>149</td>
<td>21</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Surroya tordensis</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Range extension</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Arctis brumalis</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Cenchrus floribundum</td>
<td>103</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Diploloma crocifolium subsp. chavellanum*</td>
<td>844</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Frankenia interioris*</td>
<td>454</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gymnophoia engelhardtii*</td>
<td>764</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gymnophoia septiloba*</td>
<td>624</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Maireana liddellii</td>
<td>204</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Maireana haematina</td>
<td>204</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Murtinella volubilis*</td>
<td>484</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
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</tbody>
</table>

Toro Energy Limited – Extension to the Wiluna Uranium Project
Cumulative Impact Assessment
Toro Energy Limited – Extension to the Wiluna Uranium Project
Cumulative Impact Assessment

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Total Known Individuals</th>
<th>DevelopmentEnvelope</th>
<th>Extension to the Wiluna Uranium Project</th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Direct and Indirect Impact</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Millipede</td>
<td>Haul Road</td>
<td>Lake Maitland</td>
<td>LM Beneath</td>
<td>Millipede</td>
</tr>
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<td>Tecticornia tenuis</td>
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<tr>
<td>Thyridolepis xenaphila</td>
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<td>Trachymene ceratocarpa</td>
<td>23</td>
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<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>

Other Tecticornia taxa

Tecticornia calyptrata | 32 | 3 | 2 | 1 | - | - | 1 | - | - | 1 | - | 1 | 3.1% | 3 | - | 3 | 9.4% | 4 | 12.5% | 1 | 3.1% |
Tecticornia denticulata | 147 | - | 3 | - | - | - | 3 | - | - | 3 | - | 3 | 2% | - | - | - | - | 3 | 2% | 3 | 2% |
Tecticornia doliciformis | 92 | 2 | 2 | 1 | - | - | - | - | - | 0 | - | 0 | 0% | 2 | - | 2 | 2.2% | 2 | 2.2% | - | - |
Tecticornia indica | 510 | - | 1 | 1 | - | - | - | - | - | 0 | - | 0 | 0% | 1 | - | 1 | 0.2% | 1 | 0.2% | - | - |
Tecticornia indica subsp. bidens | 419 | 6 | 4 | 3 | - | 1 | - | 1 | - | 2 | - | 2 | 0.5% | 9 | - | 9 | 2.1% | 11 | 2.6% | 2 | 0.5% |
Tecticornia indica subsp. leioschyla | 116 | 4 | 3 | - | - | - | 2 | 1 | - | - | 3 | - | 3 | 2.6% | 3 | - | 3 | 2.6% | 6 | 5.2% | 3 | 2.6% |
Tecticornia laevigata | 98 | - | 1 | 8 | - | - | - | 1 | - | - | 1 | - | 1 | 1% | 11 | - | 11 | 12.2% | 12 | 12.2% | 1 | 1% |
Tecticornia petalata | 113 | - | 1 | 4 | - | - | - | - | - | 0 | - | 0 | 0% | 2 | - | 2 | 1.8% | 2 | 1.8% | - | - |
Tecticornia pergranulata | 234 | - | 1 | - | - | - | 1 | - | - | 1 | - | 1 | 0.4% | - | - | - | - | 1 | 0.4% | 1 | 0.4% |
Tecticornia pruinosa | 115 | - | - | 1 | - | - | - | - | - | 0 | - | 0 | 0% | 1 | - | 1 | 0.9% | 1 | 0.9% | - | - |
Tecticornia pterygosperma subsp. denticulata | 49 | 1 | - | - | - | - | - | - | - | 0 | - | 0 | 0% | 4 | - | 4 | 8.2% | 4 | 8.2% | - | - |
Tecticornia sp. Bumertinmah (D. Edinger et al. 101) | 61 | 4 | 1 | 5 | - | 3 | - | - | 3 | - | 3 | 4.9% | 6 | - | 6 | 3.8% | 9 | 14.7% | 3 | 4.9% |
Tecticornia sp. Denney Crossing (K.A. Shepherd & J. English KS 152) | 105 | 10 | 5 | 1 | - | 6 | 1 | - | 7 | - | 7 | 6.7% | 13 | - | 13 | 12.4% | 20 | 19% | 7 | 6.7% |

Note there may be minor discrepancies in totals due to rounding and GIS calculations. ^ = No location data available, not mapped. * = includes each record from the WAH (FloraBase) as one individual. * = introduced flora.
- **Eremophila arachnoides** subsp. *arachnoides* (Priority 3) is known from ten records from the Murchison and Little Sandy Desert IBRA bioregions and is typically recorded on shallow loam over limestone. *Eremophila arachnoides* subsp. *arachnoides* has been recorded at the Centipede, Millipede and Lake Way deposits by Niche (2011). During these surveys, specific locations of plants were not taken, but the number of plants were recorded along transects and density of plants estimated. As locations are not available for this species, they have not been mapped. The abundance of *Eremophila arachnoides* subsp. *arachnoides* estimated by Niche (2011) in the vicinity of the project areas is as follows:
  
  o Centipede: Niche (2011) estimated that 130 plants occur within the Centipede project area, based on the extent of suitable habitat present. Due to the lack of location data for this taxon, it is assumed that all 130 plants in this area will be directly impacted by the project.
  
  o Millipede: Niche (2011) estimated 5,440 plants occur within the Millipede project area based on the extent of suitable habitat present. Due to the lack of location data for this taxon, it is assumed that all 5,440 plants in this area will be directly impacted by the project.
  
  o Lake Way: Niche (2011) estimated 9,211 plants occur at Lake Way and the surrounding area across 404 ha of suitable habitat, of which 9.4 ha, representing an estimated 214 plants is expected to be directly impacted by the project at Lake Way. The remaining 8,997 plants are likely to be within the water drawdown area.
  
  o West Creek Borefield: Niche (2011) recorded one location of *Eremophila arachnoides* subsp. *arachnoides* from the West Creek Borefield. Due to the lack of accurate location data for this record from the Niche (2011) assessment, it is assumed that this record is within the predicted 0.5 m groundwater drawdown contour.
  
  o Regional survey: Niche (2011) undertook a survey in suitable habitat approximately 100 km north of Wiluna and recorded a population of approximately 18,000 individuals.

As *Eremophila arachnoides* subsp. *arachnoides* has been recorded frequently from the Millipede, Centipede and Lake Way deposits, the West Creek Borefield and in the region (Niche 2011), it is considered to have a high likelihood of occupying additional habitat outside the project area. Of the estimated 32,966 individuals known (vouchered) to occur regionally, 5,440 (16.5%) are expected to be directly impacted by the current project and 5,784 (17.5%) cumulatively across the Wiluna project. If Western Botanical's (2015) estimate of an additional 43,255 individuals recorded from surveys of Cameco Australia's Yelirrie Project were included, the total impact of the current project would be reduced to 7.1% and 7.6% cumulatively. An additional 8,997 occur within the predicted 0.5 m groundwater drawdown contour at the Lake Way deposit, however, as this species is not considered to be groundwater dependent there is not expected to be any impacted as a result of proposed groundwater drawdown.

- **Stackhousia clementii** (Priority 3) is a widespread species with records in the Carnarvon, Central Ranges, Great Victoria Desert, Murchison and the Pilbara IBRA bioregions. *Stackhousia clementii* was recorded scattered along Abercrombie Creek in the south of the Millipede deposit and typically along a drainage line that extends from the north-west of the West Creek Borefield. Of the estimated 1,531 *Stackhousia clementii* individuals 36 (2.4%) are within the predicted 0.5 m groundwater drawdown contour. However, this species is not considered to be groundwater dependent and is therefore not expected to be impacted by groundwater drawdown.

- **Tecticornia cymbiformis** (Priority 3) is restricted to saline soils along the edges of creeklines, and has previously been recorded across the Gascoyne, Murchison and Yalgoo IBRA bioregions. The closest previous record is approximately 100 km to the north-east of the project. At the project area it has been recorded as scattered individuals along the upper edge of the main lake bed of Lake Maitland and as the dominant component of the fringing vegetation at a small salt pan approximately 7 km to the north-west of Lake Maitland. Of the estimated 5,578 individuals, 60
(1.1%), are located within the disturbance footprint: 50 along the haul road and 10 at Lake Maitland deposit. An additional 760 individuals (13.6%) are located within the predicted 0.5 m groundwater drawdown associated with the Lake Maitland deposit. However, this species is not considered to be groundwater dependent and is therefore not expected to be impacted by groundwater drawdown.

- **Eremophila pungens (Priority 4)** has been recorded extensively (from 41 locations) across the Murchison and Gascoyne IBRA bioregions on plains, ridges and breakaways. *Eremophila pungens* has previously been recorded in the vicinity of the project, with many scattered populations to the north and south of the haul road, indicating high habitat suitability outside the project. Of the conservatively estimated 2,302 individuals, 608 (26.4%) are expected to be directly impacted by the construction of the haul road, and a further 250 (10.9%) potentially indirectly impacted by dust deposition associated with haul road operations. The cumulative impact to 858 (37.3%) of known individuals of this species is unlikely to be significant as it is recorded extensively in the area and this relatively high apparent impact reflects the high survey effort within the haul road corridor. An equivalent intensity of sampling in adjacent areas is likely to reduce the proportional impact considerably. Therefore the impact to the species as a result of the project is unlikely to be significant.

- **Frankenia confusa (Priority 4)** has been recorded across the Gascoyne, Geraldton Sandplains, Murchison and Yalgoo IBRA bioregions, typically along the banks of rivers and watercourses. At the project area *Frankenia confusa* has been recorded in association with the low Samphire heath fringing the salt lakes at both Lake Way (Millipede deposit and south of Millipede) and south of Lake Maitland. Of the estimated 685 *Frankenia confusa* individuals, none will be directly impacted by the project, with 10 individuals (1.5%) within the predicted 0.5 m groundwater drawdown contour. However, this species is not considered to be groundwater dependent and is therefore not expected to be impacted by groundwater drawdown.

### 3.2.2.2 New Flora Taxa

- **Tecticornia aff. halocnemoides** s.l. *'large ovate seed aggregate'* was recorded on the edge of the main lake bed at both Lake Way and Lake Maitland, as well as Abercrombie Creek which drains into Lake Way adjacent to the Centipede and Millipede deposits and the chain of salt pans extending to the south of Lake Maitland. It is therefore apparently not restricted to any specific landform or salt lake zonation and additional suitable habitat is likely to exist outside the impact areas.

  Of the 12 confirmed individuals, 3 (25%) will be directly impacted by the project, with an additional 4 individuals (33%) within the predicted 0.5 m groundwater drawdown contours. However, this species is not considered to be groundwater dependent and is therefore not expected to be impacted by groundwater drawdown. The impact to 3 (25%) confirmed individuals of this taxon is unlikely to result in a significant impact on the total population, as it is recorded at several locations across both Lake Maitland and Lake Way, and is apparently not restricted to any specific landform or salt lake zonation, with additional suitable habitat likely to exist outside the impact areas.

- **Tecticornia aff. halocnemoides** s.l. *'tuberculate seed'* was recorded commonly on the edge of the main lake bed and the chain of salt pans extending to the south of Lake Maitland. It is therefore apparently not restricted to any specific landform or salt lake zonation and additional suitable habitat is likely to exist at Lake Maitland, and potentially further south along the paleodrainage system outside of the impact areas.

  Of the 3 confirmed individuals, none (0%) will be directly impacted and 3 (100%) are within the predicted 0.5 m groundwater drawdown contours. As this species is not considered to be...
groundwater dependent it is not expected to be impacted by groundwater drawdown. Any potential impact to this taxon may not be significant as it is recorded at several locations across Lake Maitland outside of the direct impact areas and is apparently not restricted to any specific landform or salt lake zonation, with additional suitable habitat likely to exist outside the impact areas.

- **Tecticornia sp. aff. Burnerbinmah (inflated fruit)** was recorded from a single location in Abercrombie Creek which drains into Lake Way adjacent to the Centipede and Millipede deposits. The taxonomic identification of this individual as a new species was formalised several months after the completion of the field survey. Known from a single record, the habitat specificity of this taxon is uncertain; however, targeted surveys of similar tributaries around Lake Way may detect additional populations. In her peer review of the botanical survey work and other studies of samphire communities, Bindy Datson concluded that it would be reasonable to expect most Tecticornia species to occur elsewhere in the chain of pans to the south of pans to the south of the project area. This record is close to the southern boundary of the proposed impact area at the Millipede deposit and will be directly impacted by the project. Toro proposes a temporary 50 m exclusion zone around this known individual until further survey work for the species is undertaken.

- **Tecticornia sp. aff. globulifera (small)** was recorded on the edge of the main lake bed at both Lake Way and Lake Maitland, as well as Abercrombie Creek which drains into Lake Way adjacent to the Centipede and Millipede deposits and the chain of salt pans extending to the south of Lake Maitland. It is therefore apparently not restricted to any specific landform or salt lake zonation and additional suitable habitat is likely to exist outside the impact areas.

Of the 13 confirmed individuals, none (0%) will be directly impacted by the project at Millipede, with an additional 5 individuals (38%) within the predicted 0.5 m groundwater drawdown contours. However, this species is not considered to be groundwater dependent and is therefore not expected to be impacted by groundwater drawdown.

- **Tecticornia sp. aff. laevigata (non-rotated fruitlets)** was recorded on the edge of the main lake bed at both Lake Way and Lake Maitland, as well as Abercrombie Creek which drains into Lake Way adjacent to the Centipede and Millipede deposits and the chain of salt pans extending to the south of Lake Maitland. It is therefore apparently not restricted to any specific landform or salt lake zonation and additional suitable habitat is likely to exist outside the impact areas.

Of the 12 confirmed individuals, none (0%) at Lake Maitland will be directly impacted and 6 (50%) are within the predicted 0.5 m groundwater drawdown contours. As this species is not considered to be groundwater dependent it is not expected to be impacted by groundwater drawdown. Any potential impact to individuals of this taxon may not be significant as it is recorded at several locations across both Lake Maitland and Lake Way outside of the direct impact areas, and is apparently not restricted to any specific landform or salt lake zonation, with additional suitable habitat likely to exist outside the project areas.

- **Tecticornia sp. aff. pruinosa (inflated bracts)** was recorded at one location (1 individual) within the main bed of Lake Maitland. Known from a single record, the habitat specificity of this taxon is uncertain, but targeted surveys to the north of Lake Maitland may detect additional populations.

The one confirmed individual will not be directly impacted by the project; however, it is recorded within the predicted 0.5 m groundwater drawdown contours. As this species is not considered to be groundwater dependent it is not expected to be impacted by groundwater drawdown.

- **Tecticornia sp. aff. undulata (broad articles)** was recorded extensively within the main bed of Lake Maitland and the chain of salt pans extending to the south of Lake Maitland. It was also common at the Centipede and Millipede deposits including in Abercrombie Creek (to the west of Millipede deposit) and approximately 5 km south of the Centipede deposit at Lake Way. It is
therefore apparently not restricted to any specific landform or salt lake zonation and additional suitable habitat is likely to exist outside the impact areas.

Of the 25 confirmed individuals, none are within the Lake Maitland impact area and will be directly impacted; however, 11 confirmed individuals (44%) are within the predicted 0.5 m groundwater drawdown contours. As this species is not considered to be groundwater dependent it is not expected to be impacted by groundwater drawdown. Any potential impact to individuals of this taxon may not be significant as it is recorded at numerous locations across both Lake Maitland and Lake Way outside of the direct impact areas, and is apparently not restricted to any specific landform or salt lake zonation with additional suitable habitat likely to exist outside the impact areas.

3.2.2.3 Potentially New Flora Taxa

- ?Tecticornia sp. aff. globulifera (small) was recorded on the main lake bed of Lake Way and in the small chain of salt pans running south from Lake Maitland. Known from only a single record, the habitat specificity of this taxon is uncertain, but targeted surveys at Lake Way and Lake Maitland may detect additional populations.

The single confirmed individual will not be directly impacted by the project; however, at Lake Way it is recorded within the predicted 0.5 m groundwater drawdown contours. As this species is not considered to be groundwater dependent it is not expected to be impacted by groundwater drawdown.

3.2.2.4 Atypical Variants

- Frankenia sp. aff. fecunda (glabrous leaf variant) was recorded over a large distribution at the project area, including the southern end of the Millipede deposit and the southern end of the haul road. It was recorded on low lying saline areas including floodplains and small salt pans. These habitats are not uncommon in the local area and additional suitable habitat is likely to exist at both Lake Way and in the region.

Of the estimated 149 individuals none will be directly impacted by the project, however 20 are within the predicted 0.5 m groundwater drawdown contours and one within the dust deposition zone (14.1%). As this species is not considered to be groundwater dependent it is not expected to be impacted by groundwater drawdown. The potential cumulative impact to 1 (0.7%) individual of this taxon resulting from dust deposition is unlikely to be significant as additional suitable habitat is likely to exist at both Lake Way and in the region.

- Surraya tdiandra was recorded at one location at the southern end of the Lake Maitland deposit within the 0.5 m water drawn down contour on a large floodplain that extends out of the impact areas. As this species is not considered to be groundwater dependent it is not expected to be impacted by groundwater drawdown. Known from a single record, the habitat specificity of this taxon is unclear, but the floodplain that extends outside of the Lake Maitland may yield additional populations.

3.2.2.5 Range Extensions

Eighteen range extensions have also been recorded (Table 3.2) within the disturbance footprint, predicted 0.5 m groundwater drawdown contours or dust deposition zone associated with the project: Acacia brumalis, Cynanchum floribundum, Disphyma crassifolium subsp. clavellatum, Frankenia interioris, Gnephosis angianthoides, Gunniopsis septifraga, Maireana lobiflora, Maireana luehmannii, Murchisonia volubilis, Nicotiana rotundifolia, Paspalidium gracile, Pterocaulous spatchelatum, Ptilotus murrayi, Scaevola tomentosa, Sclerolaena clelandii, Tecticornia tenuis, Thyridolepis xerophila and Trachymene ceratocarpa. As none of these species are considered to be groundwater dependent they are not expected to be impacted by groundwater drawdown.
Two of these taxa are bioregional range extensions and are discussed below.

- *Acacia brumalis* was recorded at three locations at the southern end of Lake Maitland, none of which are within the disturbance footprint. It was recorded on the minor sand dunes that occur between and surrounding the salt lakes, a habitat that occurs extensively surrounding Lake Maitland and therefore considered to have a high likelihood of occurrence outside the project areas.

- *Tecticornia tenuis* is known from approximately 500 km south-west and 1,000 km north-east of the project areas. It represents a significant bridging record from the vouchered specimens at the WAH. It was recorded at three locations at Lake Way on the floodplain to the south of the Millipede deposit which extends well beyond the impact areas and therefore has a high likelihood of occurrence outside the project area. Two confirmed individuals at the project area will be directly impacted; however, these represent only 9% of known individuals when including WAH records.

### 3.2.2.6 Other Tecticornia Taxa

In addition to those *Tecticornia* listed above, 13 *Tecticornia* taxa were also been recorded (Table 3.2). None of these taxa are considered to be endemic to the project areas and have been recorded widespread across Western Australia or the mid-west. Although three (4.9%) of the known individuals of *Tecticornia* sp. Burnerbinmah (D Edinger et al 101) (when including WAH records) will be impacted by the project, it is otherwise widespread across several IBRA regions.
3.2.3 Summary of Impacts to Priority, New and Potentially New Taxa

A summary of indirect and direct cumulative impacts to Priority, new and potentially new flora taxa is provided in Table 3.3 with species where cumulative is greater than 30% shown in Figure 3.4. Five taxa will be directly or indirectly impacted, of which the impacts to only two, *Eremophila pungens* (P4) (37.3%) and new taxa *Tecticornia* sp. aff. Burnerbinmah (inflated fruit) (100%) are potentially greater than 30% of known individuals. However the high percentage impact to *Eremophila pungens* is largely due to the intensive survey effort within the proposed impact area (ie Haul Road) and potential indirect impacts as a result of dust deposition and impacts are unlikely to be significant as it is locally and regionally common across the Gascoyne and Murchison regions and. Toro also proposes a temporary 50 m exclusion zone around this known *Tecticornia* sp. aff. Burnerbinmah (inflated fruit) individual, which is in close proximity to the southern boundary of the proposed impact area at the Millipede Deposit and would be directly impacted by the project, until further survey work for the species is undertaken.

Table 3.3 – Summary of cumulative impacts to Priority, new and potentially new flora taxa

<table>
<thead>
<tr>
<th>Taxa and Status</th>
<th>% impact^</th>
<th>Significance of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Priority 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Eremophila congesta</em></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Tecticornia sp. Sunshine Lake (K.A. Shepherd et al. KS 807)</em></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Priority 3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Eremophila arachnoides subsp. arachnoides</em></td>
<td>17.5%</td>
<td>Widespread locally and regionally across the Murchison &amp; Little Sandy Desert regions. High percentage impact is most likely due to the intensive survey effort within the project area. Unlikely to be a significant impact.</td>
</tr>
<tr>
<td><em>Stackhousia clementii</em></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Tecticornia cymbiformis</em></td>
<td>1.1%</td>
<td>Seems to be locally restricted, but common, to the western edge of the main lake bed at Lake Maitland and at one small salt pan to the west of Lake Maitland. Regionally widespread across the Gascoyne, Murchison and Yalgoo regions. Unlikely to be a significant impact.</td>
</tr>
<tr>
<td><strong>Priority 4</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Eremophila pungens</em></td>
<td>37.3%</td>
<td>Locally and regionally common across the Gascoyne and Murchison regions. High percentage impact is due to the intensive survey effort within the project area. Unlikely to be a significant impact.</td>
</tr>
<tr>
<td><em>Frankenia confusa</em></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>New taxa</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Tecticornia aff. halocnemoides s.l. 'large ovate seed aggregate'</em></td>
<td>25%</td>
<td>Does not appear to be restricted locally as it was recorded at both Lake Way and Lake Maitland across various landform types. High percentage impact is most likely due to the intensive survey effort within the project area. Unlikely to be a significant impact.</td>
</tr>
<tr>
<td><em>Tecticornia aff. halocnemoides s.l. 'tuberulate seed'</em></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Tecticornia sp. aff. Burnerbinmah (inflated fruit)</em></td>
<td>100%</td>
<td>Only one location recorded within the direct impact areas, south of the Millipede Deposit. Potentially significant impact as only one known location. Toro proposes a temporary exclusion zone around this known individual until further research is undertaken.</td>
</tr>
<tr>
<td><em>Tecticornia sp. aff. globulifera</em> (small)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Tecticornia sp. aff. laevigata</em> (non-rotated fruitlets)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Tecticornia sp. aff. pruinosa</em> (inflated bracts)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Tecticornia sp. aff. undulata</em> (broad articles)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Potential new taxa</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Tecticornia sp. aff. globulifera</em> (small)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

^ = direct + indirect (not including water draw down impacts if not considered groundwater dependent, including dust)
Priority flora and new taxa where cumulative impacts may exceed 30% of individuals
3.2.4 Summary of Impacts to Other Significant Flora

A summary of indirect and direct cumulative impacts to range extension, atypical and other Tecticornia flora taxa are listed in Table 3.4. Twenty-three taxa will be directly or indirectly impacted by the project, none of which involve impacts to greater than 30% of known individuals. None of these impacts are considered significant.

Table 3.4 – Summary of cumulative impacts to other significant flora taxa

<table>
<thead>
<tr>
<th>Taxa and Status</th>
<th>% Impact</th>
<th>Significance of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia brumalis</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cynanchum floribundum</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Diaphyema crossifolium subsp. clavellatum&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.2%</td>
<td>No, very widespread regionally. Not significant range extension.</td>
</tr>
<tr>
<td>Frankenia interior&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.2%</td>
<td>No, high likelihood of additional habitat outside impact areas and very widespread regionally.</td>
</tr>
<tr>
<td>Geophria angolitoides&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.3%</td>
<td>No, very widespread regionally. Not significant range extension.</td>
</tr>
<tr>
<td>Gomphopappus setiger&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.6%</td>
<td>No, very widespread regionally. Not significant range extension.</td>
</tr>
<tr>
<td>Maireana labiata&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Maireana lehmanni&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5%</td>
<td>No, very widespread regionally. Is a bridging record between two known populations.</td>
</tr>
<tr>
<td>Murchisonia volubilis&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.1%</td>
<td>No, very widespread regionally. Is a bridging record between two known populations.</td>
</tr>
<tr>
<td>Nicotiana rotundifolia&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.9%</td>
<td>No, very widespread regionally. Not significant range extension.</td>
</tr>
<tr>
<td>Paspalidium gracile&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.2%</td>
<td>No, low total impact.</td>
</tr>
<tr>
<td>Petrorurus sp.&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.4%</td>
<td>No, very widespread regionally. Not significant range extension.</td>
</tr>
<tr>
<td>Pilolus murray&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.2%</td>
<td>No, very widespread regionally. Not significant range extension.</td>
</tr>
<tr>
<td>Scaevola tomentosa</td>
<td>7.9%</td>
<td>No, very widespread regionally. Is a bridging record between two known populations.</td>
</tr>
<tr>
<td>Sclerolaena cleslandi</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia tenuis</td>
<td>9.1%</td>
<td>First record for the Murchison and a bridging record between known populations which are widespread across Western Australia. Likely to occur in other areas of the extensive floodplain to the south of the Millipede Deposit. Unlike to be a significant impact.</td>
</tr>
<tr>
<td>Thyridolepis xerophila</td>
<td>7.1%</td>
<td>No, very widespread regionally. Likely to have additional habitat outside impact areas.</td>
</tr>
<tr>
<td>Trachymene ceratocarpa</td>
<td>4.3%</td>
<td>No, very widespread regionally. Likely to have additional habitat outside impact areas.</td>
</tr>
<tr>
<td>Other Tecticornia taxa</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia calyptra</td>
<td>3.1%</td>
<td>No, widespread regionally. Recorded at both Lake Way and Lake Maitland.</td>
</tr>
<tr>
<td>Tecticornia disrotulata</td>
<td>2%</td>
<td>No, very widespread regionally.</td>
</tr>
<tr>
<td>Tecticornia doleformis</td>
<td>-</td>
<td>No, very widespread regionally. Recorded at both Lake Way and Lake Maitland.</td>
</tr>
<tr>
<td>Tecticornia indica</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia indica subsp. bidens</td>
<td>0.5%</td>
<td>No, very widespread regionally. Recorded very commonly at both Lake Way and Lake Maitland.</td>
</tr>
<tr>
<td>Tecticornia indica subsp. leichtercha</td>
<td>2.6%</td>
<td>No, very widespread regionally. Recorded very commonly at both Lake Way and Lake Maitland.</td>
</tr>
<tr>
<td>Tecticornia lavoigata</td>
<td>1.0%</td>
<td>No, very widespread regionally. Recorded very commonly at both Lake Way and Lake Maitland.</td>
</tr>
<tr>
<td>Tecticornia pellata</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia pergranulata</td>
<td>0.4%</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia pruinosa</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia pterygosperma subsp. denticulata</td>
<td>1%</td>
<td>-</td>
</tr>
<tr>
<td>Tecticornia sp. Burnerbinnham</td>
<td>4.3%</td>
<td>No, very widespread regionally. Recorded very commonly at both Lake Way and Lake Maitland.</td>
</tr>
<tr>
<td>Tecticornia tetragonophylla</td>
<td>6.7%</td>
<td>No, very widespread regionally. Recorded very commonly at both Lake Way and Lake Maitland.</td>
</tr>
</tbody>
</table>

<sup>a</sup> = direct + indirect (not including water draw down impacts if not considered groundwater dependent, including dust)

3.3 VEGETATION

A total of 28 vegetation units (including one combined Tecticornia dominated unit (TECT)) have been consolidated and mapped within the project areas (ecologia 2015b). Vegetation units are described in Table 3.5, an overview map is shown in Figure 3. and the mapping is provided in Appendix B.

Table 3.5 – Vegetation unit descriptions

<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>Acacia tetragonophylla sparse tall shrubland, over Senoa artemisioides and Ptilotus obovatus sparse low shrubland</td>
</tr>
<tr>
<td>AB</td>
<td>Acacia tetragonophylla, Acacia victoriae and Ptilotus obovatus sparse low shrubland</td>
</tr>
<tr>
<td>AC</td>
<td>Eucalyptus camaldulensis subsp. obtusa sparse low woodland, over Acacia aptaneura and Acacia tetragonophylla sparse tall shrubland, over Eremophila longifolia, Senoa artemisioides and Scaevola spinescens sparse mid shrubland</td>
</tr>
<tr>
<td>BA</td>
<td>Acacia aneura/aptaneura sparse low woodland, over Acacia tetragonophylla (+/- Melaleuca hamata) sparse tall shrubland, over Senoa artemisioides, Scaevola spinescens and Rhagodia drummondii sparse mid shrubland, over Ptilotus obovatus, Maireana villosa, Sclerolaena dianca and Cratystylis subspinescens sparse low shrubland</td>
</tr>
</tbody>
</table>
**Toro Energy Limited – Extension to the Wiluna Uranium Project**

**Cumulative Impact Assessment**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB</td>
<td>Casuarina pauper open low woodland, over Eremophila pantonii, Eremophila longifolia and Eremophila latrobei sparse mid shrubland, over Scaevola spiniscens, Exacarpus aphyllus, Rhagodia drummondii and Pitulat obovatus sparse low shrubland</td>
</tr>
<tr>
<td>BC</td>
<td>Scaevola spiniscens, Eremophila malacoides, Rhagodia drummondii, Maiarena villosa and Eremophila globra sparse low shrubland, over Enteropogon ramosus sparse tussock grassland</td>
</tr>
<tr>
<td>BD</td>
<td>Acacia aneura/aptaneura sparse low woodland, over Maiarena pyramidata, Maiarena triptera and Atriplex bunburyana open low shrubland</td>
</tr>
<tr>
<td>CA</td>
<td>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</td>
</tr>
<tr>
<td>CB</td>
<td>Acacia aneura/aptaneura open low woodland, over Acacia burkittii and Acacia tetragonaphylla sparse tall shrubland, over Senna artemisioides x artemisioides, Senna glaucifolia and Eremophila galeata open mid shrubland, over Aristida contorta open tussock grassland</td>
</tr>
<tr>
<td>CC</td>
<td>Acacia pteraneura/macraneeura isolated low trees, over Eremophila galeata, Senna artemisioides and Sida ectogama sparse mid shrubland, over Eragrostis eriopoda and Monachather paradoxus open tussock grassland</td>
</tr>
<tr>
<td>CD</td>
<td>Acacia aneura/aptaneura, Acacia pteraneura/macraneeura and Acacia craspedocarpa low woodland, over Eremophila gileisi, 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</td>
</tr>
<tr>
<td>D</td>
<td>Acacia aneura/aptaneura/ayersiana/caesaneura open low woodland (+/-) Acacia tetragonaphylla 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</td>
</tr>
<tr>
<td>E</td>
<td>Acacia aneura/aptaneura/ayersiana/caesaneura (+/-) Eucalyptus glyptopha sparse low woodland, over Acacia nyssophylla, Eremophila arachnoide subsp. arachnoide and Acacia victoriae sparse mid to tall shrubland, over Pitulat obovatus, Sclerolaena obliquicuspis and Rhagodia eremaea sparse low shrubland, over Eragrostis eriopoda sparse tussock grassland</td>
</tr>
<tr>
<td>F</td>
<td>+/- Acacia victoriae and/or Melaleuca interios sparse tall shrubland, over Eremophila glabra, Scaevola spiniscens, Rhagodia eremaea and Lycium austral sparse low shrubland</td>
</tr>
<tr>
<td>G</td>
<td>Acacia incurnvaneura woodland (+/-) Acacia craspedocarpa and Acacia ramulosa var. linophylla), over Eremophila maculata and Scaevola spiniscens shrubland over Triodia melvillei open hummock grassland</td>
</tr>
<tr>
<td>H</td>
<td>+/- Eucalyptus stratioclyx 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</td>
</tr>
<tr>
<td>I</td>
<td>+/- Acacia aneura/aptaneura isolated low trees, over Lycium austral, Rhagodia drummondii, Frankenia pauciflora sens. lat. and Lawrencia squamata open low shrubland</td>
</tr>
<tr>
<td>J</td>
<td>+/- Casuarina pauper sparse low woodland, over Atriplex bunburyana, Lycium austral, Lawrencia squamata and Pitulat obovatus sparse low to mid shrubland, over Eragrostis setifolia sparse tussock grassland</td>
</tr>
<tr>
<td>K</td>
<td>Casuarina obesa open low woodland, over Acacia nyssophylla sparse tall shrubland, over Lycium austral and Sclerolaena fimbrillata sparse low shrubland</td>
</tr>
<tr>
<td>L</td>
<td>+/- Acacia aneura/aptaneura and Hakea lorea subsp. lorea isolated low trees, over Alyogyne pinioniana, Androcalava loxophylla, Solanum coactileferum and Leptosema chambersii sparse low shrubland, over Triodia basedowi open hummock grassland and Eragrostis eriopoda sparse tussock grassland</td>
</tr>
<tr>
<td>M</td>
<td>Acacia aneura/aptaneura (+/-) Acacia ayersiana/caesaneura open low woodland, over Eremophila forrestii, Eremophila spectabilis subsp. brevis open mid shrubland, over Triodia basedowi open hummock grassland and Eragrostis eriopoda and Monachather paradoxus sparse tussock grassland</td>
</tr>
<tr>
<td>N</td>
<td>Acacia ayersiana/caesaneura open low woodland (+/-) Acacia aneura/aptaneura and Eucalyptus eremicola subsp. peeneri) open low woodland, over +/- Melaleuca interios sparse tall shrubland, over Triodia basedowi open hummock grassland and Eragrostis eriopoda sparse tussock grassland</td>
</tr>
<tr>
<td>O</td>
<td>Acacia ayersiana/caesaneura open low woodland (+/- Eucalyptus eremicola subsp. peeneri) open low woodland, over Triodia melvillei open hummock grassland</td>
</tr>
<tr>
<td>P</td>
<td>+/- Acacia ayersiana/caesaneura (+/-) Eucalyptus eremicola subsp. peeneri and Eucalyptus kingsmillii) sparse low woodland, over Acacia ligulata and Acacia jamesiana sparse mid shrubland, over Haigania cyannea sparse low shrubs, over Triodia basedowi open hummock grassland</td>
</tr>
<tr>
<td>Q</td>
<td>Callitris columellaris sparse tall shrubland, over Triodia melvillei open hummock grassland</td>
</tr>
<tr>
<td>R</td>
<td>Melaleuca xerophila open tall shrubland, over Muellerolimon salicorniaceum sparse low shrubland, over Eragrostis eriopoda sparse tussock grassland</td>
</tr>
<tr>
<td>W</td>
<td>Eucalyptus striatallyx sparse low woodland, over Grevillea sarissa sparse tall shrubland, over Lawrencia helmsii sparse low shrubland</td>
</tr>
</tbody>
</table>
### 3.3.1 Tecticornia Dominated Vegetation

During the vegetation consolidation conducted by ecologia (2015b) all Tecticornia species were combined as single Tecticornia-dominated units for both Lake Way and Lake Maitland on the basis of the lack of taxonomic clarification of the genera and high variation of terminology between projects. This resulted in four very broad Tecticornia communities that were delineated from the statistical analysis of floristic data (S, T, U and V) being combined into a single Tecticornia-dominated vegetation unit (TECT) at both Lake Way and Lake Maitland.

To clarify these communities, ecologia (2015a) undertook an assessment of Tecticornia dominated vegetation at the Millipede and Lake Maitland deposits. As recommended by Actis (2012) and the OEPA, 3 x 3 m quadrats were surveyed along transects from the terrestrial vegetation adjacent to the lake, across the lake fringe profile.

Multivariate analysis was conducted using the site by species matrix from the quadrats completed during the field survey. The resultant vegetation units tended to vary considerably among transects, and many vegetation units were not restricted to any one recognisable zone across the lake profile (e.g. upper, mid, or lower zones). Moreover, there was no consistent relationship between the floristic vegetation units delineated and patterns observed in the aerial photography, which was most likely due to the small quadrat size, making mapping of these individual vegetation units impractical.

As a consequence, the Tecticornia communities presented for this impact assessment have been combined into a single unit per lake (Table 3.5), and the extent of Tecticornia dominated communities present at both Lake Way and Lake Maitland have been mapped (Figure 3. and Figure 3. respectively).

### 3.3.2 Groundwater Dependent Vegetation

Indirect impacts from water draw down are calculated for each vegetation unit as a precautionary approach, however vegetation unit AC is the only unit which contains known phreatophytic species (i.e. Eucalyptus camaldulensis), so indirect impacts from groundwater drawdown are not considered likely for vegetation units other than AC, including Tecticornia-dominated vegetation as discussed in ecologia (2016).
Figure B.1

Figure B.2

Figure B.3

Figure B.4

Figure B.5

Figure B.6

Figure B.7

Figure B.8

Figure B.9

Figure B.10

Legend

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope
Groundwater Drawdown (0.5m)

Vegetation units - overview map

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

Figure: 3.5
Project ID: 1631
Drawn: MY
Date: 15/04/2015

Absolute Scale - 1:450,000
**Legend**

- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

**Direct Impacts**
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

**Indirect Impacts**
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

*Tecticornia* dominated vegetation at Lake Way

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure: 3.6

Project ID: 1631

Drawn: MY

Date: 15/04/2015

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

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope
Direct Impacts
Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area
Indirect Impacts
Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)
Tecticornia Dominated Vegetation
Lake Maitland

Figure: 3.7
Project ID: 1631
Drawn: MY
Date: 15/04/2015

Tecticornia dominated vegetation at Lake Maitland

Absolute Scale - 1:240,000
3.3.3 Discussion of Impacts

The impacts of the Wiluna Uranium Project and the Extension to the Wiluna Uranium Project to vegetation are outlined in Table 3.6.

All but four vegetation units have less than 30% of their total mapped extent impacted (see Table 3.6, Figure 3.8). These are discussed below.

- CA (10.8 ha, 31.2%) and CC (39.6 ha, 32.4%): these units are associated with the small rocky hill that the haul road passes through (Appendix B, Figure B.6). These units are part of a hill that extends for at least 4,000 ha outside of the project area and therefore this high cumulative impact percentage is likely due to the narrowly mapped project area, and sampling in adjacent areas would likely reduce the proportional impact considerably.

- R (124.8 ha, 30.9%): unit R is associated with small bands of fringing salt lake vegetation at the Millipede, Centipede and Lake Way Deposits. Therefore this habitat is likely to be common in the local area, but only in small extents.

- AC (2,164.9 ha, 31.1%): unit 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) is likely to be groundwater dependent due to the occurrence of Eucalyptus camaldulensis and therefore calculations include impacts from water draw down. Only 2.5 ha will be directly impacted. The impact percentage for AC has been based on additional mapping of the watercourse to the west of the project areas.

The cumulative impacts to Tecticornia dominated vegetation at Lake Way and Lake Maitland are 791.2 ha (6.9%) and 563.2 ha (9.8%) respectively. If groundwater drawdown (0.5m contour) is considered, the impact calculations are 1,861.3 ha (16.3%) and 2,169.6 ha (37.8%) respectively, however there is no evidence to demonstrate that these units are groundwater dependent.
Vegetation units where cumulative impacts may exceed 30% of the mapped extent
<table>
<thead>
<tr>
<th>Taxon</th>
<th>Total Mapped Extent</th>
<th>Development Envelope</th>
<th>Direct Impact</th>
<th>Indirect Impact</th>
<th>Direct and Indirect Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Millpa UML</td>
<td>Ha</td>
<td>Ha</td>
<td>%</td>
<td>Ha</td>
</tr>
<tr>
<td>AA</td>
<td>3,070.2</td>
<td>-</td>
<td>201.9</td>
<td>-</td>
<td>194.2</td>
</tr>
<tr>
<td>AB</td>
<td>1,512.1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AC</td>
<td>6,969.2</td>
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<td>-</td>
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<tr>
<td>BA</td>
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</tr>
<tr>
<td>BB</td>
<td>1,376.4</td>
<td>23.5</td>
<td>101.2</td>
<td>0.3</td>
<td>26.8</td>
</tr>
<tr>
<td>BC</td>
<td>70.2</td>
<td>0.001</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CA</td>
<td>34.6</td>
<td>-</td>
<td>4.7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CB</td>
<td>6.6</td>
<td>-</td>
<td>-</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>CC</td>
<td>122.2</td>
<td>17.1</td>
<td>-</td>
<td>13.7</td>
<td>13.5</td>
</tr>
<tr>
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<td>-</td>
<td>2.5</td>
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</tr>
<tr>
<td>D</td>
<td>9,335.4</td>
<td>1.7</td>
<td>-</td>
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</tr>
<tr>
<td>E</td>
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<td>-</td>
<td>0.1</td>
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</tr>
<tr>
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<td>-</td>
<td>8.3</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
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<td>91.0</td>
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<td>-</td>
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<tr>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>0.7</td>
</tr>
<tr>
<td>I</td>
<td>563.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>139.9</td>
</tr>
<tr>
<td>J</td>
<td>697.6</td>
<td>125.9</td>
<td>1</td>
<td>34.2</td>
<td>34.9</td>
</tr>
<tr>
<td>K</td>
<td>19.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>19.7</td>
</tr>
<tr>
<td>L</td>
<td>5,827.5</td>
<td>-</td>
<td>40.3</td>
<td>9.6</td>
<td>63.2</td>
</tr>
<tr>
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<td>-</td>
<td>10.3</td>
<td>132.6</td>
</tr>
<tr>
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<td>17.5</td>
<td>13.4</td>
<td>5.3</td>
<td>23.7</td>
</tr>
<tr>
<td>O</td>
<td>4,807.7</td>
<td>305.7</td>
<td>-</td>
<td>226.1</td>
<td>226.1</td>
</tr>
<tr>
<td>P</td>
<td>1,234.4</td>
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<td>52.7</td>
<td>200</td>
<td>42.3</td>
</tr>
<tr>
<td>Q</td>
<td>315.1</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>R</td>
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<td>77</td>
<td>-</td>
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<td>222.0</td>
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<td>154.5</td>
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</tr>
<tr>
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<td>Salt Pan</td>
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<td>-</td>
<td>-</td>
<td>55.5</td>
</tr>
</tbody>
</table>

Note there may be minor discrepancies in totals due to rounding and GIS calculations. ^ = mapping extrapolated to an area of wider interest, * = bare salt pan excluded from direct impact calculations.
4 VERTEBRATE FAUNA

4.1 SOURCES OF INFORMATION
The vertebrate fauna assemblage and fauna habitats of the project areas have been assessed in several previous vertebrate fauna assessments. Assessments interrogated for the current cumulative impact assessment included:

- ecologia (2015c): Lake Maitland Level 2 Vertebrate Fauna & Targeted Reptile Survey; and

Fauna habitat mapping has been completed for the Lake Way and Centipede areas (Outback Ecology 2011b), the Millipede to Lake Maitland haul road (ecologia 2015d) and Lake Maitland area (ecologia 2015c). Mapping of habitat types for the haul roads linking the existing Wiluna Project areas has been extrapolated using high resolution aerial imagery.

4.2 SIGNIFICANT FAUNA

4.2.1 Background
Five fauna species of conservation significance have been recorded within the development envelope. These are listed below and shown mapped on Figure 4.1.

- Sharp-tailed Sandpiper (*Calidris acuminata*; EPBC Act Migratory, WC Act Schedule 3);
- Rainbow Bee-eater (*Merops ornatus*; EPBC Act Migratory, WC Act Schedule 3);
- Peregrine Falcon (*Falco peregrinus*; WC Act Schedule 4);
- Brush-tailed Mulgara (*Dasycercus blythi*; DPaW Priority 4); and
- Australian Bustard (*Ardeotis australis*; DPaW Priority 4).

4.2.2 Discussion of Impacts
All species recorded within the development envelope are known to be widely distributed outside the study area. Two known locations of these species will be impacted: the Australian Bustard, one location at Lake Maitland or 6.6% of the known records in the area and the Sharp-tailed Sandpiper, one location at the Centipede Deposit which represents the only known record in the area, although this was an estimated location.
4.3 FAUNA HABITATS

4.3.1 Background

A total of 11 broad-scale fauna habitat types have been identified across the project areas for the purposes of this assessment. Each of these habitat types are described in more detail below. The habitat types have been synthesised from aerial photography and existing habitat mapping of the study area, as outlined above; the corresponding habitat types as listed in previous reports are also included within the descriptions below. Area calculations for habitats are shown in Table 4.1 and habitat types and survey effort are mapped in Figure 4.13 to Figure 4.14.

4.3.1.1 Low halophytic shrubland

The low halophytic shrubland habitat type is the most extensive habitat by area across the project areas. It is characterised by low, moderately open shrubland of chenopods such as *Maireana* and *Tecticornia* on clay flats, interspersed in some areas by low sandy dunes with an open cover of *Lawrencia* shrubland (Figure 4.2). This habitat type occurs primarily in association with the Lake Way and Lake Maitland, or smaller claypan areas.

After rainfall, some areas within this habitat type flood, creating wetland habitat suitable for migratory-listed waders including the Sharp-tailed Sandpiper. It also provides potentially suitable foraging habitat for Grey and Peregrine Falcons, and the Australian Bustard.

The low halophytic shrubland habitat type encompasses the following previously-mapped habitat types:

- Low halophytic shrubland (*ecologia* 2015d, c);
- Claypan; chenopod floodplain; samphire flats (*Outback Ecology* 2011a); and

4.3.1.2 Mallee/Mulga over spinifex sandplain

The Mallee/Mulga over spinifex sandplain habitat type occurs widely across the project areas, and is the second most extensive habitat type within the study area by area. It is characterised by open mixed woodland of mallee (*Eucalyptus* sp.) and Mulga (*Acacia aneura*), over an open mid-storey of *Acacia* shrubs and ground cover of open spinifex (*Triodia basedowii*) on an orange sandy clay substrate (Figure 4.3). Leaf and wood litter is abundant at the base of mallees, but sparse elsewhere (*ecologia* 2015c).

The sandy substrate within this habitat type is suitable for burrowing by Brush-tailed Mulgara and Rainbow Bee-eater, while it provides suitable foraging habitat for Grey and Peregrine Falcon, and Australian Bustard.

The mallee/Mulga over spinifex sandplain habitat type encompasses the following previously-mapped habitat types:
• Mallee/Mulga woodland over spinifex plain (*ecologia* 2015c);
• Mallee/Mulga over spinifex sandplain (*ecologia* 2015d);
• Mallee/Mulga complex over spinifex (Outback Ecology 2011a); and
• Woodland over sand plain (Outback Ecology 2012).

### 4.3.1.3 Woodland/shrubland over calcrete

The woodland/shrubland over calcrete habitat type encompasses a variety of *Eucalyptus, Acacia, Allocasuarina* and *Melaleuca* over an open shrub and ground cover layer an open shrub and ground cover layer including a mixture of *Acacia, Melaleuca, Triodia, Eremophila, Ptilotus* and *Solanum*. The substrate is clay or sandy clay, with varying levels of calcrete scattered throughout (Figure 4.4). Leaf-litter occurs under trees and shrubs, while wood-litter is moderate (Outback Ecology 2011b; *ecologia* 2015c).

This habitat type provides potential breeding habitat for Grey and Peregrine Falcons in areas where taller trees are present, as well as suitable habitat for Australian Bustard, and foraging habitat for Rainbow Bee-eater.

The woodland/shrubland over calcrete habitat type encompasses the following previously-mapped habitat types:

- Woodland on calcrete plain (*ecologia* 2015c);
- *Melaleuca* over calcrete flats (*ecologia* 2015d);
- *Melaleuca* stands; *Acacia victoriae* shrubland over calcrete; eucalypt woodland (Outback Ecology 2011a); and
- Woodland over calcrete plain (Outback Ecology 2012).
4.3.1.4 Mulga over sandplain

The Mulga over sandplain habitat type occurs widely over the project areas, and is characterised by open Mulga (Acacia aneura complex) woodland over sparse shrubland, with a scattered ground covering of Triodia sp., chenopods and tussock grasses on sandy loam or sandy clay (Figure 4.5). Leaf litter is present under trees and shrubs, while wood litter is mostly sparse (Outback Ecology 2011b; ecologia 2015d).

The Mulga over sandplain habitat type provides suitable foraging habitat for Peregrine and Grey Falcon, Australian Bustard, Rainbow Bee-eater and Brush-tailed Mulgara.

The Mulga over sandplain habitat type encompasses the following previously-mapped habitat types:

- Mulga woodland (ecologia 2015c);
- Mulga over spinifex sandplain (ecologia 2015d); and
- Open Mulga woodland over spinifex on hardpan, open Mulga woodland over spinifex, Mulga woodland over chenopod shrubland (Outback Ecology 2011a).

4.3.1.5 Open plain

The open plain habitat type occurs primarily within the Lake Maitland project area, and is characterised by flat plains of orange clay interspersed with calcrete. The habitat is very open, with a very low ground cover of native grasses and some chenopods, with sparse shrubs and low trees occurring as lone plants or occasionally in small, isolated stands (Figure 4.6). Leaf and wood litter is sparse and restricted to the base of trees and shrubs (ecologia 2015c).

The open plain habitat type provides suitable breeding habitat for the Australian Bustard as well as suitable foraging habitat for Peregrine and Grey Falcon, and Rainbow Bee-eater.

The open plain habitat type encompasses the following previously-mapped habitat types:

- Open calcrete plain (ecologia 2015c); and
- Calcrete plain (Outback Ecology 2012).
4.3.1.6 Mulga over stony plain

The Mulga over stony ground habitat type occurs widely across the project areas and is characterised by sparse *Acacia aneura*-complex woodland over open shrubland of *Eremophila* sp., and *Acacia* sp., with open *Aristida contorta*, *Enneapogon caerulescens*, *Eragrostis eriopoda*, *Monachather paradoxus* and *Eriachne* sp. tussock grassland. The soil substrate consists of a firm brownish sandy-clay or clay-loam interspersed with stones or rocky ground (Figure 4.7). Leaf-litter is found only under trees and shrubs, and wood-litter is generally sparse to moderate (Outback Ecology 2011b; *ecologia* 2015d).

The Mulga over stony ground habitat type provides suitable habitat for the Australian Bustard, and suitable foraging habitat for Rainbow Bee-eater, and Peregrine and Grey Falcon.

The Mulga over stony ground habitat type encompasses the following previously-mapped habitat types:

- Mulga over stony tussock grassland (*ecologia* 2015d); and
- Mulga over quartz loam, Mulga over calcrete (Outback Ecology 2011a).

4.3.1.7 Bare salt lake

The bare salt lake habitat type occurs at the Lake Way, Centipede East and Millipede project areas. It is characterised by bare ground on the Lake Way lake bed (Figure 4.8). No vegetation is present, so leaf and wood litter is also absent (Outback Ecology 2011a).

After rainfall, some areas within this habitat type may flood, creating suitable habitat for migratory-listed waders including the Sharp-tailed Sandpiper. At such times, it also provides suitable foraging habitat for Grey and Peregrine Falcons.

The bare salt lake habitat type encompasses the following previously-mapped habitat types

- Salt lake (Outback Ecology 2011a).
4.3.1.8 Spinifex sand dune

The spinifex sand dune habitat type occurs around the margins of both Lake Way and Lake Maitland. It is characterised by dense hummocks of *Triodia* sp. with scattered trees and shrubs on sand or sandy clay, often on raised sand dunes (Figure 4.9). Leaf and wood litter is present but limited to under trees and shrubs (Outback Ecology 2011b; *ecologia* 2015c).

The spinifex sand dune habitat type provides suitable habitat for Brush-tailed Mulgara, potential breeding habitat for the Rainbow Bee-eater, and potentially suitable foraging habitat for Grey and Peregrine Falcon, and Australian Bustard. The habitat type is also likely to be restricted in occurrence within the wider area as it is specifically associated with lake edges (Outback Ecology 2011a). It also contains particularly old and mature stands of spinifex which form tall, extensive and continuous hummocks; such mature spinifex stands are not common within the region (*ecologia* 2015c).

The spinifex sand dune habitat type encompasses the following previously-mapped habitat types:

- *Triodia plurinervata* on lake edge (*ecologia* 2015c);
- Red sand dune (Outback Ecology 2011a);
- Spinifex sand plain (Outback Ecology 2012); and

4.3.1.9 Spinifex sand plain

The spinifex sand plain habitat type occurs in patches to the north-east of Lake Maitland and west of Lake Way. It is characterised by moderately dense hummock grassland of *Triodia basedowii* with an open shrub layer of *Acacia* spp. and scattered mallee on clay-sand (Figure 4.10). Leaf litter is sparse, and largely restricted to the base of trees and shrubs (*ecologia* 2015c).

The spinifex sandplain habitat type provides suitable habitat for the Brush-tailed Mulgara, potential breeding habitat for the Rainbow Bee-eater, and potentially suitable foraging habitat for Grey and Peregrine Falcon, and Australian Bustard.

The spinifex sandplain habitat type encompasses the following previously-mapped habitat types:

- Open spinifex sandplain (*ecologia* 2015c).
4.3.1.10 Kopi dune

The kopi dune habitat type occurs around the margins of Lake Maitland. It is characterised by raised ridges of gypsum supporting low open eucalypt woodland with a sparse understory of *Grevillea*, *Lawrencea* and herbs and grasses (Figure 4.11). Beds of leaf and wood litter are present around the base of eucalypts (*ecologia* 2015c).

The taller eucalypts within this habitat type may provide suitable breeding habitat for Grey or Peregrine Falcon. The kopi dune habitat type also provides suitable foraging habitat for the Rainbow Bee-eater and Australian Bustard.

The kopi dune habitat type encompasses the following previously-mapped habitat types:

- Kopi dune (*ecologia* 2015c);
- Mosaic of Kopi dune and samphire flat (Outback Ecology 2012); and
- Kopi dune (Outback Ecology 2012).

4.3.1.11 Stony hills and footslopes

The stony hills and footslopes habitat type occurs within the proposed haul road between Lake Way and Lake Maitland, occupying an area of 79.4 ha. This habitat type is characterised by sparse Mulga (*Acacia aneura* complex) and *Eremophila forrestii* shrubland over open *Aristida contorta* tussock grassland on firm sandy-clay, with continuous quartz pebbles, as well as larger stones and boulders (Figure 4.12). Leaf-litter is dense under patches of *Acacia*, while wood-litter is moderate (*ecologia* 2015d).

The stony hills and footslopes habitat type is likely to provide suitable habitat for the Australian Bustard and potentially suitable foraging habitat for Grey and Peregrine Falcons and Rainbow Bee-eater. The stony hills and footslopes habitat type encompasses the following previously-mapped habitat types:

- Stony hills and footslopes (*ecologia* 2015d).
Fauna habitats and sample sites
Map 1 of 4
Level 2 survey effort (scaled to deposit areas)

Legend
- Systematic trap site
- Diurnal search
- Nocturnal search
- Additional bird survey
- Camera trap
- Additional bat recording

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Re-injection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Fauna Habitats
- Bare salt lake
- Kopi dune
- Low halophytic shrubland
- Mallee/mulga woodland over spinifex sandplain
- Mulga over sandplain
- Mulga over stony ground
- Open plain
- Spinifex sand dune
- Spinifex sandplain
- Stony hills and foot slopes
- Woodland/shrubland over calcrete

Figure: 4.13
Project ID: 1631
Date: 15/04/2015

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994
Legend
- Systematic trap site
- Diurnal search
- Camera trap
- Additional bat recording

Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Fauna Habitats
- Bare salt lake
- Kopi dune
- Low halophytic shrubland
- Mulga/mulga woodland over spinifex sandplain
- Mulga over sandplain
- Mulga over stony ground
- Open plain
- Spinifex sand dune
- Spinifex sandplain
- Stony hills and foothills
- Woodland/shrubland over calcrete

Fauna habitats and sample sites
Map 2 of 4
Level 2 survey effort (scaled to haul road)

Figure: 4.14
Project ID: 1631
Drawn: MY
Date: 15/04/2015

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

Absolute Scale -  1:255,000
Fauna habitats and sample sites

Map 3 of 4

Level 1 survey effort

Legend

- Diurnal search
- Camera trap
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Fauna Habitats
- Bare salt lake
- Kopi dune
- Low halophytic shrubland
- Mallee/mulga woodland over spinifex sandplain
- Mulga over sandplain
- Mulga over stony ground
- Open plain
- Spinifex sand dune
- Spinifex sandplain
- Stony hills and footslopes
- Woodland/shrubland over calcrete

Figure: 4.15
Project ID: 1631
Drawn: MY
Date: 15/04/2015

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994
Fauna habitats and sample sites

Map 4 of 4

Targeted survey effort (in addition to targeted components of Level 2s)

Legend

- Targeted Mulgara trapping
- Targeted Night Parrot SM2
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts

- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts

- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Fauna Habitats

- Bare salt lake
- Kopi dune
- Low halophytic shrubland
- Mallee/mulga woodland over spinifex sandplain
- Mulga over sandplain
- Mulga over stony ground
- Open plain
- Spinifex sand dune
- Spinifex sandplain
- Stony hills and footslopes
- Woodland/shrubland over calcrete

Coordinate System

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

Figure: 4.16
Project ID: 1631
Drawn: MY
Date: 15/04/2015

Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit
4.3.2 Discussion of Impacts

Of the eleven fauna habitats that will be impacted by the project, none are proposed to have greater than 30% of their known mapped extent within the project areas directly impacted (Table 4.1).

Table 4.1 – Fauna habitat cumulative direct impacts

<table>
<thead>
<tr>
<th>Fauna Habitat</th>
<th>Development Envelope</th>
<th>Direct Impact</th>
<th>Wiluna Uranium Project Total</th>
<th>Cumulative Direct Total</th>
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<tbody>
<tr>
<td></td>
<td>Total Mapped Extent*</td>
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<td>Extension to the Wiluna Uranium Project</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ha</td>
<td>Direct Total</td>
<td>ha</td>
<td>ha</td>
</tr>
<tr>
<td>Low halophytic shrubland</td>
<td>17,173.7</td>
<td></td>
<td>143.9</td>
<td>0.2</td>
</tr>
<tr>
<td>Mulga/mulga woodland over spinifex sandplain</td>
<td>2,545.7</td>
<td></td>
<td>264.0</td>
<td>2.2</td>
</tr>
<tr>
<td>Mulga over sandplain</td>
<td>1,563.0</td>
<td></td>
<td>66.3</td>
<td>-</td>
</tr>
<tr>
<td>Mulga over stony ground</td>
<td>912.7</td>
<td></td>
<td>108.2</td>
<td>55.2</td>
</tr>
<tr>
<td>Woodland/shrubland over calcrete</td>
<td>2,022.8</td>
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<td>21.4</td>
<td>16.1</td>
</tr>
<tr>
<td>Bare salt lake</td>
<td>718.4</td>
<td></td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>Open plan</td>
<td>919.6</td>
<td></td>
<td>66.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Spinifex sand dune</td>
<td>497.2</td>
<td></td>
<td>9.6</td>
<td>0.3</td>
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<tr>
<td>Spinifex sandplain</td>
<td>172.8</td>
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<td>1.6</td>
<td>9.0</td>
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<tr>
<td>Kopi dune</td>
<td>91.8</td>
<td></td>
<td>12.1</td>
<td>-</td>
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<td>Stony hills and footslopes</td>
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<td>Total</td>
<td>-</td>
<td>739.0</td>
<td>2,824.0</td>
<td>23.0</td>
</tr>
</tbody>
</table>

Note there may be minor discrepancies in totals due to rounding and GIS calculations. * = from consolidation of habitat mapping completed for reports listed in section 4.1.
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5 SHORT RANGE ENDEMIC INVERTEBRATE FAUNA

5.1 SOURCES OF INFORMATION

Reports used for this Short Range Endemic (SRE) cumulative impact assessment include:

- Outback Ecology (2011b): Lake Maitland Terrestrial Fauna Habitat Assessment – Borefield, Accommodation Camp, and Access Route; and

Given the ongoing development of SRE species systematics in WA, taxonomic experts (see Table 5.1) have been consulted to ensure the currency of the resulting list of SRE species. Categories of SRE habitat are consistent with those identified for vertebrate fauna, which have been revised from previous assessments to unify terminology and thus enable comparison between the Wiluna Uranium Project and the Wiluna Extension Project (Section 4.2).

Table 5.1 – Taxonomic experts consulted for invertebrate SREs

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Volker Framenau</td>
<td>Phoenix Environmental</td>
<td>Spiders</td>
</tr>
<tr>
<td>Dr Erich Volschenk</td>
<td>Scorpion ID</td>
<td>Scorpions</td>
</tr>
<tr>
<td>Dr Simon Judd</td>
<td>Phoenix Environmental</td>
<td>Slaters</td>
</tr>
</tbody>
</table>

5.1.1 Background

A total of 21 potential and one confirmed SRE species have been recorded in the project areas. Twelve species have been renamed or had their SRE status changed since previous SRE sampling in 2012, which reflects:

- Change in SRE categories used by Western Australian Museum (WAM) – three species;
- Loss of SRE status due to new taxonomic evidence – two species; and
- Gain and/or change in SRE status due to new taxonomic evidence – seven species.

The current status of all SRE species previously recorded is provided in Table 5.2. Seven of the 11 identified habitats have SRE species recorded within them. Some habitats have more SRE species recorded, and in higher abundance than others (Table 5.3). For example, the habitat ‘Woodland/shrubland over calcrete’ has 10 SRE species recorded, ‘Spinifex sandplain’ has eight species and ‘Low halophytic shrubland’ has five species. Five potential SRE species have been recorded only within the development envelope, these species being:

- Aname ‘MYG227’;
- Buddelundia ’46’;
- Lychas ‘annulatus’;
- Spherillo sp. indet. (Lake Maitland 1); and
- Urodacus sp.

These species are discussed in further detail in Section 5.1.2. One confirmed SRE species, Armadillidae 'reduropoda1' is represented by only a single specimen from a single location, within close proximity (approximately 60 m) to the development envelope. This species is discussed in further detail in Section 5.1.2.5.
Table 5.2 – Taxonomic review and current status of all previously recorded SRE species

<table>
<thead>
<tr>
<th>Current name</th>
<th>Previous name</th>
<th>Previous status</th>
<th>Current status</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arachnida – Mygalomorphae (Spiders)</td>
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<tr>
<td>Aganippe sp.</td>
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<td>Potential SRE</td>
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<td>&quot;NAME 'MYG176'&quot;</td>
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<td>Potential SRE</td>
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<td>&quot;NAME 'MYG177'&quot;</td>
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<td>Potential SRE</td>
<td>Evidence from taxonomic expert (V. Framenau, pers. comm.), new genetic evidence from Castalanelli et al. 2015</td>
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<tr>
<td>&quot;NAME 'MYG173'&quot;</td>
<td>N/A</td>
<td>Potential SRE</td>
<td>Not SRE</td>
<td>(Outback Ecology 2012)</td>
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<td>&quot;NAME 'MYG227'&quot;</td>
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<td>Potential SRE</td>
<td>Potential SRE</td>
<td>N/A</td>
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<td>Cethegus fugax</td>
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<td>Lychas ‘annulatus’</td>
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<td>Potential SRE</td>
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<td>Urodacus ‘yeelirrie’</td>
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<td>Potential SRE</td>
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<td>Malacostraca – Isopoda (Slaters)</td>
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<td>Potential SRE</td>
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<td>Likely SRE</td>
<td>Confirmed SRE</td>
<td>Evidence from taxonomic expert (S. Judd, pers. comm.)</td>
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<td>Buddelundia ‘25’</td>
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<td>Potential SRE</td>
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<td>Buddelundia ‘46’</td>
<td>Buddelundia sp. nov. 46</td>
<td>Likely SRE</td>
<td>Potential SRE</td>
<td>Change to WAM categories</td>
</tr>
<tr>
<td>Cubaris ‘wiluna’</td>
<td>Cubaris sp.1</td>
<td>Potential SRE</td>
<td>Potential SRE</td>
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<tr>
<td>Philosciidae cf. Andricophiloscia sp. indet.</td>
<td>Andricophiloscia gen. nov.</td>
<td>Potential SRE</td>
<td>Potential SRE</td>
<td>Change to WAM categories</td>
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<td>Pseudodiploexochus sp. indet.</td>
<td>Pseudodiploexochus sp. nov</td>
<td>Likely SRE</td>
<td>Potential SRE</td>
<td>Change to WAM categories</td>
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<td>Spherillo sp. indet. (Lake Maitland 1)</td>
<td>Spherillo sp. 1.</td>
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<td>Evidence from taxonomic expert (S. Judd, pers. comm.)</td>
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<td>MSS</td>
<td>WSC</td>
<td>MS</td>
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<td>Aganippe sp.</td>
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<td>Aname ‘MYG227’</td>
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<td>Aname ‘MYG176’</td>
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<td>Urodacus sp.</td>
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<tr>
<td>Urodacus ‘yeelirrie’</td>
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</tbody>
</table>

LHS: Low halophytic shrubland, MSS: Mallee/mulga over spinifex sandplain; WSC: Woodland/shrubland over calcrete, MS: Mulga over sandplain, OP: Open plain, MSG: Mulga over stony ground, B: Bare salt lake, SD: Spinifex sand dune, SS: Spinifex sandplain, KP: Kopi dune, SHF: Stony hills and footslopes
5.1.2 Project Development Envelope SRE species

Twenty-two SRE species have been recorded during assessments for the project, of which five have been recorded only within the development envelope and are discussed below.

5.1.2.1 **Aname ‘MYG227’**

This mygalomorph spider was recorded from a single location (Site 5, Outback Ecology 2012) within the ‘Open plain’ habitat type inside the Lake Maitland development envelope (Figure 5.2) approximately 25 m from the disturbance footprint. This record represents the only known specimen of this species. The total portion of this habitat proposed to be impacted by the disturbance footprint is:

- Open plain: 109.5 ha (of 912.7 ha of this habitat type mapped across the project area).

This habitat extends well beyond the development envelope and is therefore likely to support the species outside the project areas.

5.1.2.2 **Buddelundia ‘46’**

This slater is recorded only from a single location within the ‘Low halophytic shrubland’ (Site 8, Outback Ecology 2012), inside the development envelope (but outside the disturbance footprint) of the Extension to the Wiluna Uranium Project at Lake Maitland (Figure 5.2). Currently, this single record represents the only specimen known for the species (S. Judd, pers. comm.). The total portion of this habitat proposed to be impacted by the disturbance footprint is:

- Low halophytic shrubland: 1,440.9 ha (of 3,705.1 ha mapped).

Although the single record is within the development envelope, the record is situated approximately 100 m from proposed direct infrastructure impacts. This habitat extends well beyond the impact footprint and is therefore likely to support the species outside the project area.

5.1.2.3 **Lychas ‘annulatus’**

This scorpion was previously not considered to be an SRE species. However, new genetic data from WAM suggests the presence of a number of separate SRE species under this name and species within the group are now treated as a potential SRE (Dr E. Volschenk., pers. comm.). *Lychas ‘annulatus’* was recorded from the ‘Mulga over sandplain’ habitat type within the disturbance footprint at Lake Way deposit of the Wiluna Uranium Project (Site 5, Outback Ecology 2011b) and a single location within the ‘Spinifex sandplain’ (Site 4, Outback Ecology 2012) inside development envelope, but outside the disturbance footprint at Lake Maitland deposit (Figure 5.2). All records of individuals from this project are currently located within the Project development envelope. The total portion of this habitat proposed to be impacted by the disturbance footprint is:

- Mulga over sandplain: 353.2 ha (of 1,563.0 ha mapped); and
- Spinifex sand dune: 45.2 ha (of 497.2 ha mapped).

The habitat extends beyond the development envelope and therefore likely to support the species outside of the project area. The two records of specimen are from different project areas, approximately 90 km apart, indicating the species is likely to occur elsewhere in the region.

Additionally, *Lychas ‘annulatus’* has been previously recorded by *ecologia* across many regions of Western Australia, including Coolgardie, Murchison and Dampierland (Kimberley) bio-regions. According to current knowledge, *Lychas ‘annulatus’* occurs outside the project development envelope, however these specimens are likely to represent different taxa with their distribution unclear.
5.1.2.4  *Spherillo* sp. indet. (Lake Maitland 1)

This slater species was recorded from three locations (Site 8, Outback Ecology 2012), within the development envelope in two habitat types; ‘Open plain’ and ‘Spinifex sand dune’ (Figure 5.2). The total portion of this habitat proposed to be impacted by the disturbance footprint is:

- Open plain: 109.5 ha (of 919.6 ha mapped); and
- Spinifex sand dune: 45.2 ha (of 497.2 ha mapped).

Similar specimens which may represent the same species have been recorded in the region from Yeelirrie and Yakabindie. However taxonomic uncertainty exists between the specimens and further detailed morphological and genetic analysis is required to resolve this uncertainty (S. Judd, pers. comm.).

Although all three records are within the development envelope, two records are located approximately 220 m and the other approximately 10 m outside of the proposed disturbance footprint.

5.1.2.5  *Urodacus* sp. indet.

Two specimens of *Urodacus* sp. indet. have been recorded from the ‘Open plain’ habitat type (Sites 3 and 7, Outback Ecology 2012) inside the Extension to the Wiluna Uranium Project development envelope (but outside the disturbance footprint) at Lake Maitland (Figure 5.2). These specimens were unable to be identified to species level as they were both female and therefore lacking the morphological features required for identification. The total portion of this habitat proposed to be impacted by the disturbance footprint is:

- Open plain: 109.5 ha (of 919.6 ha mapped).

The habitat extends beyond the impact footprint and therefore could support the species outside the Project. Although both specimen records are within the direct impact area, both records are situated where no direct infrastructure impacts are anticipated.

Additionally, as these individuals were unable to be identified to species level due to lack of morphological features, these specimens may belong to species *Urodacus* ‘yeelirrie’, which was recorded outside direct and indirect impact areas.

5.1.3  Confirmed SRE species

5.1.3.1  Armadillidae ‘reduropoda1’

A single confirmed SRE species, Armadillidae ‘reduropoda1’ was recorded during field surveys in 2011 (Outback Ecology 2012). At the time of surveying, the specimen was considered a potential SRE species, but is now considered to be a confirmed SRE species (S. Judd, pers. comm.).

The species is represented by the single specimen collected for this project, and is significant as it represents a new genus in the family Armadillidae. It was recorded within close proximity (approximately 60 m) from the development envelope (Figure 5.2). The specimen was recorded from Mulga over sandplain habitat type. The total portion of this habitat proposed to be impacted by the disturbance footprint is:

- Mallee/mulga woodland over spinifex sandplain: 626.6 ha (of 2,545.7 ha mapped).

The habitat extends beyond the impact footprint and therefore could support the species away from the Project development envelope.
5.1.4 Discussion of Impacts

Of the 22 SRE species, five are known from within the project development envelope with the remaining 17 species recorded outside any proposed project impacts.

Of the five SRE species recorded within the development envelope only one taxon, Spherillo sp. indet. (Lake Maitland 1) is proposed to be impacted. A single location of the taxon (representing 33.3% of the known locations) will be directly impacted. All five SRE species were recorded from habitat types that extend outside of the development envelope of the project.

No SRE taxa were exclusively found within the disturbance footprint.
REFERENCES


APPENDIX A  SIGNIFICANT FLORA MAPS
Provided in alphabetical order of species
Legend

- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts

- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts

- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon

- Range extension: Acacia brumalis

Inset A: Lake Way Deposit

Inset B: Millipede (red) & Centipede (black) Deposits

Inset C: Lake Maitland Deposit

Acacia brumalis

Appendix A
Project ID: 1625
Drawn: MH
Date: 30/03/2016

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

- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts

- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts

- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon

- Range extension: *Cynanchum floribundum*

Appendix A

Project ID: 1625

Drawn: MH

Date: 30/03/2016

Coordinate System

Name: GDA 1994 MGA Zone 51

Projection: Transverse Mercator

Datum: GDA 1994
Legend

- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts

- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts

- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon

- Priority 1: Eremophila congesta

Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit

Eremophila congesta

Appendix A
Project ID: 1625
Drawn: MH
Date: 30/03/2016

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

Absolute Scale - 1:600,000
Legend

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope
Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area

Direct Impacts

Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

Indirect Impacts

Significant Flora Taxon

Priority 4: *Eremophila pungens*

*Appendix A*

Project ID: 1625
Drawn: MH
Date: 30/03/2016

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

Absolute Scale - 1:600,000

Inset A: Lake Way Deposit
Inset B: Haul Road
Inset C: Lake Maitland Deposit
Legend
Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area

Indirect Impacts
Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon
Priority 4: Frankenia confusa
Legend
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Re-injection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon
- Atypical: Frankenia sp. aff. fecunda (glabrous leaf variant)

Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit

Frankenia sp. aff. fecunda (glabrous leaf variant)
## Legend

- **Wiluna Uranium Project Development Envelope**
- **Extension to the Wiluna Uranium Project Development Envelope**

### Direct Impacts

- **Wiluna Uranium Project Disturbance Footprint**
- **Extension to the Wiluna Uranium Disturbance Footprint**
- **Lake Maitland Reinjection Area**

### Indirect Impacts

- **Groundwater Drawdown (0.5m)**
- **Haul Road Dust Deposition Zone (25m)**

### Significant Flora Taxon

- **Range extension: Paspalidium gracile**

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### Coordinate System

- **Name:** GDA 1994 MGA Zone 51
- **Projection:** Transverse Mercator
- **Datum:** GDA 1994

### Appendix A

- **Project ID:** 1625
- **Drawn:** MH
- **Date:** 30/03/2016

---

**Paspalidium gracile**

Inset A: Lake Way Deposit

Inset B: Millipede (red) & Centipede (black) Deposits

Inset C: Lake Maitland Deposit
Legend

- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts

- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts

- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon

- Range extension: *Pterocaulon sphacelatum*

Inset A: Lake Way Deposit

Inset B: Millipede (red) & Centipede (black) Deposits

Inset C: Lake Maitland Deposit

Appendix A
Project ID: 1625
Drawn: MH
Date: 30/03/2016

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

Absolute Scale - 1:600,000

Kilometres

0 10 20

Pterocaulon sphacelatum
Legend
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon
- Range extension: Sclerolaena clelandii

Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit

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

Appendix A
Project ID: 1625
Drawn: MH
Date: 30/03/2016

Absolute Scale - 1:600,000
Legend

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon
- New taxa: *Tecticornia aff. halocnemoides* s.l. 'large ovate seed aggregate'

*Tecticornia aff. halocnemoides* s.l. 'large ovate seed aggregate'

Appendix A

Project ID: 1625
Drawn: MH
Date: 30/03/2016

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

Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit
Inset C: Lake Maitland Deposit

Absolute Scale - 1:600,000
Legend

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area

Indirect Impacts
Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon
Tecticornia: *Tecticornia calyptrata*

Tecticornia calyptrata

Appendix A
Project ID: 1625
Drawn: MH
Date: 30/03/2016

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994
Legend
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon
- Priority 3: Tecticornia cymbiformis

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

Appendix A
Project ID: 1625
Drawn: MH
Date: 30/03/2016

Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit

Kilometres
Absolute Scale - 1:600,000

Tecticornia cymbiformis
Legend

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area

Indirect Impacts

Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon

Tecticornia: Tecticornia disarticulata

Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit
Legend

Wiluna Uranium Project Development Envelope

Extension to the Wiluna Uranium Project Development Envelope

Wiluna Uranium Project Disturbance Footprint

Extension to the Wiluna Uranium Disturbance Footprint

Lake Maitland Re injection Area

Indirect Impacts

Groundwater Drawdown (0.5m)

Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon

Tecticornia: Tecticornia indica

Inset A: Lake Way Deposit

Inset B: Millipede (red) & Centipede (black) Deposits

Inset C: Lake Maitland Deposit

Coordinate System

Name: GDA 1994 MGA Zone 51

Projection: Transverse Mercator

Datum: GDA 1994

Appendix A

Project ID: 1625

Drawn: MH

Date: 30/03/2016
**Legend**

- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

**Direct Impacts**

- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

**Indirect Impacts**

- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

**Significant Flora Taxon**

- Tecticornia: *Tecticornia indica* subsp. *leiostachya*

Coordinate System

- Name: GDA 1994 MGA Zone 51
- Projection: Transverse Mercator
- Datum: GDA 1994

Appendix A

- Project ID: 1625
- Drawn: MH
- Date: 30/03/2016
Legend

- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon
- Tecticornia: Tecticornia laevigata

Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit

Kilometres

Absolute Scale - 1:600,000
Legend

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area

Indirect Impacts
Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon

Tecticornia: *Tecticornia peltata*

Appendix A
Project ID: 1625
Drawn: MH
Date: 30/03/2016

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

Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit

Kilometres
Absolute Scale - 1:600,000

*Tecticornia peltata*
Legend

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<th>Description</th>
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<td>Direct Impacts</td>
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<td>Indirect Impacts</td>
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<td>Lake Maitland Reinjection Area</td>
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<td>Groundwater Drawdown (0.5m)</td>
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<tr>
<td>Haul Road Dust Deposition Zone (25m)</td>
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<tr>
<td>Tecticornia: Tecticornia pergranulata</td>
<td>Significant Flora Taxon</td>
</tr>
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Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit

Tecticornia pergranulata

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

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area

Indirect Impacts
Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon
Tecticornia: Tecticornia pterygosperma subsp. denticulata

Tecticornia pterygosperma subsp. denticulata
Legend

- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon
- New taxa: Tecticornia sp. aff. globulifera (small)

Kilometres
0 10 20
0 10 20

Absolute Scale - 1:600,000

Tecticornia sp. aff. globulifera (small)
200000 240000 280000 320000
7000000 7040000
Legend
Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope
Direct Impacts
Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area
Indirect Impacts
Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)
Significant Flora Taxon
▲ Potentially new taxa: ?Tecticornia sp. aff. globulifera (small)

Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit

Appendix A
Project ID: 1625
Drawn: MH
Date: 30/03/2016

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

Inset A
Inset B
Inset C

Absolute Scale - 1:600,000

0 10 20 Kilometres

?Tecticornia sp. aff. globulifera (small)
**Legend**
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

**Direct Impacts**
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

**Indirect Impacts**
- New taxa: *Tecticornia* sp. aff. *laevigata* (non-rotated fruitlets)

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

**Appendix A**
- Project ID: 1625
- Drawn: MH
- Date: 30/03/2016

**Inset A**: Lake Way Deposit
**Inset B**: Millipede (red) & Centipede (black) Deposits
**Inset C**: Lake Maitland Deposit

**Tecticornia sp. aff. laevigata** (non-rotated fruitlets)
Legend

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area

Indirect Impacts
Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon

New taxa: Tecticornia sp. aff. pruinosa (inflated bracts)

Appendix A
Project ID: 1625
Drawn: MH
Date: 30/03/2016

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

Tecticornia sp. aff. pruinosa (inflated bracts)
Legend
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon
- New taxa: Tecticornia sp. aff. undulata (broad articles)

Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit

Appendix A
Project ID: 1625
Drawn: MH
Date: 30/03/2016

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

Absolute Scale - 1:600,000

Tecticornia sp. aff. undulata (broad articles)
Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area

Indirect Impacts
Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon
Tecticornia: *Tecticornia* sp. Burnerbinmah (D. Edinger et al. 101)

Legend

Appendix A
Project ID: 1625
Drawn: MH
Date: 30/03/2016

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

Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit

Tecticornia* sp. Burnerbinmah (D. Edinger et al. 101)
Legend
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon
- Tecticornia: Tecticornia sp. Dennys Crossing (K.A. Shepherd and J. English KS 552)

Tecticornia sp. Dennys Crossing
(K.A. Shepherd and J. English KS 552)

Inset A: Lake Way Deposit
Inset B: Millipede (red) & Centipede (black) Deposits
Inset C: Lake Maitland Deposit

Appendix A
Project ID: 1625
Drawn: MH
Date: 30/03/2016

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

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area

Indirect Impacts
Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

Significant Flora Taxon
Range extension: Tecticornia tenuis

Tecticornia tenuis

Appendix A
Project ID: 1625
Drawn: MH
Date: 30/03/2016

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

0 10 20
Kilometres
Absolute Scale - 1:600,000
APPENDIX B  VEGETATION UNIT MAPPING
Figure B.1: Vegetation units

Legend
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

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

Figure: B.1
Project ID: 1631
Drawn: MH
Date: 29/03/2015

Figure B.1: Vegetation units

Absolute Scale - 1:100,000

Kilometres

0 1.5 3
Legend
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Figure B.2: Vegetation units

Absolute Scale - 1:55,000

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

Figure: B.2
Project ID: 1631
Drawn: MH
Date: 29/03/2015
Figure B.3: Vegetation Units

Legend

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reojection Area

Indirect Impacts
Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

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

Figure: B.3
Project ID: 1631
Drawn: MH
Date: 31/03/2016

Absolute Scale - 1:63,000
Legend
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Figure B.4: Vegetation units

Figure: B.4
Project ID: 1631
Drawn: MH
Date: 29/03/2015

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

Absolute Scale - 1:62,500
Legend

Wiluna Uranium Project Development Envelope

Extension to the Wiluna Uranium Project Development Envelope

Wiluna Uranium Project Disturbance Footprint

Extension to the Wiluna Uranium Disturbance Footprint

Lake Maitland Reinjection Area

Groundwater Drawdown (0.5m)

Haul Road Dust Deposition Zone (25m)

Absolute Scale - 1:63,000

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure B.5: Vegetation Units

Figure: B.5
Project ID: 1631
Date: 31/03/2016

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

Drawn: MH
**Legend**

- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

**Direct Impacts**
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

**Indirect Impacts**
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

**Figure B.6: Vegetation units**

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

*Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, GeoEye, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community*
Figure B.7: Vegetation units

Legend
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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

Figure: B.7
Project ID: 1631
Date: 29/03/2015

Drawn: MH

Absolute Scale - 1:63,000
Figure B.8: Vegetation units

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Geoeye, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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

Figure: B.8
Project ID: 1631
Drawn: MH
Date: 29/03/2015

Legend
- Wiluna Uranium Project Development Envelope
- Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
- Wiluna Uranium Project Disturbance Footprint
- Extension to the Wiluna Uranium Disturbance Footprint
- Lake Maitland Reinjection Area

Indirect Impacts
- Groundwater Drawdown (0.5m)
- Haul Road Dust Deposition Zone (25m)
Figure B.10: Vegetation Units

Legend

Wiluna Uranium Project Development Envelope
Extension to the Wiluna Uranium Project Development Envelope

Direct Impacts
Wiluna Uranium Project Disturbance Footprint
Extension to the Wiluna Uranium Disturbance Footprint
Lake Maitland Reinjection Area

Indirect Impacts
Groundwater Drawdown (0.5m)
Haul Road Dust Deposition Zone (25m)

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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

Figure: B.10
Project ID: 1631
Date: 31/03/2016

Drawing: MH

Absolute Scale - 1:80,000