Yandi Expansion
Vegetation and Flora Survey

Hamersley Iron Pty Ltd

December 2004
# Yandi Expansion Vegetation and Flora Survey

## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Summary</td>
<td>5</td>
</tr>
<tr>
<td>2.0</td>
<td>Introduction</td>
<td>8</td>
</tr>
<tr>
<td>2.1</td>
<td>Scope of the Study</td>
<td>8</td>
</tr>
<tr>
<td>2.2</td>
<td>Background to the Study Area</td>
<td>8</td>
</tr>
<tr>
<td>3.0</td>
<td>Methodology</td>
<td>11</td>
</tr>
<tr>
<td>3.1</td>
<td>Review of Existing Information</td>
<td>11</td>
</tr>
<tr>
<td>3.2</td>
<td>Field Survey</td>
<td>11</td>
</tr>
<tr>
<td>3.3</td>
<td>Limitations of the Assessment</td>
<td>14</td>
</tr>
<tr>
<td>4.0</td>
<td>Vegetation</td>
<td>15</td>
</tr>
<tr>
<td>4.1</td>
<td>Vegetation Types</td>
<td>15</td>
</tr>
<tr>
<td>4.2</td>
<td>Vegetation Condition</td>
<td>23</td>
</tr>
<tr>
<td>4.3</td>
<td>Vegetation Conservation Significance</td>
<td>23</td>
</tr>
<tr>
<td>5.0</td>
<td>Flora</td>
<td>27</td>
</tr>
<tr>
<td>5.1</td>
<td>General</td>
<td>27</td>
</tr>
<tr>
<td>5.2</td>
<td>Flora of Conservation Significance</td>
<td>28</td>
</tr>
<tr>
<td>5.3</td>
<td>Introduced Flora</td>
<td>31</td>
</tr>
<tr>
<td>6.0</td>
<td>Discussion</td>
<td>33</td>
</tr>
<tr>
<td>6.1</td>
<td>Summary of Features of Conservation Significance within the Yandi Expansion Area</td>
<td>33</td>
</tr>
<tr>
<td>6.2</td>
<td>Impacts of the Proposed Development</td>
<td>34</td>
</tr>
<tr>
<td>6.3</td>
<td>Recommendations for Management</td>
<td>36</td>
</tr>
<tr>
<td>7.0</td>
<td>Acknowledgements</td>
<td>37</td>
</tr>
<tr>
<td>8.0</td>
<td>References</td>
<td>38</td>
</tr>
</tbody>
</table>

### Appendix 1
List of Vascular Flora Recorded from the Yandi Expansion Area

### Appendix 2
Raw Data from Floristic Survey Sites and Representative Photographs
### Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 2.1</td>
<td>Description and area of each Land System occurring within the Yandi Expansion area (data from Department of Agriculture 2002).</td>
<td>10</td>
</tr>
<tr>
<td>Table 4.1</td>
<td>Area of each vegetation type within the Yandi Expansion area.</td>
<td>19</td>
</tr>
<tr>
<td>Table 4.2</td>
<td>Summary of number of sites from each project area in the 14-groups and 100-groups of the PATN analysis.</td>
<td>26</td>
</tr>
<tr>
<td>Table 5.1</td>
<td>Most species rich families and genera within the Yandi Expansion Area.</td>
<td>27</td>
</tr>
<tr>
<td>Table 5.2</td>
<td>Categories of conservation significance for flora species (Atkins 2004).</td>
<td>28</td>
</tr>
<tr>
<td>Table 5.3</td>
<td>Summary of Priority flora locations within the Yandi Expansion area.</td>
<td>29</td>
</tr>
<tr>
<td>Table 5.4</td>
<td>Introduced flora recorded from the Yandi Expansion area.</td>
<td>31</td>
</tr>
<tr>
<td>Table 6.1</td>
<td>Area of each vegetation type to be cleared for the Yandi Expansion.</td>
<td>34</td>
</tr>
</tbody>
</table>

### Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 2.1</td>
<td>Land Systems within the Yandi Expansion area (data from Department of Agriculture 2002).</td>
<td>9</td>
</tr>
<tr>
<td>Figure 3.1</td>
<td>Monthly rainfall for the Newman weather station from January 2003 to September 2004 (data supplied by Bureau of Meteorology).</td>
<td>11</td>
</tr>
<tr>
<td>Figure 4.1</td>
<td>Vegetation types occurring in the Yandi Expansion area.</td>
<td>20</td>
</tr>
</tbody>
</table>
1.0 Summary

Hamersley Iron Pty Ltd proposes to extend existing iron ore mining operations at Yandi, approximately 90 km northwest of Newman. To support an assessment of the biological impacts of the project, Biota Environmental Sciences was commissioned to assess the vegetation and flora and fauna of the Yandi Expansion area.

Vegetation
Twenty vegetation types were identified for the area:

1. Low Stony Hills
   1a. Hakea chordophylla scattered low trees over Grevillea wickhamii scattered shrubs to open shrubland over Acacia hilliana and Ptilotus rotundifolius low open shrubland over Triodia aff. basedowii mid-dense hummock grassland; stony hillcrests.
   1b. Eucalyptus leucophloia low open woodland over Acacia hilliana and A. adoxa var. adoxa low open shrubland over Triodia aff. basedowii mid-dense hummock grassland; skeletal hillslopes and low stony hills.
   1c. Eucalyptus leucophloia, Corymbia ferriticola scattered low trees over Eremophila latrobei subsp. filiformis ms., Senna spp. scattered shrubs over Cymbopogon ambiguus, Eriachne mucronata, Themeda sp. Mt. Barricade and T. triandra open tussock grassland; exposed ridges and rocky gullies.
   1d. Eucalyptus gamophylla low open woodland over Acacia ancistrocarpa open shrubland over Triodia aff. basedowii mid-dense hummock grassland; stony baseslopes.
   1e. Acacia inaequilatera, Grevillea wickhamii scattered shrubs over Triodia wiseana mid-dense hummock grassland and Paraneurachne muelleri very open grassland; stony hillcrests.
   1f. Corymbia hammersleyana scattered low trees over Acacia inaequilatera, Grevillea wickhamii scattered shrubs over Triodia wiseana mid-dense hummock grassland and Paraneurachne muelleri very open grassland; stony hillcrests.
   1g. Acacia pruinocarpa, Acacia aneura (flat curved; MET 15 548) scattered low trees over Eremophila fraseri, Senna glutinosa subsp. x luerssenii over Triodia aff. basedowii mid-dense hummock grassland; small low stony hills.

2. Valleys (mosaic communities)
   2a. Corymbia hammersleyana open woodland over Acacia inaequilatera, A. dictyophleba, A. tenuissima, A. ancistrocarpa, A. sclerosperma, A. pruinocarpa, Hakea chordophylla, Eremophila longiflora tall open shrubland to open shrubland over Triodia spp. mid-dense hummock grassland; detrital stony lowlands adjacent to Yandicoogina Creek.
   2b. Mosaic of Mulga Acacia aneura and other Acacia species on clay flats, including:
      2b.1 Eucalyptus xerothermica, Acacia aneura low open woodland over Acacia bivenosa open shrubland over Themeda triandra, Paraneurachne muelleri open tussock grassland and Triodia wiseana and/or Triodia pungens open hummock grassland; shallow drainages and flats.
      2b.2 Acacia aneura (flat curved; MET 15 548), Acacia ayersiana, A. pruinocarpa, Eucalyptus xerothermica low woodland over Eremophila forrestii, Senna artemisioides subsp. helmsii shrubland over Aristida contorta, A. inaequiglumis, Enneapogon polyphyllus open annual grassland and mixed very open herbland; flats.
   2c. Acacia dictyophleba, A. pruinocarpa, Acacia pachyacra, A. inaequilatera, A. ancistrocarpa tall open shrubland to shrubland over Senna artemisioides subsp. oligophylla low shrubland over Triodia lanigera mid-dense hummock grassland; semi-sandplain habitat in an alluvial fan.

3. Drainage lines
   3a. Eucalyptus leucophloia, Corymbia hammersleyana low open woodland over Acacia tumida var. pilbarenensis, A. bivenosa, A. ancistrocarpa, Petalostylis labicheoides, Grevillea wickhamii tall open shrubland over Acacia adoxa var. adoxa, A. hilliana low open shrubland over Triodia spp. mid-
dense hummock grassland with *Themeda triandra* and *Paraneurachne muelleri* very open tussock grassland; stony minor creeks.

3b. *Corymbia hammersleyana* open woodland over *Acacia tumida* var. *pilibbensis*, *A. dictyophleba*, *A. pyrfolia*, *Gossypium robinsonii*, *Petalostylis labicheoides*, *Grevillea wickhamii*, *Rulingia luteiflora*, *Eremophila longifolia* mixed shrubland to open shrubland over *Triodia pungens* open hummock grassland and *Themeda triandra* tussock grassland; secondary creeks.

3c. *Eucalyptus camaldulensis* open woodland over *Acacia citrinoviridis*, *A. coriacea* subsp. *pendens*, *A. pruinocarpa*, *Hakea lorea* subsp. *lorea*, *Atalaya hemiglauca* low open woodland over *Stylosanthes spathulatum*, *Gossypium robinsonii* open shrubland over *Cenchrus ciliaris* closed tussock grassland; floodbank of Weeli Wolli Creek.

3d. *Eucalyptus camaldulensis* and *E. victrix* scattered trees over scattered mixed shrubs, sedges, tussock grasses and *Triodia pungens*; major creek channel.

3e. *Eucalyptus victrix* woodland over *Acacia coriacea* subsp. *pendens*, *Atalaya hemiglauca* and *Melaleuca glomerata* tall open shrubland over *Triodia pungens* open hummock grassland over *Cymbopogon dependens*, *Eulalia aurea* and *Themeda triandra* open tussock grassland; secondary braided channel of a major creek.

3f. *Acacia citrinoviridis*, *A. coriacea* subsp. *pendens* low open forest over *Acacia pyrfolia* scattered tall shrubs over *Corchorus crozophorifolius*, *Tephrosia rosea* var. *glabrior* scattered low shrubs to low open shrubland over *Triodia pungens* very open hummock grassland and *Themeda triandra*, *Cenchrus ciliaris* open grassland; major creek flood-out.

3g. *Corymbia hammersleyana* scattered low trees over *Acacia citrinoviridis*, *A. pruinocarpa* low open woodland over *Triodia longiceps* mid-dense hummock grassland and *Cenchrus ciliaris* tussock grassland; Weeli Wolli Creek flood-out area.

3h. *Eucalyptus victrix* woodland to open woodland over *Acacia citrinoviridis* low open woodland over *Atalaya hemiglauca*, *Acacia tumida* var. *pilibbensis*, *A. bivenosa*, *Petalostylis labicheoides*, *Gossypium robinsonii* shrubland to tall shrubland over *Triodia pungens* hummock grassland and *Themeda triandra* open tussock grassland; Yandicoogina Creek flood-out area.

The vegetation was generally considered to be in very good to excellent condition, with the exception of areas along the Weeli Wolli Creek and parts of the Yandicoogina and Marillana Creek systems that were degraded through infestation with weeds, particularly Buffel Grass.

**Flora**

A total of 319 taxa of native vascular flora from 150 genera belonging to 53 families was recorded from the Yandi Expansion area. Thirteen introduced species were also recorded (*Ruby Dock* *Acetosa vesicaria*, *Mexican Poppy* *Argemone ochroleuca* subsp. *ochroleuca*, *Beggars Ticks* *Bidens bipinnata*, *Buffel Grass* *Cenchrus ciliaris*, *Flaxleaf Fleabane* *Conyza bonariensis*, *Couch Grass* *Cynodon dactylon*, *Native Thornapple* *Datura leichhardtii*, *Spiked Malvastrum* *Malvastrum americanum*, *Jersey Cudweed* *Pseudognaphalium luteoalbum*, *Whorled Pigeon Grass* *Setaria verticillata*, *London Rocket* *Sisymbrium irio*, *Black Berry Nightshade* *Sonchus oleraceus* and *Common Sowthistle* *Sonchus oleraceus*).

No Declared Rare Flora were recorded from the area, and none are expected to occur. Five Priority flora were recorded:

- *Olearia fluvialis* (Priority 2);
- *Sida* sp. Barlee Range (S van Leeuwen 1642) (Priority 2);
- *Abutilon trudgenii* ms. (Priority 3);
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (Priority 3); and
- *Goodenia stellata* (Priority 4).

**Features of Conservation Significance**

No Threatened Ecological Communities or Declared Rare Flora are known from the Yandi Expansion area. None of the vegetation types appear to be restricted in the region based on their floristic composition, hence none are considered to be of regional conservation significance. The main feature of conservation significance in the study area is the major drainage system formed by the Weeli Wolli, Yandicoogina and Marillana Creeks.
The main features of conservation significance within the project area thus comprise:

- vegetation types 3c – 3h of major creeklines, particularly where these are in excellent to very good condition (ie. along Yandicoogina and Marillana Creeks); these comprise an ecosystem at risk (Kendrick 2003) and support suites of species restricted to major creekline habitats;
- vegetation type 1c of breakaways small areal extent and supports suites of species restricted to such rocky habitats; and
- the five Priority flora (*Olearia fluvialis*, *Sida* sp. Barlee Range (S van Leeuwen 1642), *Abutilon trudgenii* ms., *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) and *Goodenia stellata*).

**Impacts of the Development**

A total of 511 ha will be cleared for the proposed Yandi Expansion, which will include 4.2 ha of riverine vegetation along Yandicoogina and Marillana Creeks, and 0.16 ha of breakaway vegetation. Clearing of the latter small areas would not be expected to decrease the conservation value of these vegetation types of high conservation significance in the locality.

Four of the locations of *Abutilon trudgenii* identified within the project area will be cleared (two along the heavy haulage road and two within the pit area), and the location of *Goodenia stellata* will be cleared to construct the eastern cut-off drain. Both of these species have been recorded numerous times in the locality, and the loss of these stands of individuals would not be expected to impact on the conservation status of the species.

Both groundwater drawdown and disposal of excess dewatering water could impact riverine vegetation in the study area. Hydrological studies are currently under way to define the extent of these impacts, along with studies by the University of Western Australia to determine the likely effect on vegetation.

Other potential impacts of the project include introduction and/or spread of weed species within the study area, particularly into the section of Yandicoogina Creek west of the Marillana Creek junction, and an increase in fire frequency and dust levels.

**Management Recommendations**

- Prior to construction, undertake rare flora searches in the areas burnt prior to this survey to ensure that any such populations are fully documented.
- Maintain surface drainage features, and minimise disturbance to the Marillana, Yandicoogina and Weeli Wolli Creek systems, wherever possible. Both direct (eg. vegetation clearing, possible discharge of excess water from mine dewatering) and indirect (eg. groundwater drawdown, spread of weeds) mechanisms should be considered as part of the mine planning process. Impacts of such factors will need to be reviewed following completion of the hydrological and other studies.
- Avoid disturbance to the locations supporting Priority flora species wherever possible, particularly with respect to *Olearia fluvialis* and *Sida* sp. Barlee Range (S van Leeuwen 1642).
- Minimise disturbance to general vegetation and flora:
  - Clearing limits should be clearly defined in the field and strictly adhered to;
  - Existing tracks should be utilised wherever possible and off-road driving should be prohibited;
  - Appropriate weed hygiene measures should be carried out to minimise the risk of introduction/spread of weed propagules or infected soil (ie. standard washdown of earth-moving equipment should be done prior to any earthworks in the area of Yandicoogina Creek upstream of the Marillana Creek junction, and also prior to equipment leaving the Yandi Expansion area, to prevent spread of weeds into other areas).
2.0 Introduction

2.1 Scope of the Study

Hamersley Iron Pty Ltd proposes to expand existing iron ore mining operations at its Yandi minesite, approximately 90 km northwest of Newman, with a new open-cut pit, waste dump and physical plant in the Yandi Expansion area. The Western Australian Environmental Protection Authority will review the environmental acceptability of this expansion under an Environmental Protection Statement being prepared by Hamersley. To support an assessment of the biological impacts of the project, Biota Environmental Sciences was commissioned to assess the vegetation and flora and fauna of the Yandi Expansion area.

The scope of the study was to:

- define and map the vegetation types within the study area, and identify any vegetation types of conservation significance;
- identify the flora present within the study area, with particular emphasis on species of conservation significance; and
- prepare recommendations for management of any features of conservation significance within the study area.

2.2 Background to the Study Area

2.2.1 Pilbara IBRA Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 85 bioregions (see Environment Australia 2000). The Pilbara Bioregion has four main components, based on the physiographic work of Beard (1975): the Hamersley Range, Fortescue Plains, Chichester Range and Roebourne Plains sub-regions. The Yandi Expansion area is located near the boundary of the Hamersley and Fortescue sub-regions, with the majority of the project area typical of the Hamersley Range and the major creek systems (Marillana, Yandicoogina and Weeli Wolli Creek) forming part of the Fortescue sub-region.

The Pilbara Bioregion is listed as a medium priority for funding for land purchase under the National Reserves System Co-operative Program due to the limited representation of the area in conservation reserves. The Hamersley Range sub-region is relatively well reserved, with 10-30% of the land area protected in reserves, while the Fortescue Plains sub-region is poorly reserved (2-3% only within reserves).

2.2.2 Land Systems

Land System (rangelands) mapping covering the project area has been prepared by the Department of Agriculture Western Australia (Department of Agriculture 2002). Six Land Systems occur within the Yandi Expansion area (Figure 2.1, Table 2.1), all of which are widely distributed through the Pilbara.
Figure 2.1: Land Systems within the Yandi Expansion area (data from Department of Agriculture 2002).
Table 2.1: Description and area of each Land System occurring within the Yandi Expansion area (data from Department of Agriculture 2002).

<table>
<thead>
<tr>
<th>Land System</th>
<th>Description</th>
<th>Area within Yandi Expansion (ha)</th>
<th>% of area mapped in Pilbara</th>
</tr>
</thead>
<tbody>
<tr>
<td>McKay</td>
<td>Hills, ridges, plateaux remnants and breakaways of metasedimentary and sedimentary rocks supporting hard spinifex grasslands; dominated the low hills of the study area</td>
<td>1151.93</td>
<td>0.27%</td>
</tr>
<tr>
<td>Boolgeeda</td>
<td>Stony lower slopes and plains found below hill systems supporting hard and soft spinifex grasslands and mulga shrublands; broadly distributed in the central and southern study area, on plains fringing river systems</td>
<td>640.70</td>
<td>0.08%</td>
</tr>
<tr>
<td>River</td>
<td>Active flood plains and major rivers supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands; comprised the sections of Marillana, Yandicoogina and Weeli Wolli Creek within the study area</td>
<td>426.02</td>
<td>0.09%</td>
</tr>
<tr>
<td>Robe</td>
<td>Low limonite mesas and buttes supporting soft spinifex (and occasionally hard spinifex) grasslands; two small patches in the northern study area</td>
<td>143.14</td>
<td>0.17%</td>
</tr>
<tr>
<td>Newman</td>
<td>Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands; a single patch along the northern boundary of the study area</td>
<td>59.62</td>
<td>&lt;0.01%</td>
</tr>
<tr>
<td>Rocklea</td>
<td>Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands; a small strip along the north-eastern boundary of the study area</td>
<td>12.37</td>
<td>&lt;0.01%</td>
</tr>
</tbody>
</table>

2.2.3 Beard’s Vegetation Mapping

Beard (1975) mapped the vegetation of the Pilbara at a scale of 1:1,000,000. The study area lies within the Fortescue Botanical District of the Eremaean Botanical Province as defined by Beard. The vegetation of this province is typically open, and frequently dominated by spinifex, wattles and occasional eucalypts.

Beard mapped the area encompassing the Yandi Expansion area as the following vegetation units:
- Snappy Gum *Eucalyptus leucophloia* trees over *Triodia wiseana* hummock grassland; and
- Mulga trees in groves or patches.

However, due to the coarse scale at which Beard’s mapping was done, these units are only broadly applicable to the actual vegetation occurring on site (see Section 4.1).

2.2.4 Previous Studies at Yandi

Numerous baseline biological studies have been done in the Yandi area as part of the environmental impact assessment process for both BHP Billiton Iron Ore and Hamersley Iron Pty Ltd.

Vegetation and flora surveys of particular relevance include the studies of the Yandicoogina Junction area (Mattiske and Associates 1995a) and the transport corridor extending south (Mattiske and Associates 1995b), which together encompass the current Yandi Expansion area. These reports were reviewed for context.
3.0 Methodology

3.1 Review of Existing Information

Searches of the Department of Conservation and Land Management (CALM) and Western Australian Herbarium rare flora databases were commissioned to identify rare and Priority flora species that have been previously recorded from the Yandi area.

Previous vegetation and flora studies of the area were also reviewed. These studies were used in conjunction with the results of the database searches to assist in identification of rare flora and vegetation types occurring within the Yandi Expansion area.

3.2 Field Survey

3.2.1 Survey Timing

Three botanists (Kelli McCreery and Raimond Orifici of Biota Environmental Sciences and Brian Morgan, Consultant Botanist) surveyed the Yandi Expansion area for vegetation and flora between 30th August and 5th of September 2004.

The site visit was done approximately 6 months after heavy rain in the area over the summer period (Figure 3.1). The vegetation was visibly drought-affected at the time of survey. Annual flora within the stony hills and plains habitats were typically dead, but still recognisable; specimens in good condition were uncommon and largely restricted to more mesic habitats such as creeklines.

![Figure 3.1: Monthly rainfall for the Newman weather station from January 2003 to September 2004 (data supplied by Bureau of Meteorology).](image)

3.2.2 Vegetation Sampling Method

Thirty-nine sites were assessed within the Yandi Expansion survey area (Figure 4.1; Appendix 2).

Quadrats were 50 m x 50 m in size. This is generally accepted as the standard plot size in the Pilbara, as it gives a good sample of flora presence while being small enough to accommodate within a single vegetation type. Quadrat shape and/or size was adjusted as
necessary to fit smaller or oddly shaped habitats (eg. flowlines), or small vegetation stands.

The quadrats were uniquely numbered (YEX01 to YEX39) and marked with pink flagging tape, but were not permanently marked.

The following parameters were recorded for each quadrat:

1. Location AMG coordinates recorded in WGS84 (GDA94) datum using a hand-held Global Positioning System (GPS), to an accuracy within 5 m; readings taken at all four corners;

2. Vegetation Description Broad description based on the height and estimated cover of dominant species after Aplin’s (1979) modification of the vegetation classification system of Specht (1970);

3. Habitat Description of landform and habitat;

4. Soil Broad description of soil type and stony surface mantle;

5. Disturbance Details Evidence of grazing, mining exploration activities, weed invasion, frequent fires etc. Note that fire effects are only considered as a negative impact if they appear to be caused by repeated burning (such as that done for pastoral purposes). Fire is a natural and frequent process in the Pilbara to which the vegetation has adapted, and to class areas as being in poor condition simply because they have been recently burnt is misleading; and

6. Percentage Foliar Cover Estimated visually for each species. Estimates were made to the nearest percent where possible, or a range (eg. 5-10%) was used. ‘+’ was used where only occasional individuals were present, with a cover of less than 1%.

Colour photographs of the vegetation at each site were taken using a digital camera.

Numerous exploration tracks allowed access to the majority of the survey area. Additional foot traverses were done to allow assessment of areas that were inaccessible by vehicle. Opportunistic flora collections were made on these traverses to supplement the list of species recorded from the flora survey sites.

Particular attention was paid to searching habitats and vegetation types likely to support flora species with sporadic distributions (eg. creeklines). Location coordinates were recorded for stands of rare or unusual flora using a hand-held GPS (WGS84 datum). Readings were typically accurate to within 5m.

### 3.2.3 Flora Identifications

Common species that were well known to the survey botanists were identified in the field. Voucher specimens of most flora were collected and assigned a unique number to facilitate tracking of data.

The vouchers were identified by keying out, reference to appropriate publications, use of reference collections and comparison to the collections held at the Western Australian Herbarium. Some specimens of difficult taxa were submitted to relevant specialists for identification (see Section 7.0). Specimens will be lodged with the Western Australian Herbarium and Karratha Regional Herbarium for all taxa for which suitable material is available.
Nomenclature was checked against the current listing of scientific names recognised by the Western Australian Herbarium <http://www.florabase.calm.wa.gov.au>, and updated as necessary.

### 3.2.4 PATN Floristic Analysis

A spreadsheet of species presence / absence at each site assessed during the Yandi Expansion was generated and used in a PATN floristic clustering analysis. Releves were also included in the dataset where the list of species recorded was believed to be a good sample of the available flora.

The analysis examined the variation in species composition in a combined dataset of some 2160 sites from 19 projects:

- 45 sites from the current survey of the Yandi Expansion area (designated project YANEXP in Table 4.2);
- 118 sites from the FMG Stage A rail corridor (Biota 2004a) (project FMGA);
- 219 sites from the survey of the FMG Stage B rail corridor and Mindy Mindy, Christmas Creek, Mt Lewin and Mt Nicholas mine areas (Biota 2004b) (project FMGB);
- 286 sites from the Hope Downs rail corridor between Port Hedland and Weeli Wolli (Biota and Trudgen 2002) (project HDRAIL);
- 56 sites from an extension to the Hope Downs rail corridor through the Hamersley Range (Biota 2004c) and an addition to the same rail corridor through the Chichester Range (Biota 2004d) (project HDRAIL A/D);
- 312 sites from the core area surveyed for Robe River Iron Associates’ West Angelas mine (Trudgen and Casson 1998) (project WASA);
- 12 sites from the West Angelas mine access road (Trudgen and Casson 1998) (project WAACRD);
- 59 sites from the West Angelas Coondewanna West rail corridor (Trudgen and Casson 1998) (project WACOOWES);
- 84 sites from an alternative rail corridor to the Coondewanna West route, extending from the West Angelas mine north to near Mt Robinson, then west towards Juna Downs (Trudgen and Casson 1998) (project WAMTROB);
- 46 sites from a rail corridor in the Four Corners Bore area, on Hamersley Station (Trudgen and Casson 1998) (project WAFCBOR);
- 3 sites from near Eight Mile Well on Hamersley Station (Trudgen and Casson 1998) (project WAEIMIWE);
- 22 other sites from Hamersley Station (Trudgen and Casson 1998) (project WAHAMSTN);
- 26 sites from the Fortescue Slopes study area, along the lower slopes of the Chichester Range (Trudgen and Casson 1998) (project WAFORSLO);
- 104 sites from the West Angelas Millstream Rail Segment, extending from the Fortescue Slopes study area along the lower slopes of the Chichester Range parallel to the existing Hamersley Iron rail line, then to Barowanna Hill (project MILL);
- 296 sites from the West Angelas George River rail corridor, extending along the southern slopes of the Chichester Range to approximately the Table Hill area (Trudgen and Casson 1998) (project WAGEORIV);
- 97 sites from the West Angelas Hamersley Parallel rail corridor; parallel to the existing Hamersley Iron rail line, extending northwest through the Chichester Range from near Barowanna Hill (Trudgen and Casson 1998) (project WAHAMPAR);
• 144 sites from the West Angelas Mt Herbert rail corridor, extending from the central Chichester Range down the Chichester escarpment to join the George River rail corridor (Trudgen and Casson 1998) (project WAMTHER);
• 141 sites from the West Angelas Mt Leal study area, extending from the Fortescue Slopes study area west across the mid-slopes of the Chichester Range to near the Millstream Road intersection with the Wittenoom-Roebourne Road (Trudgen and Casson 1998) (project WAMTLEA); and
• 90 sites from the Panorama survey area, south-southeast of Port Hedland (Trudgen et al. 2002) (project PAN).

The analysis thus included sites from an area of approximately 300 km by 300 km, extending from Port Hedland west to the Mt Herbert area, south to West Angelas and east to Mt Nicholas, including survey areas in both the Hamersley Range and Chichester Range.

3.2.5 Map Preparation
Vegetation types were mapped onto a hardcopy of rectified colour aerial photography supplied by Hamersley Iron. The resulting map was scanned and registered, and the vegetation polygons were digitised in ArcView GIS 3.2. The polygons were then attributed according to their vegetation classification codes. Other point sources datasets, such as locations of quadrats, weeds and Priority flora, were generated into spatial data using ArcView and saved as separate shapefiles.

3.3 Limitations of the Assessment
There are two peak flowering periods in the Pilbara – after summer rain and after winter rain. The field work was done in spring, which means that some of the summer peak species (particularly grasses and some herbs) would have been dormant at the time of the survey.

Fungi and nonvascular flora (eg. algae, mosses and liverworts) were not specifically sampled.

Approximately a third of the study area had been burnt in August 2004, two weeks preceding the survey. These areas were mapped from aerial photography only, as ground truthing was generally not possible. These areas may not be mapped to the same accuracy as unburnt areas, however given the familiarity of the survey botanists with the site, the mapping should still give a reasonable representation of the vegetation.

As the study area was only visited once, and conditions were quite dry at the time, the flora recorded for the Yandi Expansion is unlikely to be a complete representation of the species in the area. The flora species list should therefore be taken as indicative rather than exhaustive.

The recently burnt sections of the study area could not be surveyed for rare flora. Given the level of survey work that has been completed in the Yandi locality, it is unlikely that any species additional to those known for the area would be recorded.
4.0 Vegetation

4.1 Vegetation Types

4.1.1 General Overview

The Yandi Expansion area falls within the area mapped by Mattiske Consulting (1995a, 1995b) as the Yandicoogina Junction area and the southern transport corridor. The vegetation types mapped by Mattiske generally correspond with those mapped for the current exercise, although they are at considerably broader level.

Twenty vegetation types were identified by Biota within the Yandi Expansion area (Figure 4.1). Broadly, the vegetation comprised spinifex hummock grasslands on low stony hills and ranges, with open Eucalypt woodlands and Acacia shrublands over spinifex on plains, and Eucalypt woodlands in major creeks.

Hills generally had a scattered overstorey of Snappy gum Eucalyptus leucophloia, Bloodwood Corymbia hamersleyana, Kanji Acacia inaequilateralia and/or Hakea chordophylla over moderately dense spinifex, predominantly Triodia aff. basedowii, with some Triodia wiseana on slopes. Soils were generally skeletal sandy clay loams, with greater than 80% stony detrital material, over (frequently exposed) massive, banded iron formation. Rocky, sheltered ridges often had a suite of specialist plants or species more typical of lowlands.

Undulating, low stony plains in valleys had Bloodwood Corymbia hamersleyana over sparse mixed shrubs and various species of spinifex. Alluvial flats had Mulga Acacia aneura and other Acacia communities over moderately rich assemblages of shrubs, herbs and tussock grasses, as well as spinifex Triodia wiseana and T. pungens (although spinifex was much less conspicuous in this community than in those above). Soils varied from relatively deep, stony, red clay loams on low undulating plains to deep red clay loam soils with massive clay substrates on Mulga flats.

The drainage lines in the study area varied from small gullies in upper hills to some of the major creeklines in the Hamersley Ranges (Weeli Wolli, Yandicoogina and Marillana Creeks). Small, stony creeks in hills differed very little from the vegetation type surrounding them, and were usually species poor with occasional eucalypts over Triodia aff. basedowii and T. wiseana. Lower in the landscape, they become more densely vegetated and species rich, including Eucalypt and Bloodwood species, shrubs, annual and perennial tussock grasses and herbs. Major creeklines had woodlands and forests of River Red Gum Eucalyptus camaldulensis, Coolibah E. victrix and other tree species over mixed shrublands, grasslands and herbs. Spinifex (usually Triodia pungens or T. longiceps) was comparatively sparse in drainage lines. Typical shrubs in drainage lines included Acacia coriacea subsp. pendens (major creeks only), A. anistocarpa (mainly in minor creeks), A. bivenosa, A. pyriformia, A. tumida var. pilbarensis, Gossypium robinsonii and Petalostylis labicheoides. Major creeks sometimes had areas of apparent permanent or persistent water, that supported specialised water plants.
4.1.2 Description of Individual Vegetation Types

Vegetation types recorded from the Yandi Expansion area are described in more detail below. Vegetation was considered to be in excellent condition, unless otherwise specified.

1. Low Stony Hills

1a. *Hakea chordophylla* scattered low trees over *Grevillea wickhamii* scattered shrubs to open shrubland over *Acacia hilliana* and *Ptilotus rotundifolius* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland

This vegetation was recorded from skeletal stony hillcrests. Occasional low trees of *Eucalyptus leucophloia* were also noted, and there were often patches of *Triodia wiseana* on hillcrests. Other associated species: *Acacia aneura* (flat curved; MET 15548), *A. dictyophleba*, *Aristida contorta*, *A. holathera* var. *holathera*, *Dysphania rhadinostachya*, *Eucalyptus leucophloia*, *Senna glutinosa* subsp. *luerssenii*, *Solanum lasiophyllum*, *Triodia pungens* and *T. wiseana*. Sites YEX35, YEX37.

1b. *Eucalyptus leucophloia* low open woodland over *Acacia hilliana* and *A. adoxa* var. *adoxa* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland

This vegetation was recorded from skeletal hillslopes and low stony hills. Steeper slopes and slopes of creeks and gullies sometimes had patches of *Triodia wiseana* mid-dense hummock grassland. Other associated species: *Acacia aneura* (flat curved; MET 15548), *A. inaequilatera*, *Amphipogon caricinus*, *Bulbostylis barbata*, *Dampiera candidans*, *Grevillea wickhamii*, *Ptilotus calostachyus*, *Triodia pungens* and *T. wiseana*. Sites YEX01, YEX06, YEX13, YEX24, YEX30, YEX36.

1c. *Eucalyptus leucophloia*, *Corymbia ferricola* scattered low trees over *Eremophila latrobei* subsp. *filiformis* ms., *Senna* spp. scattered shrubs over *Cymbopogon ambiguus*, *Eriachne mucronata*, *Themeda* sp. Mt. Barricade and *T. triandra* open tussock grassland

The vegetation of exposed ridges and rocky gullies was variable, and often included species typical of low-lying areas. Other associated species: *Acacia pruinocarpa*, *Enchylaena tomentosa*, *Eriachne pulchella* subsp. *dominii*, *Gomphrena cunninghamii*, *Polycarpaea* spp., *Rhadodia eremaea*, *Rhodanthe margarethae*, *Salsola tragus*, *Triodia pungens* and *T. wiseana*. Releves YEX-B, YEX-D, YEX-H (two latter releves not shown on map as locations not recorded).

1d. *Eucalyptus gamophylla* low open woodland over *Acacia ancistrocarpa* open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland

This vegetation was recorded from detrital stony baseslopes. Other associated species: *Acacia tenuissima*, *Goodenia stobbsiana*, *Grevillea wickhamii*, *Sida arenicola* and *Triodia pungens*. Site YEX05.

1e. *Acacia inaequilatera*, *Grevillea wickhamii* scattered shrubs over *Triodia wiseana* mid-dense hummock grassland and *Paraneurachne muelleri* very open grassland

This vegetation was recorded from skeletal stony hillcrests. Other associated species: *Aristida holathera* var. *holathera*, *Corymbia hammersleyana*, *Cymbopogon ambiguus*, *Schizachyrium fragile* and *Solanum phlomoides*. Site YEX22.

1f. *Corymbia hammersleyana* scattered low trees over *Acacia inaequilatera*, *Grevillea wickhamii* scattered tall shrubs to tall open shrubland over *Acacia ancistrocarpa* open shrubland over *Acacia adoxa* var. *adoxa*, *Ptilotus calostachyus*, *Gompholobium polyzygum* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland

This vegetation was recorded from low undulating stony hills (burnt 1-2 years ago). Occasional *Eucalyptus leucophloia* or *E. gamophylla* were sometimes noted. Other associated species: *Acacia pruinocarpa*, *Corchorus lasiocarpus* subsp. *parvus*, *Hakea chordophylla*, *Ptilotus exaltatus*, *Senna notabilis* and *Sida arencola*. Site YEX18 and releve YEX-A.

1g. *Acacia pruinocarpa*, *Acacia aneura* (flat curved; MET 15 548) scattered low trees over *Eremophila fraseri*, *Senna glutinosa* subsp. *luerssenii* over *Triodia* aff. *basedowii* mid-dense hummock grassland

This vegetation was recorded from small low stony hills. Other associated species: *Aristida contorta*, *Dysphania rhadinostachya*, *Maireana vilosa*, *Paraneurachne muelleri*, *Solanum lasiophyllum* and *Triodia wiseana*. Site YEX12.
2. Valleys (Mosaic Communities)

2a. Corymbia hammersleyana open woodland over Acacia inaequilateral, A. dictyophleba, A. tenuiissima, A. anistocarca, A. sclerosperma, A. pruinocarca, Hakea chordophylla, Eremophila longiflora tall open shrubland to open shrubland over Triodia spp mid-dense hummock grassland

This vegetation was recorded from detrital stony lowlands adjacent to Yandicoogina Creek. The dominant spinifex species was variable depending on soil and local aspect, and this vegetation type is therefore a mosaic. The dominant species was typically Triodia aff. basedowii near hills or on alluvial clay-loam drainage flats, Triodia lanigera on valley floors and plains, or Triodia pungens near creeks and on alluvial clay flat areas. Aristida holothera var. holothera was present as a scattered tussock grass, becoming dense in areas burnt 1-2 years ago. Other associated species: Acacia aff. aneura (scythe-shaped; MET 15 743), Corchorus aff. lasiocarpus subsp. lasiocarpus, Eragrostis eriopoda, Eucalyptus gamophylla, Eulalia aurea, Gossypium austral, Paraneurachne muelleri, Ptilotus astrolasius var. astrolasius, Sida aff. cardiophylla (Site 1215) and S. arenicola. Sites YEX10, YEX14, YEX15, YEX27, YEX31.

2b. Mosaic of Mulga Acacia aneura and other Acacia species on clay flats, including:

2b.1 Eucalyptus xerothermica, Acacia aneura low open woodland over Acacia bivenosa open shrubland over Themeda triandra, Paraneurachne muelleri open tussock grassland and Triodia wiseana and/or Triodia pungens open hummock grassland.

This vegetation was recorded from shallow drainages and flats. Aristida holothera var. holothera was often prominent in recently burnt areas. Other associated species: Acacia pruinocarca, Aristida contorta, Corymbia hammersleyana, Eulalia aurea, Gossypium austral, Ptilotus astrolasius var. astrolasius, P. calostachyus, Senna artemisioides subsp. oligophylla and S. notabilis. Sites YEX04, YEX19 (burn regrowth).

2b.2 Acacia aneura (flat curved; MET 15 548), Acacia ayersiana, A. pruinocarca, Eucalyptus xerothermica low woodland over Eremophila forestii, Senna artemisioides subsp. helmsii shrubland over Aristida contorta, A. inaequiglumis, Enneapogon polyphyllus open annual grassland and mixed very open herbland.

This vegetation was recorded from flats. Other associated species: Acacia tenuissima, Codonocarpus cotinifolius, Cymbopogon ambiguus, Eremophila longifolia, Pterocaulon sphaeranthoides and Triodia lanigera. Site YEX09.

2b.3 Acacia pruinocarca, A. synchronia, Acacia aneura tall open shrubland over Senna glutinosa subsp. x luerssenii open shrubland over Triodia wiseana (T. pungens) hummock grassland

This vegetation was recorded from loamy flats adjacent to Weeli Woll Creek. An open annual grassland dominated by Aristida contorta was also often recorded. Other associated species: Acacia bivenosa, A. dictyophleba, Enneapogon lindleyanus, Ptilotus exaltatus, Senna artemisioides subsp. helmsii, S. artemisioides subsp. oligophylla and Solanum lasiophyllum. Sites YEX03, YEX32 and relieve YEX-N.

2c. Acacia dictyophleba, A. pruinocarca, Acacia pachycara, A. inaequilateral, A. anistocarca tall open shrubland to shrubland over Senna artemisioides subsp. oligophylla low shrubland over Triodia lanigera mid-dense hummock grassland

This vegetation was recorded from semi-sandplain habitat in an alluvial fan. Triodia pungens was common in lower lying areas, and an open tussock grassland of Eragrostis eriopoda and Paraneurachne muelleri was also often recorded. Other associated species: Aristida holothera var. holothera, Goodenia micropteris, Hakea lorea subsp. lorea, Ptilotus astrolasius var. astrolasius, Senna notabilis, Scaevola parvifolia subsp. pilbarae and Senna notabilis. Sites YEX23, YEX33.

3. Creeks

3a. Eucalyptus leucophloia, Corymbia hammersleyana low open woodland over Acacia tumida var. pilbarensis, A. bivenosa, A. anistocarca, Petalostylis labicheoides, Grevillea wickhamii tall open shrubland over Acacia adoxa var. adoxa, A. hilliana low open shrubland over Triodia spp mid-dense hummock grassland with Themeda triandra and Paraneurachne muelleri very open tussock grassland

This vegetation was recorded from stony minor creeks including rocky gullies, occurring on skeletal sandy clay loams. Eucalyptus gamophylla was also sometimes recorded. The hummock grassland was variably dominated by Triodia pungens (in creekbeds, low in the landscape) or T.
aff. basedowii and T. wiseana (on stony banks). Other associated species: Acacia dictyophleba, A. tenuissima, Bonamia pannosa, Eragrostis cumingii, Eulalia aurea, Hakea chordophylla and Ptilotus obovatus var. obovatus. Site YEX26 and releves YEX-G, YEX-J.

3b. Corymbia hammerleyana open woodland over Acacia tumida var. pilbarensis, A. dictyophleba, A. pyrifolia, Gossypium rossinii, Petalostylis labicheoides, Grevillea wickhamii, Rulingia luteiflora, Eremophila longifolia mixed shrubland to open shrubland over Triodia pungens open hummock grassland and Themeda triandra tussock grassland
This vegetation was recorded from clay loam substrates in secondary creeks. Paraneurachne muelleri and Eragrostis cumingii were also typically recorded from the grass stratum. Condition of this vegetation was considered to be Very Good to Excellent (some areas were invaded by Buffel grass *Cenchrus ciliaris). Other associated species: Acacia bivenosa, A. citrinoviridis, A. sclerosperma, Centipeda minima, *Conyza bonariensis, Eragrostis tenellula, Eucalyptus victrix, E. xerothermica, Ptilotus obovatus var. obovatus, Senna artemisioides subsp. oligophylla x helmsi, Sida aff. fibulifera and Sida sp. spiciform panicles. Sites YEX07, YEX08, YEX11, YEX20, YEX34.

3c. Eucalyptus camaldulensis open woodland over Acacia citrinoviridis, A. coriacea subsp. pendens, A. pruinocarpa, Hakea lorea subsp. lorea, Atalaya hemiglauca low open woodland over Stylolobium spathulatum, Gossypium rossinii open shrubland over *Cenchrus ciliaris closed tussock grassland
This vegetation was recorded from clay substrates on a major creek floodbank (Weeli Wolli Creek). It was in very poor condition, due to invasion by Buffel grass *Cenchrus ciliaris. Other associated species: Cyperus vaginatus, Eucalyptus victrix, *Malvastrum americanum, Ptilotus obovatus var. obovatus, Rulingia luteiflora and Themeda triandra. Site YEX02.

3d. Eucalyptus camaldulensis and E. victrix scattered trees over scattered mixed shrubs, sedges, tussock grasses and Triodia pungens
This vegetation type was recorded from a major creek channel, from areas of scoured coarse river sand. Occasional Silver Cadjeput Melaleuca argentea trees were recorded. Permanent water areas sometimes had the aquatic or semi-aquatic species Bulrush Typha domingensis, Potamogeton tricarinatus and Schoenoplectus subulatus and fringing plants such as Cyperus vaginatus, Lobelia quadrangularis and Ammarnia spp. Condition was considered to be Very Good, with scattered weeds including Buffel grass *Cenchrus ciliaris, Mexican poppy *Argemone ochroleuca and Ruby dock *Acetosa vescaria. Other associated species: Acacia coriacea subsp. pendens, A. tumida var. pilbarensis, Atalaya hemiglauca, Cleome viscosa, Corchorus crozophorifolius, Eragrostis tenellula, Eulalia aurea, Melaleuca glomerata, Pluchea rubelliflora, Rostellaria adscendens, Stemodia grossa, Themeda triandra and Wahlenbergia tumidiflucta. Sites YEX16, YEX28 and releves YEX-E, YEX-K, YEX-L.

3e. Eucalyptus victrix woodland over Acacia coriacea subsp. pendens, Atalaya hemiglauca and Melaleuca glomerata tall open shrubland over Triodia pungens open hummock grassland over Cymbopogon dependens, Eulalia aurea and Themeda triandra open tussock grassland
This vegetation type was recorded from coarse river sand in a secondary braided channel of a major creek. Scattered Silver Cadjeput Melaleuca argentea trees occurred in some areas. Condition was considered to be Very Good, with occasional weeds including Buffel grass *Cenchrus ciliaris and Mexican poppy *Argemone ochroleuca. Other associated species: Acacia citrinoviridis, A. pyrifolia, Cleome visciosa, Corchorus crozophorifolius, Cyperus vaginatus, Cymbopogon obtectus, Enneapogon pilbarensis, Erichae helmsi, Eucalyptus camaldulensis, *Malvastrum americanum, Pluchea dentex, Stemodia grossa and Tephrosia rosea var. glabrior. Sites YEX21, YEX25, YEX39.

3f. Acacia citrinoviridis, A. coriacea subsp. pendens low open forest over Acacia pyrifolia scattered tall shrubs over Corchorus crozophorifolius, Tephrosia rosea var. glabrior scattered low shrubs to low open shrubland over Triodia pungens very open hummock grassland and Themeda triandra, *Cenchrus ciliaris open grassland
This vegetation type was recorded from clay loam in a major creek flood-out. Occasional Coolibah Eucalyptus victrix trees were also noted. Condition was considered to be Very Good, due to some patches of Buffel grass *Cenchrus ciliaris in Yandicoogina Creek. Other associated species: Atalaya hemiglauca, Cleome viscosa, Corymbia ferritica, Eragrostis cumingii, Erichae tenuiculmis, Polycarpaea longiflora and Triodia pungens. Site YEX17 and releves YEX-M.
3g. *Corymbia hamersleyana* scattered low trees over *Acacia citrinoviridis, A. pruinocarpa* low open woodland over *Triodia longiceps* mid-dense hummock grassland and *Cenchrus ciliaris* tussock grassland

This vegetation type was recorded from clay loam substrate in a major creek (Weeli Wolli Creek) flood-out area. Condition was considered to be poor to very poor due to invasion by Buffel grass *Cenchrus ciliaris*. Other associated species: *Acacia bivenosa, Aristida inaequiglumis, Atalaya hemiglauca, Enneapogon polyphyllus, Eragrostis eriopoda, Paraneurachne muelleri, Ptilotus obovatus var. obovatus and Themeda triandra*. Site YEX38.

3h. *Eucalyptus victrix* woodland to open woodland over *Acacia citrinoviridis* low open woodland over *Atalaya hemiglauca, Acacia tumida var. pilbarensis, A. bivenosa, Petalostylis labicheoides, Gossypium robinsonii* shrubland to tall shrubland over *Triodia pungens* hummock grassland and *Themeda triandra* open tussock grassland

This vegetation type was recorded from stony clay loam in a major creek flood-out (Yandicoogina Creek). Other associated species: *Acacia pyriformia, Aristida inaequiglumis, *Cenchrus ciliaris, Digitaria brownii, Enneapogon lindleyanus, Eriachne mucronata, Eulalia aurea, Hakea lorea subsp. lorea, Hybanthus aurantiacus, Pluchea dentex, Porana commixta and Stemodia grossa*. Site YEX29 and Releve YEX-F.

### 4.1.3 Area of Individual Vegetation Types

The area of each vegetation type within the Yandi Expansion area is shown in Table 4.1. (The unmapped section is the area that was lacking aerial photography.) The vegetation types with the smallest areal extent in the study area were units 3c and 3g (both associated with major creeklines) and unit 1c (occurring on breakaways).

**Table 4.1:** Area of each vegetation type within the Yandi Expansion area.

<table>
<thead>
<tr>
<th>Vegetation Type</th>
<th>Total area mapped within the Yandi Expansion area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Stony Hills</td>
<td></td>
</tr>
<tr>
<td>1a</td>
<td>221.41</td>
</tr>
<tr>
<td>1b</td>
<td>743.10</td>
</tr>
<tr>
<td>1c</td>
<td>5.49</td>
</tr>
<tr>
<td>1d</td>
<td>49.80</td>
</tr>
<tr>
<td>1e</td>
<td>44.28</td>
</tr>
<tr>
<td>1f</td>
<td>63.51</td>
</tr>
<tr>
<td>1g</td>
<td>17.42</td>
</tr>
<tr>
<td>Valley Floors</td>
<td></td>
</tr>
<tr>
<td>2a</td>
<td>217.38</td>
</tr>
<tr>
<td>2b</td>
<td>199.49</td>
</tr>
<tr>
<td>2c</td>
<td>43.88</td>
</tr>
<tr>
<td>Creeks</td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>207.68</td>
</tr>
<tr>
<td>3b</td>
<td>157.09</td>
</tr>
<tr>
<td>3c</td>
<td>1.12</td>
</tr>
<tr>
<td>3d</td>
<td>36.91</td>
</tr>
<tr>
<td>3e</td>
<td>84.34</td>
</tr>
<tr>
<td>3f</td>
<td>66.44</td>
</tr>
<tr>
<td>3g</td>
<td>1.79</td>
</tr>
<tr>
<td>3h</td>
<td>36.08</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2197.22</strong></td>
</tr>
</tbody>
</table>
Legend

- Burnt August 2004

### Biota Vegetation Sites

#### Priority Flora

- **Of**: Olea suliva
- **Sa**: Sida sp. Barlee Range (5 van Leeuwen 1642)
- **At**: Abutilon tridentati
- **Tc**: Thesaretty Papaw / Chameleon (M.E. Trudgen 11421)
- **Gs**: Goodenia stellata

#### Weeds

- **Ab**: Argemone ochroleuca subsp. ochroleuca
- **Av**: Acetosa vesicaria
- **Bb**: Bidens bipinnata
- **Cb**: Convolvus benjami
- **Cg**: Conchirus ciliatus
- **Ds**: Datura lechhardtii
- **Ma**: Malvastrum americanum
- **Ps**: Pseudophyllium lutealbum
- **Cr**: Cryptostegia gracilis
- **Sn**: Solanum nigrum
- **Sc**: Sennos sp. 2
- **Sc**: Sonchus elaeaceus
- **Sy**: Setaria verticillata

### 1. Hills

1a. **Hakea chordophylla** scattered low trees over *Grevillea wickhamii* scattered shrubs to open shrubland over *Acacia hilliana* and *Peltophorum reticulatum* low open shrubland over *Triodia sp.* basedowii mid-dense hummock grassland

1b. **Eucalyptus leucoxylon** low open woodland over *Acacia hilliana* and *A. adoxa var. adoxa* low open shrubland over *Triodia sp.* basedowii mid-dense hummock grassland

1c. **Eucalyptus leucoxylon**, *Corokia ferruginea* scattered low trees over *Eremophila latispans* subsp. *filiiformis* **rs**, *Senna* spp. scattered shrubs over *Cymbopogon ambiguus*, *Eriachne muronata*, *Thesareia sp.*, Mt Barracade and T. triandra open tussock grassland

1d. **Eucalyptus gamophylla** low open woodland over *Acacia aneura* open shrubland over *Triodia aff. basedowii* mid-dense hummock grassland

1e. **Acacia inaequilateralis**, *Grevillea wickhamii* scattered shrubs over *Triodia wiseana* mid-dense hummock grassland and *Paraneurachne muelleri* open grassland

1f. *Corokia harmsleyana* scattered low trees over *Acacia harmsleyana*, *Grevillea wickhamii* scattered shrubs to tall open shrubland over *Acacia aneura* open shrubland over *Acacia adoxa var. adoxa*, *Pillicola tuberculata*, *Doryphillus polygynus* low open shrubland over *Triodia aff. basedowii* mid-dense hummock grassland

1g. **Acacia punicea**, **Acacia aneura** (flat curved; MET 15548) scattered low trees over *Eremophila fraseri*, *Senna glutinosa* subsp. *luerssenii* over *Triodia aff. basedowii* mid-dense hummock grassland

### 2. Valleys (Mosaic Communities)

2a. *Corokia harmsleyana* open woodland over *Acacia inaequilateralis*, *A. dicyophleba*, *A. tenuissima*, *A. aneura*, *A. sclerosperma*, *A. punicea*, *Hakea chordophylla*, *Eremophila longifolia* tall shrubs to open shrubland over *Triodia aff. basedowii* mid-dense hummock grassland

2b. **Mosaic of Mulga**, *Acacia aneura* and other *Acacia* species on clay flats, including:

- 2b1. **Eucalyptus venterima**, *Acacia aneura* low open woodland over *Acacia bivenosa* open shrubland over *Thesareia triandra*, *Paraneurachne muelleri* open tussock grassland and *Triodia wiseana* and/or *Triodia dunnii* open hummock grassland

- 2b2. *Acacia aneura* (flat curved; MET 15548), *Acacia aveniata*, *A. punicea*, *Eucalyptus venterima* low woodland over *Eremophila forresti*, *Senna artemisia* subsp. *heliosis* shrubland over *Aristida contorta*, *A. inequidens*, *Enneapogon polyphyllus* open annual grassland and mixed very open herbland

- 2b3. *Acacia punicea*, *A. synchronica*, *A. aneura* tall open shrubland over *Senna glutinosa* subsp. *luerssenii* open shrubland over *Triodia wiseana* and/or *T. pungens* hummock grassland

- 2c. **Acacia dicyophleba**, *A. punicea*, *A. pachyaera*, *A. inaequilateralis*, *A. aneura* tall open shrubland to shrubland over *Senna artemisia* subsp. *oligophylla* low shrubland over *Triodia angustata* mid-dense hummock grassland
### 3. Creeks

| 3a | Eucalyptus leucoxylon, Corymbia hamesleyana low open woodland over *Acacia turida var. pilbarensis*, *A. bivenosa*, *A. anistocarpa*, *Petalostylis labioides*, *Grevillea williamiana* tall open shrubland over *A. adoxa var. adoxa*, *A. hilliana* low open shrubland over *Triodia* spp., mid-dense hummock grassland with *Themeda triandra* and *Parramournah fusuliferi* very open tussock grassland |
| 3b | Corymbia hamesleyana open woodland over *Acacia turida var. pilbarensis*, *A. dictyophleba*, *A. pyrfolia*, *Gossypium rossii*, *Petalostylis labioides*, *Grevillea williamiana*, *Kulpinga lutesifera*, *Eremophila longifolia* mixed shrubland to open shrubland over *Triodia pungens* open hummock grassland and *Themeda triandra* tussock grassland |
| 3c | Eucalyptus camaldulensis open woodland over *Acacia citrinoviridis*, *A. coriacea* subsp. pendens, *A. prinicarca*, *Hakea leuea* subsp. leuea, *Aralia hemiglaucia* low open woodland over *Stylotusum spathulatum*, *Gossypium rossii* open shrubland over *Cenchclus ciliaris* closed tussock grassland |
| 3d | Eucalyptus camaldulensis and *E. victrix* scattered trees over scattered mixed shrubs, sedges, tussock grasses and *Triodia pungens* |
| 3e | Eucalyptus victrix woodland over *Acacia turida var. pilbarensis*, *A. bivenosa*, *A. coriacea* subsp. pendens, *Grevillea hilliana* and *Mesora* glomerata tall open shrubland over *Triodia pungens* open hummock grassland over *Cymbopogon dependens*, *Eulalia aures* and *Themeda triandra* open tussock grassland |
| 3f | *Acacia citrinoviridis*, *A. coriacea* subsp. pendens low open forest over *Acacia pyriformis* scattered tall shrubs over *Cenchclus ciliaris* *crozophyllidius*, *Tephrosia rosea* var. *glabra* scattered low shrubs to low open shrubland over *Triodia pungens* very open hummock grassland and *Themeda triandra* *Cenchclus ciliaris* open grassland |
| 3g | Corymbia hamesleyana scattered low trees over *Acacia citrinoviridis*, *A. prinicarca* low open woodland over *Triodia longiceps* mid-dense hummock grassland and *Cenchclus ciliaris* tussock grassland |
| 3h | Eucalyptus victrix woodland to open woodland over *Acacia citrinoviridis* low open woodland over *Aralia hemiglaucia*, *Acacia turida var. pilbarensis*, *A. bivenosa*, *Petalostylis labioides*, *Gossypium rossii* shrubland to tall shrubland over *Triodia pungens* hummock grassland and *Themeda triandra* open tussock grassland |

**No Aerial Coverage**
4.2 Vegetation Condition

The study area had been partially burnt two weeks prior to the survey; approximately a third of the study area was affected (Figure 4.1). Fire is a part of the landscape, however it is usually through lightning strikes in summer, or sometimes through methodological mosaic burns. The current burn was for pastoral purposes and was neither controlled like a mosaic burn nor during the summer months as would be expected of a lightning fire. Nonetheless, this area is expected to regenerate fully and the fire is therefore not considered to have decreased vegetation condition.

The main signs of disturbance resulting from human activities were land clearing and dust associated with mining activities, and the presence of weeds. Clearing was limited to the network of vehicle tracks and drill pads associated with exploration and development. Dust was evident on vegetation along main access tracks however this did not appear to be having an obvious effect on vegetation condition. Signs of cattle grazing were noted in creeklines in the northern portion of the study area and also in Weeli Wolli Creek at the southern end.

Thirteen weed species were recorded from the Yandi Expansion area, mostly from drainage areas (see Section 5.3). Buffel Grass (*Cenchrus ciliaris*) was widespread and abundant as a result of pastoral activities. The remaining species generally occurred as scattered individuals or in isolated patches.

The vegetation of the section of Weeli Wolli Creek within the study area was seriously degraded, with almost total cover of Buffel Grass in the understorey. The length of Weeli Wolli downstream from this point is also very degraded from pastoral activities (K. McCreery, pers. obs.). Upstream is the Weeli Wolli Springs, which is in excellent condition and an area of high conservation significance.

Yandicoogina Creek is a tributary of Weeli Wolli Creek. The vegetation of Yandicoogina Creek within the study area was in excellent condition west of the junction with Marillana Creek, and in moderately good condition for the remainder, with several weed species present (including Buffel Grass) but at very low density. It would therefore be quite vulnerable to future degradation if physical disturbance was to result in the proliferation of one or more weed species.

Marillana Creek is a tributary of Yandicoogina Creek. The short section of Marillana Creek within the study area was in moderately good condition, with several weed species recorded from the area but at relatively low densities.

With the exception of the floodbanks of Weeli Wolli Creek and tracks associated with mine activities, the vegetation was thus in Very Good to Excellent condition.

4.3 Vegetation Conservation Significance

4.3.1 Results of the PATN Analysis

As described in Section 3.2.4, the data from the Yandi Expansion study was included in a PATN analysis of 2160 sites from 19 survey areas in the Pilbara. A summary of the results of this analysis is shown in Table 4.2.

With the exception of a single relevé (YEX-J), all of the sites from the Yandi Expansion area occurred in floristic community types that have also been recorded from other areas in the Pilbara (see Table 4.2). Relevé YEX-J has been separated in a unique floristic group (group 42) at the 100-group level of classification, however this is a spurious result, as the relevé was actually incomplete (containing only five species) and should not have been included in the analysis.
It therefore appears that the vegetation types of the Yandi Expansion area are not restricted in the Pilbara in terms of their floristic composition. This is as expected, given that most of the landforms and flora species recorded are widespread in the Hamersley Range sub-region, and the Land Systems occurring in the study area are also widespread and relatively abundant. The vegetation types occurring on the low stony hills and plains dominating the project area comprise suites of common species for the area, and are likely to have a widespread distribution in this section of the Pilbara.

Vegetation types 1a, 1b, 1e and 1f (the *Triodia* aff. *basedowii* and *T. wiseana* hummock grasslands dominating the low stony hills of the study area) occurred entirely within group 54 at the 100-group level of the analysis. This floristic group was relatively common in the locality, including sites from low hills in the Hamersley Ranges only.

Vegetation type 1d (*Triodia* aff. *basedowii* hummock grasslands with an overstorey of *Eucalyptus gamophylla* and *Acacia ancistrocarpa*, indicative of deep loamy soils on stony detrital base-slopes) occurred in group 57 at the 100-group level of the analysis. Vegetation types 2a, 2b.1 and 2c of detrital lowlands and valley floors, and 3b of creeklines, also occurred mainly within group 57. This floristic group appears to include sites from more mesic areas such as low base-slopes, valley floors and shallow drainages. This group was relatively common in the locality, and again included only sites from the Hamersley Ranges.

Vegetation type 1g (*Triodia* aff. *basedowii* hummock grasslands with scattered Mulga and *Acacia pruinocarpa* on low stony hills in the central section of the study area) occurred in group 88 at the 100-group level of the analysis, along with vegetation types 2b.2 and 2b.3 of the valley floors, and vegetation type 3g in a flood-out area of Weeli Wolli Creek. All of these sites contained Mulga as a dominant or conspicuous species. Floristic group 88 was relatively widely distributed across the Hamersley Ranges, including sites from various different project areas (Table 4.2).

Vegetation type 3a of creeklines was split between groups 54 and 57, highlighting variability in floristic composition, even within structurally similar vegetation with common dominant species. As discussed previously, both of these floristic groups are widespread in the Hamersley Ranges.

Vegetation types 3c, 3d, 3e, 3f and 3h of creeklines were mainly in group 49 at the 100-group level, with occasional sites in group 40 (releve YEX-K) and group 48 (releve YEX-M). These floristic groups all comprised sites in creekline vegetation in the region, and all three groups were widespread in the Hamersley Ranges (Table 4.2).

### 4.3.2 Summary of Vegetation Types of Conservation Significance

Given that none of the vegetation types appear to be restricted in the region based on their floristic composition, none are considered to be of regional conservation significance. However, the vegetation types occurring in the major creeks in the study area (particularly in the section of Yandicoogina Creek west of the Marillana Creek junction) are of conservation value at the scale of the Hamersley Ranges.

Large creek systems that have persistent or available water do not occur extensively within the Hamersley Range. These typically have a high relative species richness; creek banks in particular may have over 100 species per standard 50 m by 50 m survey quad (a figure typically only rivalled by Mulga vegetation). The flora (and fauna) assemblage of these areas also includes numerous species that are restricted to and reliant on such habitat.

In addition, all ephemeral watercourses of the Hamersley sub-region are considered to be at risk, as they are frequently subject to threatening processes, particularly heavy grazing pressure and weed infestation (Kendrick 2003). Many creeklines in the Hamersley Range are seriously degraded by Buffel Grass (*Cenchrus ciliaris* and other *Cenchrus* species, the introduction and spread of which are a result of pastoral activities. They are often also
under serious threat from grazing and trampling by cattle and other introduced herbivores, as stock tend to gravitate towards them for foraging and shelter. Any major creeklines within the Hamersley Range supporting relatively intact vegetation are therefore of conservation significance.

While the section of Weeli Wolli Creek within the Yandi Expansion area is infested with Buffel Grass, the sections of Yandicoogina and Marillana Creeks currently have only minor levels of weeds. The vegetation types 3c, 3d, 3e, 3f and 3h, particularly within the latter two creeks, are therefore of high conservation value at the level of the Hamersley Ranges.

The other vegetation type of high conservation value at this scale is unit 1c (vegetation of breakaways). Although breakaways are widespread through the Hamersley Ranges, they comprise only a small proportion of the area, and typically support restricted flora species (sometimes including Priority taxa).
Table 4.2: Summary of number of sites from each project area in the 14-groups and 100-groups of the PATN analysis.

Numbers in brackets indicate the number of these sites with >5% cover of taxa with affinities to Mulga (i.e. *Acacia aneura*, *A. ayersiana*, *A. catenulata* and/or *A. minyura*).

<table>
<thead>
<tr>
<th>Project Area</th>
<th>14-groups</th>
<th>100-groups</th>
<th>14-groups</th>
<th>100-groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMGA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FMGB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDRAIL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDRAIL A/D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MILL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAN</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAACRD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WACOOWES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAEIMIWE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAFCBOR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAFEORIV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAHAMPAR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAHAMSMTN</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAHAMSTN</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAMTHER</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAMTLEA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAMTROB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WASA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YANEXP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPLANATION OF PROJECT CODES</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMGA</td>
</tr>
<tr>
<td>FMGB</td>
</tr>
<tr>
<td>HDRAIL</td>
</tr>
<tr>
<td>HDRAIL A/D</td>
</tr>
<tr>
<td>MILL</td>
</tr>
<tr>
<td>PAN</td>
</tr>
<tr>
<td>WAACRD</td>
</tr>
<tr>
<td>WACOOWES</td>
</tr>
<tr>
<td>WAEIMIWE</td>
</tr>
<tr>
<td>WAFCBOR</td>
</tr>
<tr>
<td>WAFEORIV</td>
</tr>
<tr>
<td>WAHAMPAR</td>
</tr>
<tr>
<td>WAHAMSMTN</td>
</tr>
<tr>
<td>WAMTHER</td>
</tr>
<tr>
<td>WAMTLEA</td>
</tr>
<tr>
<td>WAMTROB</td>
</tr>
<tr>
<td>WASA</td>
</tr>
<tr>
<td>YANEXP</td>
</tr>
</tbody>
</table>
5.0 Flora

5.1 General

A total of 319 taxa of native vascular flora from 150 genera belonging to 53 families was recorded from the Yandi Expansion area (see Appendix 1). Thirteen introduced species were also recorded (see Section 5.3).

The number of vascular flora recorded from the Yandi expansion area is comparable to the number of species recorded for surveys undertaken in similar areas of a similar size. The previous surveys of the Yandicoogina Junction area and southern transport corridor recorded 336 species from 57 families and 392 species from 60 families respectively (Mattiske and Associates 1995a, 1995b), however both areas were considerably larger than the current study area.

The families and genera with the greatest number of taxa are shown in Table 5.1. These families and genera are typically predominant in the vegetation of the central Pilbara, and usually have most representatives on flora lists from this region, due to their prominence in the Eremaean flora. Some of the families (eg. the Amaranthaceae, Malvaceae and Poaceae) are more species rich in the Northern flora and poorer in the Southern flora, while others (such as the Mimosaceae) are abundant in all three.

Table 5.1: Most species rich families and genera within the Yandi Expansion Area.

<table>
<thead>
<tr>
<th>Family</th>
<th>No. of Native Taxa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poaceae (grass family)</td>
<td>52</td>
</tr>
<tr>
<td>Malvaceae (hibiscus family)</td>
<td>31</td>
</tr>
<tr>
<td>Mimosaceae (wattle family)</td>
<td>29</td>
</tr>
<tr>
<td>Papilionaceae (pea family)</td>
<td>23</td>
</tr>
<tr>
<td>Asteraceae (daisy family)</td>
<td>18</td>
</tr>
<tr>
<td>Amaranthaceae (mulla-mulla family)</td>
<td>18</td>
</tr>
<tr>
<td>Chenopodiaceae (goosefoot family)</td>
<td>11</td>
</tr>
<tr>
<td>Convolvulaceae (morning glory family)</td>
<td>10</td>
</tr>
<tr>
<td>Myrtaceae (eucalypt/myrtle family)</td>
<td>10</td>
</tr>
<tr>
<td>Euphorbiaceae (spurge family)</td>
<td>9</td>
</tr>
<tr>
<td>Caesalpinaceae (cassia family)</td>
<td>9</td>
</tr>
<tr>
<td>Goodeniaceae (leschenaultia family)</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Genus</th>
<th>No. of Native Taxa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia (wattle family)</td>
<td>28</td>
</tr>
<tr>
<td>Ptilotus (mulla mulla family)</td>
<td>13</td>
</tr>
<tr>
<td>Sida (hibiscus family)</td>
<td>10</td>
</tr>
<tr>
<td>Abutilon (hibiscus family)</td>
<td>8</td>
</tr>
<tr>
<td>Hibiscus (hibiscus family)</td>
<td>8</td>
</tr>
<tr>
<td>Senna (cassia family)</td>
<td>8</td>
</tr>
<tr>
<td>Eriachne (grass family)</td>
<td>7</td>
</tr>
<tr>
<td>Tephrosia (pea family)</td>
<td>7</td>
</tr>
<tr>
<td>Goodenia (leschenaultia family)</td>
<td>7</td>
</tr>
<tr>
<td>Solanum (potato family)</td>
<td>7</td>
</tr>
<tr>
<td>Euphorbia (spurge family)</td>
<td>6</td>
</tr>
<tr>
<td>Triodia (grass family)</td>
<td>5</td>
</tr>
</tbody>
</table>

The most frequently encountered species through the area included: *Acacia bivenosa*, *A. dictyophleba*, *A. pruinocarpa*, *Aristida holathera var. holathera*, *Bulbostylis barbata*, *Corymbia hamersleyana*, *Dysphania rhadinostachya*, *Eriachne pulchella subsp. dominii*,...
Goodenia microptera, *G. stobbsiana*, *Gossypium australe* (Burrup Peninsula form), *Grevillea wickhamii*, *Paraneurachne muelleri*, *Polycarpaea holtzei*, *Porana commixta*, *Pterocaulon sphaeranthoides*, *Ptilotus astrolasius var. astrolasius*, *P. exaltatus*, *Senna glutinosa* subsp. *x luerssenii*, *Themeda triandra*, *Trichodesma zeylanicum* var. *zeylanicum*, *Triodia pungens*, *T. aff. basedowii* and *T. wiseana*. Some of these species were common dominant species in the area (eg. the spinifex *Triodia* spp.) or frequently contributed to vegetation structure (eg. the wattles *Acacia bivenosa* and *A. dictyophleba* and the eucalypt *Corymbia hamersleyana*). Others were species with wide environmental tolerance, but usually with low abundance (eg. *Eriachne pulchella* subsp. *dominii* and *Porana commixta*).

### 5.2 Flora of Conservation Significance

#### 5.2.1 Levels of Conservation Significance

While all native flora are protected under the *Wildlife Conservation Act 1950-1979*, a number of plant species are assigned an additional level of conservation significance based on the limited number of known populations and the perceived threats to these populations (Table 5.2). Species of the highest conservation significance are designated Declared Rare Flora (DRF), either extant or presumed extinct. Species that appear to be rare or threatened, but for which there is either insufficient information to properly evaluate their conservation significance or they are variously threatened to a lesser degree than DRF, are assigned to one of four Priority flora categories.

In addition, the presence of some flora species means that it may be necessary to refer proposals to the Federal Minister for the Environment under the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*). In the Pilbara, only the two DRF species *Lepidium catapycnon* and *Thryptomene wittweri* are currently listed under the *EPBC Act*.

**Table 5.2: Categories of conservation significance for flora species (Atkins 2004).**

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declared Rare Flora - Extant Taxa</td>
<td>Taxa that have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction or otherwise in need of special protection.</td>
</tr>
<tr>
<td>Declared Rare Flora - Presumed Extinct</td>
<td>Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently.</td>
</tr>
<tr>
<td>Priority 1 - Poorly Known Taxa</td>
<td>Taxa which are known from one or a few (generally &lt;5) populations which are under threat.</td>
</tr>
<tr>
<td>Priority 2 - Poorly Known Taxa</td>
<td>Taxa which are known from one or a few (generally &lt;5) populations, at least some of which are not believed to be under threat.</td>
</tr>
<tr>
<td>Priority 3 - Poorly Known Taxa</td>
<td>Taxa which are known from several populations, at least some of which are not believed to be under threat.</td>
</tr>
<tr>
<td>Priority 4 - Rare Taxa</td>
<td>Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.</td>
</tr>
</tbody>
</table>

#### 5.2.2 DRF and Priority flora previously recorded from the vicinity of the project area

One Declared Rare Flora and four Priority flora have been recorded previously in the vicinity of Yandi:

- *Lepidium catapycnon* (Declared Rare Flora);
- *Goodenia omearana* (Priority 1);
- *Olearia fluvialis* (Priority 2);
• Abutilon trudgenii (Priority 3);
• Goodenia stellata (Priority 4).

5.2.3 DRF and Priority flora recorded from the Yandi Expansion Area

The two DRF species known to occur in the Pilbara, Lepidium catapycnon and Thryptomene wittweri, were not recorded from the Yandi Expansion area. There are therefore no flora of significance under the EPBC Act in the survey area.

The survey recorded five Priority species (Table 5.3), each of which is discussed below. Locations of these species are shown on Figure 4.1.

<table>
<thead>
<tr>
<th>Species</th>
<th>Priority</th>
<th>Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olearia fluvialis</td>
<td>P2</td>
<td>1 (YEX-K)</td>
</tr>
<tr>
<td>Sida sp. Barlee Range (S van Leeuwen 1642)</td>
<td>P2</td>
<td>1 (YEX16)</td>
</tr>
<tr>
<td>Abutilon trudgenii ms.</td>
<td>P3</td>
<td>5 (YEX25, 27, 31, 32, 33)</td>
</tr>
<tr>
<td>Themeda sp. Hamersley Station (M.E. Trudgen 11431)</td>
<td>P3</td>
<td>1 (YEX23)</td>
</tr>
<tr>
<td>Goodenia stellata</td>
<td>P4</td>
<td>1 (YEX08)</td>
</tr>
</tbody>
</table>

- Olearia fluvialis  
  Priority 2
  This perennial, low-shrub form daisy was recorded as scattered individuals from releve YEX-K in Yandicoogina Creek (Figure 4.1).
  O. fluvialis was recorded from three sites during the West Angelas surveys (Trudgen and Casson 1998), and is also known from the Hamersley Range and Karijini National Park (Atkins 2004), and from Marillana Creek (Weston and Trudgen 1995; K. McCreery and M. Maier, pers. obs.). A collection of O. fluvialis was also made from the Shaw River, during another survey south-south-east of Port Hedland (Trudgen et al. 2002), and has been recorded from the Turner River and Chinnamon Creek (Biota and Trudgen 2002). This species appears to be quite uncommon, rather than rare, and is certainly restricted to sporadic populations in riverine habitats.

- Sida sp. Barlee Range (S van Leeuwen 1642)  
  Priority 2
  This low shrub was recorded as scattered individuals from a single site (YEX16) on the bank of Yandicoogina Creek (Figure 4.1). Five specimens of this species are currently lodged at the Western Australian Herbarium from four separate locations; Kookhabinna Gorge in the Barlee Range Nature Reserve, southwest of Turee Creek Homestead, west of Hamersley Homestead and near Tom Price.

- Abutilon trudgenii ms.  
  Priority 3
  This short-lived (1-2 years) low shrub is stimulated by fire and is consequently typically recorded from recently burnt areas. A. trudgenii is poorly collected, rather than rare, because of its straggly, open appearance and inconspicuous flowers.
  Specimens of A. trudgenii are lodged at the WA Herbarium from Cane River, Hillside Station, Goldsworthy and Tom Price. However, according to the Priority Species List this species is known from other locations including Warralong, Woodstock, Point Sampson, Karratha and Pannawonica (Atkins 2004). It has also been recorded from Yanrey Station on the eastern side of the Exmouth Gulf (M. Maier, pers. obs.), west of Dampier (Halpern Glick Maunsell 2000), south-south-east of Port Hedland (Trudgen et al. 2002), from the Hope Downs rail corridor (Biota and Trudgen 2002), the Fortescue Metals Group rail corridors (Biota 2004a, 2004b), and 23 times by Trudgen and Casson (1998) during the West Angelas surveys. This species is poorly collected rather than rare and should be removed from the Priority flora list.
During the current survey this species was recorded from five sites, mostly on alluvial clay flats (Figure 4.1, Table 5.3). It is probable that it will also be recorded from the recently burnt sections of the Yandi Expansion area when these are surveyed in 2005.

**Abutilon trudgenii ms.:** growth form, leaf, and fruit (note reflexed pedicels).

- **Themeda sp. Hamersley Station (ME Trudgen 11,431)**  
  Priority 3

This perennial tussock grass is from 1.3 to 1.8 m tall, and typically grows in red cracking clay in tussock grasslands or in clayey creeks. It often occurs as an occasional specimen but may form dense grasslands over large areas of cracking clay plains. It differs from the more common and widespread **Themeda triandra** by its larger size and sturdier culms and its pale bluish colouring (**T. triandra** has yellowish colouring).

Atkins (2004) lists **Themeda sp. Hamersley Station** as occurring at Karratha, Millstream, Hamersley Station, West Angelas and Coondewanna Flats. According to Florabase, there appear to be eight records of this species. It has also recently been observed at West Angelas and Wannamunna Flats (50km south-east of West Angelas) (Kelli McCreery, pers. obs.), and has been recorded from the Hope Downs rail corridor (Biota and Trudgen 2002) and Fortescue Metals Group rail corridors (Biota 2004a, 2004b).

During the current survey, **Themeda sp. Hamersley Station** was recorded from a single site (YEX23) on a floodplain north of Yandicoogina Creek (Figure 4.1).

- **Goodenia stellata**  
  Priority 4

This small rhizomatous perennial herb has been recorded from several localities in the West Angelas area (Trudgen and Casson 1998), and is known from numerous populations in the vicinity of Yandi (Weston and Trudgen 1995; Halpern Glick Maunsell 1997). It is also known from a number of additional Pilbara locations including Vampire Gorge, Sandstone and Erlistoun Station (Atkins 2004), and extends to the South Carnarvon Range in the Little Sandy Desert. Of concern with respect to this species is that what appear to be populations of numerous individuals (rosettes) may in fact be clones of one or a few individuals.

During the current survey, this species was recorded once from YEX08, in a tributary of Weeli Wolli Creek (Figure 4.1).

### 5.2.4 Other Flora of Conservation Interest

Several families and genera show a particularly high degree of speciation in the Pilbara (eg. the Malvaceae and Tiliaceae families, and the genera **Euphorbia**, **Indigofera** and **Tephrosia**). As a consequence of the sporadic nature of botanical collections from the Pilbara and the lack of resources for taxonomic research, there are numerous undescribed taxa, most of which are poorly collected.
The following undescribed flora are not listed as DRF or Priority species by CALM, but may still be of some conservation interest:

- **Euphorbia**  
The spurge genus *Euphorbia* in the Pilbara contains many more taxa than are currently recognised. The undescribed taxa recorded from the Yandi Expansion area have been recorded previously during surveys in the region and are not restricted to the project area.

- **Indigofera monophylla**  
*Indigofera 'monophylla' in the Pilbara contains a number of distinct entities. The forms present in the Yandi Expansion area are frequently recorded during surveys in the region.

- **Polymeria aff. ambiguа**  
The two forms of *Polymeria* with apparent affinities to *P. ambiguа* collected from the Yandi Expansion area have been recorded during previous surveys in the region and are not restricted.

- **Tephrosia**  
The pea genus *Tephrosia* contains many more taxa than are currently recognised for the Pilbara. The undescribed taxa recorded from the Yandi Expansion area have been recorded previously during surveys in the region.

- **Malvaceae**  
The Malvaceae family is in urgent need of a taxonomic revision, and most Pilbara surveys record undescribed taxa from this group. A number of the *Abutilon, Hibiscus* and *Sida* taxa collected from the Yandi Expansion area appear to represent undescribed taxa. While the status of these taxa is not known, all have been recorded during previous surveys in the region and are thus not restricted to the project area.

### 5.3 Introduced Flora

Thirteen species of introduced flora were recorded from the project area (Table 5.4). With the exception of *Sisymbrium irio*, which appears to be a new record for the Pilbara, all of the species are common weeds in the region. Drainage features are particularly susceptible to weeds, and most of the Yandi Expansion sites with substantial weed infestations were located in such habitats.

**Table 5.4:** Introduced flora recorded from the Yandi Expansion area.

<table>
<thead>
<tr>
<th>Species</th>
<th>Number of Records</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acetosa vesicaria</em> (Ruby Dock)</td>
<td>2 (YEX17, 25)</td>
</tr>
<tr>
<td><em>Argemone ochroleuca subsp. ochroleuca</em> (Mexican Poppy)</td>
<td>4 (YEX16, 17, 21, 25)</td>
</tr>
<tr>
<td><em>Bidens bipinnata</em> (Beggars Ticks)</td>
<td>3 (YEX09, 17, 25)</td>
</tr>
<tr>
<td><em>Cenchrus ciliaris</em> (Buffel Grass)</td>
<td>14 (YEX02, 03, 04, 08, 09, 16, 17, 20, 21, 23, 25, 27, 28, 29)</td>
</tr>
<tr>
<td><em>Cynodon dactylon</em> (Couch)</td>
<td>1 (YEX-K)</td>
</tr>
<tr>
<td><em>Datura leichhardtii</em> (Native Thornapple)</td>
<td>1 (YEX-K)</td>
</tr>
<tr>
<td><em>Malvastrum americanum</em> (Spiked Malvastrum)</td>
<td>9 (YEX02, 04, 08, 17, 20, 21, 25, 27, 29)</td>
</tr>
<tr>
<td><em>Pseudognaphalium luteoalbum</em> (Jersey Cudweed)</td>
<td>3 (YEX20, 39, YEX-K)</td>
</tr>
<tr>
<td><em>Setaria verticillata</em> (Whorled Pigeon Grass)</td>
<td>5 (YEX07, 16, 21, 25, YEX-L)</td>
</tr>
<tr>
<td><em>Sisymbrium irio</em> (London Rocket)</td>
<td>2 (YEX17, 21)</td>
</tr>
<tr>
<td><em>Sonchus oleraceus</em> (Common Sowthistle)</td>
<td>3 (YEX16, 21, YEX-K)</td>
</tr>
</tbody>
</table>

Distribution of the weed species was as follows (see also Figure 5.1):

- Ruby Dock *Acetosa vesicaria* occurred as scattered individuals at two sites, one in Marillana Creek and one in Yandicoogina Creek.
• Mexican Poppy *Argemone ochroleuca occurred as scattered individuals at one site in Marillana Creek and three sites in Yandicoogina Creek. Although this species is listed as a Declared Plant under the Agriculture and Related Resources Protection Act 1976, there are no specific requirements for its control in the Pilbara region; it is listed as P1 (movement of plants or their seeds is prohibited) for the whole of the State, except the municipal districts of Ashburton, East Pilbara, Port Hedland and Roebourne.

• Beggars Ticks *Bidens bipinnata is an annual daisy that is a common weed of creekside and Mulga habitats. It was recorded once from Marillana Creek, once from Yandicoogina Creek and once from a floodplain associated with a tributary of Weeli Wolli Creek.

• Buffel Grass *Cenchrus ciliaris was introduced as a fodder species by pastoralists. While this highly invasive species has demonstrated allelopathic capacities (whereby it releases chemicals that inhibit growth of other species), it is not listed as a Declared Weed due to its importance to the pastoral industry. In spite of this, *Cenchrus ciliaris is acknowledged by the Department of Agriculture Weed Science Group as a serious environmental problem and its spread is to be actively avoided (Rod Randall, pers. comm.). Dense grasslands of *Cenchrus are common along creeksides and on loamy plains in the Pilbara, particularly those that have been subject to disturbance. Within the Yandi Expansion area, *C. ciliaris was recorded from 14 sites, largely associated with the Yandicoogina, Marillana and Weeli Wolli Creek systems.

• Flaxleaf Fleabane *Conyza bonariensis is an occasional weed of drainage areas in the Pilbara and was recorded from two sites associated with the Yandicoogina Creek system.

• Couch *Cynodon dactylon was recorded from a single location in Yandicoogina Creek. It is a very occasional weed of inland drainage areas in the Pilbara.

• Native Thornapple *Datura leichhardtii was recorded from a single location in Yandicoogina Creek. As indicated by the common name, this species was originally thought to be native, however it is actually a native of Mexico (Hussey et al. 1997). While it remains a Declared Plant in other regions of Western Australia, *D. leichhardtii was removed from the Department of Agriculture’s Declared Plants list for the Eastern Pilbara in 2004 (Department of Agriculture 2004).

• Spiked Malvastrum *Malvastrum americanum was recorded as scattered individuals from nine sites, all located within the Yandicoogina, Marillana and Weeli Wolli Creek systems. This species can be abundant in creekline and Mulga habitats, particularly in good seasons.

• Jersey Cudweed *Pseudognaphalium luteoalbum was recorded from three sites associated with the Yandicoogina Creek system. This species is an occasional weed of drainage areas in the Pilbara.

• Whorled Pigeon Grass *Setaria verticillata was recorded as scattered individuals at three sites in Yandicoogina Creek, one site in Marillana Creek and one site in a tributary of Weeli Wolli Creek. In good seasons, this species can be abundant in some habitats.

• London Rocket *Sisymbrium irio was recorded as scattered individuals at two sites in Yandicoogina Creek.

• Black berry nightshade *Solanum nigrum was recorded as scattered individuals at two sites in Yandicoogina Creek.

• Common Sowthistle *Sonchus oleraceus was recorded as scattered individuals at three locations in Yandicoogina Creek. This species is a common weed of creek habitat in the Pilbara, but is rarely abundant.
6.0 Discussion

6.1 Summary of Features of Conservation Significance within the Yandi Expansion Area

Features of conservation significance have been assessed at the following levels:

1. National level – features at this level would essentially comprise nationally listed flora species (essentially Declared Rare Flora) or nationally listed Threatened Ecological Communities (including only some of the TECs listed at the State level) protected under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999;

2. State level – features at this level would essentially comprise species on the Declared Rare and Priority flora listing maintained by CALM or Threatened Ecological Communities listed by CALM;

3. Pilbara bioregion level – features at this level would include regionally restricted flora species and vegetation communities; and

4. Hamersley Ranges sub-region level – features at this level would include flora taxa of restricted distribution within the sub-region and ephemeral watercourses and other ecosystems as risk (see Kendrick 2003).

6.1.1 National Level

No flora species or Threatened Ecological Communities listed under the EPBC Act 1999 are known from the Yandi Expansion area. There are thus no features of national conservation significance within the project area.

6.1.2 State Level

At the State level, there are no Declared Rare Flora known from the Yandi Expansion area, however five Priority flora have been recorded. No Threatened Ecological Communities listed by CALM occur in the area.

6.1.3 Pilbara Bioregion Level

The vegetation types recorded from the study area do not appear to be restricted within the region in terms of their floristic composition. With the exception of the Priority flora (mainly *Olearia fluvialis* and *Sida* sp. Barlee Range (S van Leeuwen 1642)), the flora species recorded are relatively common and widespread in the region.

6.1.4 Hamersley Ranges Sub-region Level

The suite of flora species recorded from the Yandi Expansion area is largely typical of that expected for this part of the Hamersley Ranges. With the exception of *Sida* sp. Barlee Range (S van Leeuwen 1642), all of the Priority flora species have been recorded during other surveys in the locality. The study area thus has moderate conservation value for both general flora and significant flora species.

The following vegetation types are of conservation significance at the level of the Hamersley Ranges sub-region:

- 3c, 3d, 3e, 3f and 3h, associated with the Yandicoogina, Marillana and Weeli Wolli Creek systems; comprise an ecosystem at risk (Kendrick 2003) and support suites of species restricted to major creekline habitats; and
• 1c of breakaways; small areal extent and supports suites of species restricted to such rocky habitats.

6.2 Impacts of the Proposed Development

The proposed development is relatively small in scale, but is situated adjacent to existing mining operations along Marillana Creek. The initial impact of the development would comprise direct clearing of vegetation to establish the mine pit and infrastructure, with subsequent possible impacts including changes to surface and below ground hydrology. An increase in the level of weeds and fires within the area is also possible. While the impacts of the Yandi Expansion alone are unlikely to be significant, the proposed project is located along a creek system already subject to several other mining developments, and cumulative impacts therefore need to be considered.

6.2.1 Vegetation Clearing

Clearing of vegetation will be required for the mine pit area, a waste dump, and for establishment of infrastructure such as physical plant, a conveyor, an access track and haul road.

The area of each vegetation type required to be cleared for the proposed project (on the basis of the currently proposed mine plan) is shown in Table 6.1. A total of 511 ha will be cleared for the development.

Table 6.1: Area of each vegetation type to be cleared for the Yandi Expansion.

<table>
<thead>
<tr>
<th>Vegetation Type</th>
<th>Area to be cleared (ha)</th>
<th>Proportion of total area mapped within the Yandi Expansion area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Stony Hills</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1a</td>
<td>11.50</td>
<td>5.2</td>
</tr>
<tr>
<td>1b</td>
<td>213.97</td>
<td>28.8</td>
</tr>
<tr>
<td>1c</td>
<td>0.16</td>
<td>3.0</td>
</tr>
<tr>
<td>1d</td>
<td>27.13</td>
<td>54.5</td>
</tr>
<tr>
<td>1e</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1f</td>
<td>1.31</td>
<td>2.1</td>
</tr>
<tr>
<td>1g</td>
<td>12.29</td>
<td>70.6</td>
</tr>
<tr>
<td><strong>Valley Floors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a</td>
<td>27.06</td>
<td>12.4</td>
</tr>
<tr>
<td>2b</td>
<td>98.40</td>
<td>49.3</td>
</tr>
<tr>
<td>2c</td>
<td>34.99</td>
<td>79.7</td>
</tr>
<tr>
<td><strong>Creeklines</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Minor Creeks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>22.80</td>
<td>11.0</td>
</tr>
<tr>
<td>3b</td>
<td>52.58</td>
<td>33.5</td>
</tr>
<tr>
<td><strong>Major Creeks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3c</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>3d</td>
<td>0.34</td>
<td>0.9</td>
</tr>
<tr>
<td>3e</td>
<td>1.75</td>
<td>2.1</td>
</tr>
<tr>
<td>3f</td>
<td>1.11</td>
<td>1.7</td>
</tr>
<tr>
<td>3g</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>3h</td>
<td>0.97</td>
<td>2.7</td>
</tr>
<tr>
<td><strong>Unmapped</strong></td>
<td>4.60</td>
<td>8.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>510.96</strong></td>
<td><strong>22.7</strong></td>
</tr>
</tbody>
</table>

* would comprise vegetation types 1a, 1b and 3a.
Clearing in the vicinity of the significant vegetation types should be avoided where possible, and otherwise minimised. This essentially comprises riverine vegetation of Weeli Woll, Yandicoogina and Marillana Creeks (vegetation types 3c-3h) and vegetation of breakaways (vegetation type 1c). Based on the current mine plan, a total of 4.2 ha of riverine vegetation will be required to be cleared, together with 0.16 ha of breakaway habitat. Clearing of these small areas would not be expected to decrease the conservation value of these habitats in the locality.

Similarly, clearing of the locations supporting the five Priority flora species should be avoided wherever possible, particularly with respect to the less widespread Olearia fluvialis and Sida sp. Barlee Range (S van Leeuwen 1642). The current mine plan indicates that four of the locations of Abutilon trudgenii identified within the project area will be cleared (two along the heavy haulage road and two within the pit area) and the location of Goodenia stellata will be cleared to construct the eastern cut-off drain. Both of these species have been recorded numerous times in the locality, and the loss of these stands of individuals would not be expected to impact on the conservation status of the species.

6.2.2 Groundwater Drawdown

Drawdown of groundwater levels in underground aquifers as a result of mining below the watertable and/or water abstraction from borefields can impact phreatophytic vegetation dependent on such water sources (eg. Cadjeputs Melaleuca argentea, River Red Gums Eucalyptus camaldulensis and Coolibahs E. victrix). The nature of such impacts depends on the location, depth and extent of any drawdown cone, together with the speed of drawdown and timeframe of the impact.

Within the Yandi Expansion area, phreatophytic vegetation is restricted to the major creek systems of Yandicoogina, Marillana and Weeli Woll Creek. The sections of these creeks within the study area support various combinations of Cadjeput Melaleuca argentea, River Red Gum Eucalyptus camaldulensis, Coolibah E. victrix and an assemblage of aquatic plants, all of which are reliant on either surface water or ground water.

The degree of likely drawdown arising from the development, and therefore the distance along the creek alluvium that may be affected, are uncertain at present. Similarly the cumulative impacts of mine dewatering from the various operations along Marillana Creek are at present unknown. Hydrological studies for the Yandi Expansion area are under way and will be completed in 2005, and a study by the University of Western Australia is also being undertaken to investigate the probable impacts of groundwater drawdown on phreatophytic vegetation in the Yandi Expansion area.

6.2.3 Disposal of Excess Water

Water arising from dewatering of mine pits is typically utilised in mine operations wherever possible (eg. for dust suppression, cooling systems etc), with the aim of having nil discharge requirements. Where dewatering generates water quantities in excess of those that can be used on site, the excess is typically discharged into existing creek systems, provided that the water quality is appropriate. This can lead to the establishment of artificially high densities of riverine vegetation, which cannot be maintained post-closure.

Hydrological studies are currently under way to determine whether the proposed Yandi Expansion project will generate excess water from mine pit dewatering.

6.2.4 Disruption to Surface Hydrology

Given the presence of three major creek systems in the project area, care will need to be taken to minimise disruption to existing surface water flows.
Two crossings of Yandicoogina Creek will need to be constructed for a heavy haulage road and light vehicle access road; the former will be a causeway style crossing, while the latter will be bridged. Neither crossing would be expected to impede surface water flow through this creek system.

The mine pit and waste dump are located over the tributary system from the Weeli Wolli Creek in the southern section of the study area. The section of the tributary within the mine pit and waste dump areas will obviously be lost, while the remaining sections will need to be diverted around the mine pit via cut-off drains. This would result in a reduction in water input to the section of the creek tributary system downstream of the pit, which may effectively mean that a greater area will be lost than that immediately impacted by the mine pit and waste dump.

6.2.5 Introduction and/or Spread of Weed Species

Thirteen introduced flora species were recorded from the Yandi Expansion area, at least one of which is a serious environmental weed (Buffel grass *Cenchrus ciliaris; Section 5.3). Earthworks, disturbance to vegetation, vehicle movement and other factors have the potential to introduce additional weeds to the area and to spread existing populations of introduced flora within the development areas. The presence of cattle may add to the disturbance, through trampling and also selective grazing, as they tend to prefer native grasses to Buffel Grass.

Mesic habitats such as creeklines and floodplains are particularly susceptible to weed invasion. Within the Yandi Expansion area, the main areas supporting significant weed infestations were within Weeli Wolli Creek, and to a lesser extent areas of Marillana Creek and the section of Yandicoogina Creek downstream of the junction with Marillana Creek. Care will need to be taken to avoid spread of weeds into the section of Yandicoogina Creek upstream of the junction with Marillana Creek, particularly during construction of the light vehicle access road.

6.2.6 Increase in Fire Frequency / Intensity

The long-term effect of changed fire regimes on vegetation condition is unknown, however repeated burns can favour the spread of weeds such as Buffel Grass as these tend to recover before native grasses and herbs. In addition, frequent fires can prevent the regeneration of some vegetation communities (eg. Mulga) by continually removing stands of perennial species before they can reach reproductive maturity and replenish the soil seed bank.

6.2.7 Dust

Dust generated during the construction, operation and maintenance of the proposed mine has the potential to negatively affect surrounding vegetation, but this is considered to be a minor impact provided standard dust suppression measures are implemented.

6.3 Recommendations for Management

The following management strategies are aimed at minimising disturbance to the vegetation and flora of the Yandi Expansion area:

- Prior to construction, undertake rare flora searches in the areas burnt prior to this survey to ensure that any such populations are fully documented.

- Maintain surface drainage features, and minimise disturbance to the Marillana, Yandicoogina and Weeli Wolli Creek systems, wherever possible. Both direct (eg. vegetation clearing, possible discharge of excess water from mine dewatering) and
indirect (eg. groundwater drawdown, spread of weeds) mechanisms should be considered as part of the mine planning process. Impacts of such factors will need to be reviewed following completion of the hydrological and other studies.

- Avoid disturbance to the locations supporting Priority flora species wherever possible, particularly with respect to *Olearia fluvialis* and *Sida* sp. Barlee Range (S van Leeuwen 1642).

- Minimise disturbance to general vegetation and flora:
  - Clearing limits should be clearly defined in the field and strictly adhered to;
  - Existing tracks should be utilised wherever possible and off-road driving should be prohibited;
  - Appropriate weed hygiene measures should be carried out to minimise the risk of introduction/spread of weed propagules or infected soil (ie. standard washdown of earth-moving equipment should be done prior to any earthworks in the area of Yandicoogina Creek upstream of the Marillana Creek junction, and also prior to equipment leaving the Yandi Expansion area, to prevent spread of weeds into other areas).

**7.0 Acknowledgements**

Malcolm Trudgen (ME Trudgen & Associates) determined some of the flora specimens, particularly the Malvaceae, Tiliaceae and *Euphorbia*. His assistance with this study is gratefully acknowledged.
8.0 References


Beard J.S. (1975). Vegetation Survey of Western Australia. 1:100,000 Vegetation Series Mapsheet 5 - Pilbara.


Department of Agriculture (authors unknown) (2002). Land Systems Mapping of the Pilbara region, WA.

Department of Agriculture (2004). Declared plants list for Western Australia.


List of Vascular Flora Recorded from the Yandi Expansion Area
NB. - Use of an asterisk (*) prior to a species name indicates an introduced (weed) species.

**Acanthaceae**
- Dicladanthera forrestii
- Rostellularia adscendens subsp. clementii

**Adiantaceae**
- Chelanthes sieberi subsp. sieberi

**Aizoaceae**
- Trianthema glossostigma
- Trianthema pilosa

**Amaranthaceae**
- Acanthaceae
  - Dicladanthera forrestii
  - Rostellularia adscendens subsp. clementii
- Adiantaceae
  - Chelanthes sieberi subsp. sieberi
- Aizoaceae
  - Trianthema glossostigma
  - Trianthema pilosa
- Amaranthaceae
  - Achyranthes aspera
  - Alternanthera nana
  - Alternanthera nodiflora
  - Amaranthus pallidiflorus
  - Gomphrena cunninghamii
  - Ptitolus aervoides
  - Ptitolus astroslius var. astroslius
  - Ptitolus auriculifolius
  - Ptitolus calostachyus var. calostachyus
  - Ptitolus clementii
  - Ptitolus exaltatus var. exaltatus
  - Ptitolus fusiformis var. fusiformis
  - Ptitolus gaudichaudii var. gaudichaudii
  - Ptitolus helipteroides var. helipteroides
  - Ptitolus obovatus var. obovatus
  - Ptitolus polystachyus var. polystachyus
  - Ptitolus roei
  - Ptitolus rotundifolius
- Apiales
  - Trachymene oleracea subsp. oleracea
- Asclepiadaceae
  - Sarcostemma viminale subsp. australe

**Asteraceae**
- Achyranthes aspera
- Alternanthera nana
- Alternanthera nodiflora
- Amaranthus pallidiflorus
- Gomphrena cunninghamii
- Ptitolus aervoides
- Ptitolus astroslius var. astroslius
- Ptitolus auriculifolius
- Ptitolus calostachyus var. calostachyus
- Ptitolus clementii
- Ptitolus exaltatus var. exaltatus
- Ptitolus fusiformis var. fusiformis
- Ptitolus gaudichaudii var. gaudichaudii
- Ptitolus helipteroides var. helipteroides
- Ptitolus obovatus var. obovatus
- Ptitolus polystachyus var. polystachyus
- Ptitolus roei
- Ptitolus rotundifolius

**Asprocaceae**
- Trachymene oleracea subsp. oleracea

**Asclepiadaceae**
- Sarcostemma viminale subsp. australe

**Asteraceae**
- *Bidens bipinnata*
- Calotis plumulifera
- Centipeda minima
- Chrysocephalum apiculatum
* Conyza bonariensis
- Flaveria australasica
- Helichrysum gilesii
- Ixiochlamys cuneifolia
- Olearia fluvialis
- Pluchea dentex
- Pluchea dunlopii
- Pluchea fernandii-muelleri
- Pluchea rubelliflora
* Pseudognaphalium luteoalbum
- Pterocaulon sphaeranthoides
- Rodanthel floribunda
- Rodanthel margarethae
* Sonchus oleraceus
- Streptoglossa bubakii
- Streptoglossa decurrens
- Vittadinia arida
- Vittadinia obovata

**Boraginaceae**
- Heliotropium inexplicitum
- Heliotropium pachyphyllum
- Heliotropium tenuifolium
- Trichodesma zeylanicum var. zeylanicum

**Brassicaceae**
- Lepidium muelleri-ferdinandii
- Lepidium oxytrichum
- Lepidium phlebotetalum
* Sisymbrium irio

**Caesalpiniaeae**
- Petalostylis labicheoides
- Senna artemisioides subsp. x artemisioides
- Senna artemisioides subsp. helmsii
- Senna artemisioides subsp. oligophylla
- Senna artemisioides subsp. oligophylla x helmsii
- Senna glutinosa subsp. glutinosa
- Senna glutinosa subsp. x luerssenii
- Senna glutinosa subsp. pruinosa
- Senna notabilis

**Campanulaceae**
- Wahlenbergia tumidifructa

**Capparaceae**
- Capparis spinosa var. nummularia
- Cleome viscosa

**Caryophyllaceae**
- Polycarpea corymbosa var. corymbosa
- Polycarpea holtzei
- Polycarpea longiflora

**Chenopodiaceae**
- Chenopodium melanocephalum
- Dysphania kalpari
- Dysphania rhadinostachya
- Enchytraea tomentosa
- Maireana planifolia
- Maireana planifolia x villosa
- Maireana villosa
- Rhagodia eremaeae
- Salsola tragus
- Sclerolaena cornishiana
- Sclerolaena ericanthia

**Convolvulaceae**
- Bonamia media var. villosa
- Bonamia pannosa
- Bonamia rosea
- Convolvulus angustissimus subsp. angustissimus
- Evolvulus alsinoides var. decumbens
- Evolvulus alsinoides var. villosulcylyx
- Ipomoea muelleri
- Polymeria aff. ambigua (CGC-25)
- Polymeria aff. ambigua (PAN 26B-20)
- Porana commixta

**Cucurbitaceae**
- Mukia maderaspatana

**Cyperaceae**
- Bulbostylis barbata
- Cyperus difformis
Cyperus iria
Cyperus vaginatus
Eleocharis geniculata
Fimbristylis dichotoma
Fimbristylis simulans
Schoenoplectus subulatus
**Elatinaceae**
Bergia trimera
**Euphorbiaceae**
Euphorbia australis (mid-green form)
Euphorbia aff. australis (B191)
Euphorbia boophthona
Euphorbia coghlanii
Euphorbia sp. (site 1089)
Euphorbia tannensis subsp. eremophila (Hammersley form)
Leptopus decaisnei var. decaisnei
Phyllanthus erwinii
Phyllanthus maderaspatensis
**Goodeniaceae**
Dampiera candicans
Goodenia lamprosperma
Goodenia microptera
Goodenia muelleriana
Goodenia stellata
Goodenia stobbsiana
Goodenia triodiophila
Goodenia vilmoriniae
Scaevola parvifolia subsp. pilbarae
**Gyrostemonaceae**
Codonocarpus cotinifolius
**Haloragaceae**
Haloragis gossei
**Lamiaceae**
Clerodendrum tomentosum
Dicrastylis cordifolia
Dicrastylis georgei
**Lobeliaceae**
Lobelia quadrangularis
**Loranthaceae**
Amyema hilliana
Amyema miquelli
**Lythraceae**
Ammannia auriculata
Ammannia baccifera
Ammannia multiflora
**Malvaceae**
Abutilon dioicum
Abutilon fraseri
Abutilon lepidum
Abutilon aff. lepidum (1) (MET 15 352)
Abutilon aff. lepidum (4)
Abutilon macrum
Abutilon otocarpum
Abutilon trudgenii
Gossypium australe (Burrup Peninsula form)
Gossypium australe (Whim Creek form)
Gossypium rossianum
Gossypium sturtianum
Hibiscus brachychlaenus
Hibiscus burtonii
Hibiscus aff. coatesii (MET 15,642)
Hibiscus aff. coatesii (site 664)
Hibiscus goldsworthy
Hibiscus leptocladus
Hibiscus sturtii var. aff. campylochlamys (MET 15,957)
Hibiscus sturtii var. platychlamys
*Sida aff. cardiophylla*
*Sida aff. fibulifera* (Site 1394)
Sida arenicola
Sida cardiophylla
Sida echinocarpa
Sida sp. A Kimberley Flora (P.A.Fryxell & L.A.Craven 3900)
Sida sp. Barlee Range (S.van Leeuwen 1642)
Sida sp. spiciform panicles (E. Leyland sn 14/8/90)
Sida sp. Wittenoom (W.R. Barker 1,962)
Sida sp. 'rugose'
**Mimosaceae**
Acacia adoxa var. adoxa
Acacia adsurgens
Acacia ancistrocarpa
Acacia aneura var. aneura
Acacia aneura var. longicarpa
Acacia aneura var. aff. longicarpa (MET 16,050)
Acacia aneura (flat curved; MET 15 548)
Acacia aneura (grey bushy form; MET 15 732)
Acacia aff. aneura (scythe-shaped; MET 15,743)
Acacia ayersiana
Acacia bivenosa
Acacia citrinoviridis
Acacia colei var. colei
Acacia coriacea subsp. pendens
Acacia coriacea subsp. sericophylla
Acacia dictyophleba
Acacia elachantha
Acacia farnesiana
Acacia hilliana
Acacia inaequilatera
Acacia maitlandii
Acacia pachyacra
Acacia pruinocarpa
Acacia pyrifolia
Acacia scleropserma
Acacia synchronica
Acacia tenuissima
Acacia tumida var. pilbarenis
Dichrostachys spicata
**Molluginaceae**
Mollugo molluginis
**Moraceae**
Ficus brachypoda
Myoporaceae
Eremophila forrestii
Eremophila fraseri
Eremophila latrobei subsp. filiformis
Eremophila longifolia

Myrtaceae
Calytrix carinata
Corymbia candida subsp. candida
Corymbia hamersleyana
Eucalyptus camaldulensis
Eucalyptus gamophylla
Eucalyptus leptophloia
Eucalyptus victoria
Eucalyptus xerothermica
Melaleuca argentea
Melaleuca glomerata

Nyctaginaceae
Boerhavia coccinea
Boerhavia gardneri

Oleaceae
Jasminum didymum subsp. lineare

Papaveraceae
*Argemone ochroleuca subsp. ochroleuca

Papilionaceae
Crotalaria medicaginea
Crotalaria nova-hollandiae subsp. nova-hollandiae
Cullen leucanthum
Cullen leucochaites
Glycine canescens
Gompholobium polyzygum
Indigofera georgei
Indigofera monophylla
Indigofera monophylla (brown calyx form)
Indigofera monophylla (small calyx form)
Indigofera rugosa
Isotropis atropurpurea
Rhynchosia minima var. australis
Swainsona decurrens
Swainsona kingii
Tephrosia arenicola
Tephrosia aff. clementii (2)
Tephrosia densa
Tephrosia rosea var. glabrior
Tephrosia aff. supina (HD133-20)
Tephrosia sp. Bungaroo Creek (M.E.Trudgen 11601)
Tephrosia sp. Pilbara Ranges (S.van Leeuwen 4246)
Vigna lanceolata

Poaceae
Amphipogon caricinus
Amphipogon sericeus
Aristida contorta
Aristida holathera var. holathera
Aristida inaequiglumis
Aristida latifolia
*Chenchrus ciliaris

Chrysopogon falax
Cymbopogon ambiguus
Cymbopogon dependens
Cymbopogon obtectus
*Cyodon dactylon
Dichanthium sericeum subsp. humilis
Digitaria brownii
Digitaria ctenanthera
Elytrochis spicatus
Enneapogon caerulescens
Enneapogon celandii
Enneapogon lindleyanus
Enneapogon polyphyllus
Enteropogon acicularis
Eragrostis cumingii
Eragrostis dielsii
Eragrostis eriopoda
Eragrostis leptocarpa
Eragrostis pergracilis
Eragrostis tenellula
Eriachne aristidea
Eriachne helmsii
Eriachne lanata
Eriachne mucronata
Eriachne pulchella subsp. domini
Eriachne pulchella subsp. pulchella
Eriachne tenuiculmis
Eulalia aerea
Heteropogon contortus
Iseilema vaginiformum
Paraneurachne muelleri
Paspalidium basicladum
Paspalidium jubiflorum
Perotis rara
Schizachyrium fragile
Setaria dielsii
Setaria modesta
*Setaria verticillata
Sporobolus actinoclados
Sporobolus australasicus
Thenedra sp. Hamersley Station (M.E.Trudgen 11431)
Thenedra triandra
Triodia aff. basedowii
Triodia Ianigera
Triodia longiceps
Triodia pungens
Triodia wiseana
Triraphis mollis

Polygalaceae
Polygala aff. isingii

Polygonaceae
*Acetosa vesicaria

Portulacaceae
Calandrinia ptychosperma
Portulaca oleracea
Portulaca pilosa

Potamogetonaceae
Potamogeton tricarinatus
Proteaceae
Grevillea wickhamii
Grevillea wickhamii subsp. aprica
Grevillea wickhamii subsp. hispidula
Hakea chordophylla
Hakea lorea subsp. lorea
Rubiacae
Oldenlandia crouchiana
Psyrax latifolia
Santalaceae
Anthobolus leptomerioides
Santalum lanceolatum
Sapindaceae
Atalaya hemiglauca
Dodonaea coriacea
Dodonaea petiolaris
Scrophulariaceae
Peplidium sp. E (Flora of Australia)
Stemodia grossa
Solanaceae
*Datura leichhardtii
Nicotiana occidentalis subsp. obliqua
Solanum centrale
Solanum cleistogamum
Solanum gabrielae
Solanum horridum
Solanum lasiophyllum
*Solanum nigrum
Solanum phlomoides
Sterculiaceae
Keraudrenia velutina subsp. elliptica ms.
Melhania oblongifolia
Rulingia luteiflora
Waltheria indica
Surianaceae
Stylobasium spathulatum
Tiliaceae
Corchorus crozophorifolius
Corchorus aff. lasiocarpus subsp. lasiocarpus
Corchorus lasiocarpus subsp. parvus
Corchorus tectus
Triumfetta maconochieana
Typhaceae
Typha domingensis
Violaceae
Hybanthus aurantiacus
Zygophyllaceae
Tribulus macroparus
Tribulus suberosus
Raw Data from Floristic Survey Sites and Representative Photographs
Yandi Expansion Vegetation and Flora Survey

Yandi Expansion Site  
**YEX01**

Described by Brian Morgan  
**Date** 31/08/2004  
**Size** 50 x 50m

**AMG Zone**  
50732041mE, 7473229mN  
732061mE, 7473274mN  
732017mE, 7473295mN  
731995mE, 7473249mN

**Habitat**  
Gently sloping, East-facing upper slope of hill.

**Soil**  
Red brown pebbly, cobbly, loamy sand.

**Rock Type**  
Ironstone?

**Vegetation**  
Eucalyptus leucophloia scattered low trees over Hakea chordophylla scattered tall shrubs over Triodia aff. basedowii mid-dense hummock grassland

**Veg Condition**  
Excellent

**Fire Age**  
Burnt ? 5 years ago

---

Yandi Expansion Site  
**YEX02**

Described by Raimond  
**Date** 31/08/2004  
**Size** 10 x 250 m

**AMG Zone**  
50733554mE, 7474371mN  
733562mE, 7474368mN  
733454mE, 7474136mN  
733444mE, 7474142mN

**Habitat**  
Riparian zone (E. bank) of Weeli Wolli Creek.

**Soil**  
Red clay with small amount of loam present.

**Rock Type**  
Ironstone

**Vegetation**  
Eucalyptus victrix open woodland over Acacia coriacea subsp. pendens, A. citrinoviridis low open woodland over *Cenchrus ciliaris closed tussock grassland

**Veg Condition**  
Very poor; total domination of understorey by Buffel grass. Cattle also graze the vegetation.

**Fire Age**  
This side of creek not recently burnt

---

Yandi Expansion Site  
**YEX03**

Described by Brian Morgan  
**Date** 31/08/2004  
**Size** 50 x 50m

**AMG Zone**  
50732881mE, 7473769mN  
732920mE, 7473800mN  
732953mE, 7473762mN  
732913mE, 7473731mN

**Habitat**  
Flat plain

**Soil**  
Red-brown pebbly loam to clay loam

**Rock Type**  
Ironstone

**Vegetation**  
Acacia aneura var. aff. longicarpa (MET 16,050), A. synchronicia, A. pruinocarpa low open woodland over Senna glutinosa subsp. x luerssenii open shrubland over Senna artemisioides subsp. oligophylla x helmsii, Solanum lasiophyllum low open shrubland over Triodia wiseana open hummock grassland

**Veg Condition**  
Excellent

**Fire Age**  
Burnt >7-10 years ago.

**Notes**  
Vegetation very variable with mixing of Mulga and areas of Acacia synchronica, A. pruinocarpa / Triodia wiseana.

---

Yandi Expansion Site  
**YEX04**

Described by Kelli  
**Date** 31/08/2004  
**Size** 50 x 50 m

**AMG Zone**  
50732961mE, 7473965mN  
732983mE, 7473946mN  
732926mE, 7473884mN  
732900mE, 7473898mN

**Habitat**  
Creek

**Soil**  
Red clay

**Rock Type**  
Ironstone

**Vegetation**  
Corymbia hamersleyana, Eucalyptus xerothermica, Acacia aneura (flat curved; MET 15 548) low open woodland over Acacia bivenosa open shrubland over Themeda triandra, Paraneurachne muelleri open tussock grassland and Triodia wiseana (T. pungens) open hummock grassland

**Veg Condition**  
Excellent

**Fire Age**  
Recent, extremely patchy - occasional trees burnt.

---

Yandi Expansion Site  
**YEX05**

Described by Raimond  
**Date** 31/08/2004  
**Size** 50 x 50 m

**AMG Zone**  
50732240mE, 7473976mN  
732276mE, 7474022mN  
732311mE, 7473977mN  
732283mE, 7473936mN

**Habitat**  
Rocky, alluvial clay mild slope at base of low hills.

**Soil**  
Red colluvial / alluvial clay with lots of ironstone pebbles on soil surface.

**Rock Type**  
Ironstone

**Vegetation**  
Eucalyptus gamophylla low open woodland over Acacia anistocarpa open shrubland over Triodia aff. basedowii mid-dense hummock grassland

**Veg Condition**  
Excellent

**Fire Age**  
No sign of fire in the last 3-4 years

---

Yandi Expansion Site  
**YEX06**

Described by Brian Morgan  
**Date** 31/08/2004  
**Size** 50 x 50 m

**AMG Zone**  
50731993mE, 7474007mN  
731957mE, 7474041mN  
731921mE, 7474009mN  
731957mE, 7473971mN

**Habitat**  
Moderate, NE facing hill slope.

**Soil**  
Red-brown pebbly, cobbly loamy sand

**Rock Type**  
Ironstone

**Vegetation**  
Eucalyptus leucophloia scattered low trees over Grevillea wickhamii, Hakea chordophylla scattered tall shrubs over Acacia hilliana, A. adoza var. adoza low open heath over Triodia aff. basedowii hummock grassland
<table>
<thead>
<tr>
<th>Veg Condition</th>
<th>Excellent</th>
<th>Fire Age</th>
<th>Burnt &gt;5-7 years ago</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yandi Expansion Site</strong></td>
<td>YEX07</td>
<td><strong>Described by</strong></td>
<td>Raimond</td>
</tr>
<tr>
<td><strong>Yandi Expansion Site</strong></td>
<td>YEX08</td>
<td><strong>Described by</strong></td>
<td>Brian Morgan</td>
</tr>
<tr>
<td><strong>Yandi Expansion Site</strong></td>
<td>YEX09</td>
<td><strong>Described by</strong></td>
<td>Raimond</td>
</tr>
<tr>
<td><strong>Yandi Expansion Site</strong></td>
<td>YEX10</td>
<td><strong>Described by</strong></td>
<td>Raimond</td>
</tr>
<tr>
<td><strong>Yandi Expansion Site</strong></td>
<td>YEX11</td>
<td><strong>Described by</strong></td>
<td>Kelli</td>
</tr>
<tr>
<td><strong>Yandi Expansion Site</strong></td>
<td>YEX12</td>
<td><strong>Described by</strong></td>
<td>Brian Morgan</td>
</tr>
</tbody>
</table>

---

Yandi Expansion Vegetation and Flora Survey
Rock Type: Ironstone
Vegetation: Acacia aneura (grey bushy form; MET 15 732), A. aneura (flat curved; MET 15 548), A. pruinocarpa scattered low trees over Senna glutinosa subsp. x luerssenii, Eremophila fraseri subsp. fraseri open shrubland over Triodia aff. basedowii hummock grassland
Veg Condition: Excellent
Fire Age: Burnt >5-7 years ago

Yandi Expansion Site YEX13
Described by: Brian Morgan
Date: 1/09/2004
AMG Zone: 5073 7116mE, 7478 140mn 731161mE, 7478 166mN 731187mE, 7478 122mN 731146mE, 7478 095mN
Habitat: Edge, breakaway and upper slope of flat ridge
Soil: Red-brown gravelly, pebbly sand
Rock Type: Ironstone
Vegetation: Eucalyptus leucophloia low open woodland over Grevillea wickhamii subsp. hispidula scattered tall shrubs to tall open shrubland over Triodia aff. basedowii mid-dense hummock grassland
Veg Condition: Excellent
Fire Age: Burnt >5-7 years ago
Notes: Irregular shaped flat - follows edge of ridge (breakaway) as it curves - snappy gum habitat

Yandi Expansion Site YEX14
Described by: Raimond
Date: 1/09/2004
AMG Zone: 5073 0116mE, 7478 214mN 730164mE, 7478 228mN 730179mE, 7478 181mN 730132mE, 7478 166mN
Habitat: Alluvial, red clay-loam drainage flat
Soil: Red alluvial clay-loam with ironstone pebbles on soils surface
Rock Type: Ironstone
Vegetation: Acacia aff. aneura (scythe-shaped; MET 15, 743) low open woodland over Acacia ancistrocarpa open shrubland over Triodia aff. basedowii (T. pungens) mid-dense hummock grassland
Veg Condition: Excellent; no weed species present and no evidence of livestock grazing.
Fire Age: No evidence of fire scars or recent burn on veg.

Yandi Expansion Site YEX15
Described by: Kelli
Date: 1/09/2004
AMG Zone: 5073 0116mE, 7478 214mN 730164mE, 7478 228mN 730179mE, 7478 181mN 730132mE, 7478 166mN
Habitat: Plain
Soil: Red sandy clay loam
Rock Type: Ironstone
Vegetation: Corymbia hamersleyana scattered low trees over Eucalyptus gamophylla scattered low mallees over Acacia inaequilatera, Hakea chordophylla tall open shrubland over Triodia lanigera mid-dense hummock grassland
Veg Condition: Excellent
Fire Age: Old - none evident

Yandi Expansion Site YEX16
Described by: Raimond
Date: 2/09/2004
AMG Zone: 5073 0116mE, 7478 695mN 731155mE, 7478 718mN 730914mE, 7478 528mN 730918mE, 7478 522mN
Habitat: Riparian zone (permanently and seasonally wet) beside Yandicoogina Creek
Soil: Red alluvial deposited sand and loam amongst a high level of ironstone pebble cover
Rock Type: Ironstone
Vegetation: Eucalyptus camaldulensis open woodland to woodland over Acacia coriacea subsp. pendens, Melaleuca glomerata tall open shrubland over Cyperus vaginatus open sedgeland and Themeda triandra very open tussock grassland
Veg Condition: Very Good; Mexican poppy present - 2 young plants. Buffel grass also present on creek edge.
Fire Age: No evidence of burn scars on the mature Eucalypts
Notes: Site YEX16 was done in riparian vegetation adjacent to permanent pool in main river flow line

Yandi Expansion Site YEX17
Described by: Raimond
Date: 2/09/2004
AMG Zone: 5073 0116mE, 7478 840mN 730989mE, 7478 854mN 731012mE, 7478 826mN 730939mE, 7478 812mN
Habitat: River flood banks
Soil: Red-brown gravelly, pebbly, cobbly matrix with some coarse sand
Rock Type: ?
Vegetation: Acacia citrinoviridis, A. coriacea subsp. pendens low open forest over Acacia pyriformia, Gossypium robinsonii scattered tall shrubs over Triodia pungens very open hummock grassland and *Cenchrus ciliaris, Themeda triandra open tussock grassland
Veg Condition: Good to Very Good
Fire Age: >7-10 years ago
Notes: Site YEX16 was done in riparian vegetation adjacent to permanent pool in main river flow line
<table>
<thead>
<tr>
<th>Yandi Expansion Site</th>
<th>YEX18</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Described by</strong></td>
<td>Brian Morgan</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>2/09/2004</td>
</tr>
<tr>
<td><strong>AMG Zone</strong></td>
<td>50729933mE, 7478963mN 729976mE, 7478944mE 729948mE, 7478897mN 728907mE, 7478915mN</td>
</tr>
<tr>
<td><strong>Habitat</strong></td>
<td>Very gently sloping, north-facing slopes of low rises in Marillana Creek valley</td>
</tr>
<tr>
<td><strong>Soil</strong></td>
<td>Red-brown gravelly, pebbly sand</td>
</tr>
<tr>
<td><strong>Rock Type</strong></td>
<td>Ironstone</td>
</tr>
<tr>
<td><strong>Vegetation</strong></td>
<td>Corymbia hamersleyana scattered low trees over Acacia inaequilatera, Grevillea wickhamii subsp. hispida, scattered low shrubs to tall open shrubland over Acacia anisophloia open shrubland over Acacia adoxa var. adoxa, Gompholobium polyzygum, Corchorus lasiocarpus subsp. parvus, low open shrubland over Triodia aff. basedowii hummock grassland</td>
</tr>
<tr>
<td><strong>Veg Condition</strong></td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Fire Age</strong></td>
<td>Burnt about 2 years ago.</td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>Also scattered Eucalyptus leucophloia in this unit.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yandi Expansion Site</th>
<th>YEX19</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Described by</strong></td>
<td>Raimond</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>2/09/2004</td>
</tr>
<tr>
<td><strong>AMG Zone</strong></td>
<td>50730343mE, 7497249mN 730381mE, 7479285mN 730418mE, 7479250mN 730385mE, 7479211mN</td>
</tr>
<tr>
<td><strong>Habitat</strong></td>
<td>Alluvial clay floodplain / flat area</td>
</tr>
<tr>
<td><strong>Soil</strong></td>
<td>Red clay-loam (mostly clay) with a very small amount of ironstone pebbles on the soil surface</td>
</tr>
<tr>
<td><strong>Rock Type</strong></td>
<td>Ironstone</td>
</tr>
<tr>
<td><strong>Vegetation</strong></td>
<td>Eucalyptus xerotheca low open woodland over Acacia bivenosa open shrubland over Triodia pungens open hummock grassland and Aristida holathera var. holathera grassland</td>
</tr>
<tr>
<td><strong>Veg Condition</strong></td>
<td>Excellent; no weed species present, some evidence of cattle grazing in the area.</td>
</tr>
<tr>
<td><strong>Fire Age</strong></td>
<td>Burnt in the last year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yandi Expansion Site</th>
<th>YEX20</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Described by</strong></td>
<td>Kelli</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>2/09/2004</td>
</tr>
<tr>
<td><strong>AMG Zone</strong></td>
<td>50730194mE, 7479231mN 730222mE, 7479189mN 730180mE, 7479166mN 730155mE, 7479210mN</td>
</tr>
<tr>
<td><strong>Habitat</strong></td>
<td>Creek</td>
</tr>
<tr>
<td><strong>Soil</strong></td>
<td>Red sandy clay</td>
</tr>
<tr>
<td><strong>Rock Type</strong></td>
<td>Ironstone</td>
</tr>
<tr>
<td><strong>Vegetation</strong></td>
<td>Eucalyptus xerotheca, Corymbia hamersleyana low open woodland over Petalostylis labicheoides, Acacia sclerosperma subsp. sclerosperma, A. dictyophleba, Gossypium robinsonii shrubland to tall shrubland over Triodia pungens open hummock grassland and mixed open tussock grassland</td>
</tr>
<tr>
<td><strong>Veg Condition</strong></td>
<td>Very Good; seedlings of Conyza bonariensis 5% cover, cattle dung and trampling - probably grazed as well.</td>
</tr>
<tr>
<td><strong>Fire Age</strong></td>
<td>No evidence</td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>Would expect to see Goodenia stellata, but none seen</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yandi Expansion Site</th>
<th>YEX21</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Described by</strong></td>
<td>Brian Morgan</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>2/09/2004</td>
</tr>
<tr>
<td><strong>AMG Zone</strong></td>
<td>50731224mE, 7478720mN 731415mE, 7478787mN</td>
</tr>
<tr>
<td><strong>Habitat</strong></td>
<td>Sandy, gravelly, cobbly low rises in river bed.</td>
</tr>
<tr>
<td><strong>Soil</strong></td>
<td>Red-brown gravelly, pebbly, cobbly matrix with coarse sand</td>
</tr>
<tr>
<td><strong>Rock Type</strong></td>
<td>Ironstone</td>
</tr>
<tr>
<td><strong>Vegetation</strong></td>
<td>Eucalyptus camaldulensis (E. victrix) open forest over Acacia coriacea subsp. pendens, A. citrinoviridis low open forest over Corchorus crozophorolius low open shrubland over Themeda triandra, Eriachne helmsii, Cymbopogon obtectus, *Cenchrus ciliaris and Triodia pungens very open hummock grassland</td>
</tr>
<tr>
<td><strong>Veg Condition</strong></td>
<td>Very Good</td>
</tr>
<tr>
<td><strong>Fire Age</strong></td>
<td>&gt;5-7 years since fire</td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>Only elevated area within this site (not adjacent wash line)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yandi Expansion Site</th>
<th>YEX22</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Described by</strong></td>
<td>Raimond</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>2/09/2004</td>
</tr>
<tr>
<td><strong>AMG Zone</strong></td>
<td>50730891mE, 7479434mN 730935mE, 7479462mN 730963mE, 7479417mN 730917mE, 7479393mN</td>
</tr>
<tr>
<td><strong>Habitat</strong></td>
<td>Rocky hill slope and upper slopes</td>
</tr>
<tr>
<td><strong>Soil</strong></td>
<td>Red skeletal clay over plate ironstone</td>
</tr>
<tr>
<td><strong>Rock Type</strong></td>
<td>Ironstone (7shale)</td>
</tr>
<tr>
<td><strong>Vegetation</strong></td>
<td>Grevillea wickhamii, Acacia inaequilatera scattered shrubs over Triodia wisana mid-dense hummock grassland and Paraneurachne muelleri very open tussock grassland</td>
</tr>
<tr>
<td><strong>Veg Condition</strong></td>
<td>Excellent; no weed species present</td>
</tr>
<tr>
<td><strong>Fire Age</strong></td>
<td>No evidence of recent fire</td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>Elevation at NW point 521 m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yandi Expansion Site</th>
<th>YEX23</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Described by</strong></td>
<td>Kelli</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>2/09/2004</td>
</tr>
<tr>
<td><strong>AMG Zone</strong></td>
<td>50731013mE, 7479142mN 731062mE, 7479134mN 731056mE, 7479084mN 731005mE, 7479093mN</td>
</tr>
<tr>
<td><strong>Habitat</strong></td>
<td>Floodplain</td>
</tr>
<tr>
<td>Site</td>
<td>Soil</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>YEX24</td>
<td>Red sandy plain</td>
</tr>
<tr>
<td>YEX25</td>
<td>Red skeletal clay, small amount deposited through alluvial action over outcropping ironstone.</td>
</tr>
<tr>
<td>YEX26</td>
<td>Red sandy clay loam</td>
</tr>
<tr>
<td>YEX27</td>
<td>Red alluvial clay-loam; small amount of pebbles present on soil surface</td>
</tr>
<tr>
<td>YEX28</td>
<td>Pebble - cobble matrix</td>
</tr>
</tbody>
</table>
Yandi Expansion Vegetation and Flora Survey

Yandi Expansion Site | YEX29
Described by | Kelli
Date | 3/09/2004
AMG Zone | 50728444mE, 7477386mN 728477mE, 7477350mE 728411mE, 7477317mE 728407mE, 7477352mN
Habitat | Creek floodout
Soil | Red stony (>80%) sand and clay
Rock Type | Ironstone
Vegetation | Eucalyptus victrix woodland to open woodland over Acacia citrinoviridis low open woodland over Atalaya hemiglaucua, Acacia tumida var. pilbarensis, A. bivenosa, Gossypium robinsonii, Petalostylis labicheoides shrubland to tall shrubland over Themeda triandra open tussock grassland and Triodia pungens hummock grassland
Veg Condition | Excellent
Fire Age | None evident

Yandi Expansion Site | YEX30
Described by | Brian Morgan
Date | 3/09/2004
AMG Zone | 50728305mE, 7477694mN 728320mE, 7477667mN 728391mE, 7477692mN 728382mE, 7477719mN
Habitat | Moderately sloping, mid to upper slope of ridge spur
Soil | Red-brown pebbly, cobbly sand with rocky outcrop
Rock Type | Ironstone
Vegetation | Grevillea wickhamii subsp. hispidula scattered shrubs over Dampiera candicans, Ptilotus calostachyus low shrubland over Triodia aff. basedowii mid-dense hummock grassland
Veg Condition | Excellent
Fire Age | About 2-3 years since fire

Yandi Expansion Site | YEX31
Described by | Raimond
Date | 4/09/2004
AMG Zone | 50731902mE, 7474809mN 731939mE, 7474843mN 731973mE, 7474806mN 731936mE, 7474772mN
Habitat | Alluvial, stony clay drainage flat
Soil | Red alluvial clay over ironstone with lots of ironstone pebbles on soil surface.
Rock Type | Ironstone
Vegetation | Acacia aneura var. aff. longicarpa (MET 16,050), A. aff. aneura (scythe-shaped; MET 15,743), A. pruinocarpa low open woodland over Triodia pungens, T. wiseana hummock grassland
Veg Condition | Excellent; weed species present
Fire Age | Possibly burnt in the last 3-4 years.
Notes | Kangaroos graze vegetation in this area. Elevation at NE point is 509 m

Yandi Expansion Site | YEX32
Described by | Kelli
Date | 4/09/2004
AMG Zone | 50731725mE, 7474569mN 731756mE, 7474606mN 731795mE, 7474674mN 731764mE, 7474536mN
Habitat | Floodout alluvial plain
Soil | Red sandy clay. Patches of sand overlay
Rock Type | Ironstone
Vegetation | Acacia dictyophleba, A. ancistrocarpa, A. pruinocarpa, A. inaequilatera tall open shrubland to open shrubland over Senna artemisioides subsp. oligophylla low shrubland over Triodia pungens hummock grassland
Veg Condition | Excellent
Fire Age | No evidence of recent fire

Yandi Expansion Site | YEX33
Described by | Kelli
Date | 4/09/2004
AMG Zone | 50731725mE, 7474569mN 731756mE, 7474606mN 731795mE, 7474674mN 731764mE, 7474536mN
Habitat | Floodout alluvial plain
Soil | Red sandy clay. Patches of sand overlay
Rock Type | Ironstone
Vegetation | Acacia dictyophleba, A. ancistrocarpa, A. pruinocarpa, A. inaequilatera tall open shrubland to open shrubland over Senna artemisioides subsp. oligophylla low shrubland over Triodia pungens hummock grassland
Veg Condition | Excellent
Fire Age | No evidence of recent fire

Yandi Expansion Site | YEX34
Described by | Brian Morgan
Date | 4/09/2004
AMG Zone | 50732068mE, 7477130mN 732226mE, 7477252mN
Habitat | Banks of cobbley, stony creek
Soil | Red-brown gravelly, pebbly and cobbly sand
Rock Type | ?
Vegetation | Corymbia hamersleyana scattered low trees over Acacia tumida var. pilbarensis, Grevillea wickhamii subsp. hispidula, Petalostylis labicheoides open scrub over Triodia pungens hummock grassland and Themeda triandra open tussock grassland
Veg Condition | Excellent
<table>
<thead>
<tr>
<th>Location</th>
<th>AMG Zone</th>
<th>Date</th>
<th>Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yandi Expansion Vegetation and Flora Survey</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fire Age</strong></td>
<td>&gt;5-7 years since fire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>The creek bank habitat is narrow (often 5m); where drainage spreads, banks are up to 10-15 m wide. Survey did not include creek bed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Yandi Expansion Site</strong></td>
<td>YEX35</td>
<td>Raimond</td>
<td>4/09/2004</td>
<td>50 x 50 m</td>
</tr>
<tr>
<td><strong>AMG Zone</strong></td>
<td>50732640mE, 7477352mN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Habitat</strong></td>
<td>Ironstone hilltop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Soil</strong></td>
<td>Red skeletal clay over ironstone hill, with lots of ironstone pieces on the soil surface.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rock Type</strong></td>
<td>Ironstone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vegetation</strong></td>
<td>Grevillea wickhamii tall open shrubland over Ptilotus rotundifolius open shrubland over Acacia hilliana low shrubland over Triodia aff. basedowii mid-dense hummock grassland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Veg Condition</strong></td>
<td>Excellent; no weed species or other signs of disturbance present</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fire Age</strong></td>
<td>Patchily burnt in the last year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>Elevation at NW point 532 m. Some portions of the quadrat (~ up to 40%) are in the areas which have been recently burnt; remainder unburnt for at least 3 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Yandi Expansion Site</strong></td>
<td>YEX36</td>
<td>Kelli</td>
<td>4/09/2004</td>
<td>50 x 50 m</td>
</tr>
<tr>
<td><strong>AMG Zone</strong></td>
<td>50732480mE, 7477363mN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Habitat</strong></td>
<td>Lower hill slopes, intersected by numerous small drainages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Soil</strong></td>
<td>Red skeletal detrital sandy clay loam (coarse fraction &gt;80%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rock Type</strong></td>
<td>Ironstone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vegetation</strong></td>
<td>Eucalyptus leucophloia scattered low trees over Acacia inaequilatera, Hakea chordophylla tall open shrubland over Acacia bivenosa, Grevillea wickhamii shrubland over Acacia hilliana, A. adoxa var. adoxa low shrubland over Triodia aff. basedowii closed hummock grassland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Veg Condition</strong></td>
<td>Excellent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fire Age</strong></td>
<td>Burnt &gt;5 years ago</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>Elevation at NW point 532 m. Some portions of the quadrat (~ up to 40%) are in the areas which have been recently burnt; remainder unburnt for at least 3 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Yandi Expansion Site</strong></td>
<td>YEX37</td>
<td>Brian Morgan</td>
<td>4/09/2004</td>
<td>60 x 40 m</td>
</tr>
<tr>
<td><strong>AMG Zone</strong></td>
<td>50731927mE, 7473357mN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Habitat</strong></td>
<td>Crest of hill range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Soil</strong></td>
<td>Red-brown pebbly, cobbly sand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rock Type</strong></td>
<td>Ironstone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vegetation</strong></td>
<td>Hakea chordophylla, Grevillea wickhamii subsp. hispidula scattered tall shrubs over Triodia aff. basedowii mid-dense hummock grassland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Veg Condition</strong></td>
<td>Excellent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fire Age</strong></td>
<td>&gt;7 years since fire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>Elevation at NW point 513 m. Some portions of the quadrat (~ up to 40%) are in the areas which have been recently burnt; remainder unburnt for at least 3 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Yandi Expansion Site</strong></td>
<td>YEX38</td>
<td>Raimond</td>
<td>4/09/2004</td>
<td>50 x 50 m</td>
</tr>
<tr>
<td><strong>AMG Zone</strong></td>
<td>50733541mE, 7473501mN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Habitat</strong></td>
<td>Weeli Wolli Creek floodplain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Soil</strong></td>
<td>Red alluvial clay deposited during flooding of Weeli Wolli creek.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rock Type</strong></td>
<td>Ironstone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vegetation</strong></td>
<td>Corymbia hamersleyana scattered low trees over Acacia pruinocarpa, A. citrinoviridis low open woodland over Triodia longiceps mid-dense hummock grassland and *Cenchrus ciliaris tussock grassland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Veg Condition</strong></td>
<td>Very poor; due to domination of understorey stratum by Buffel grass in large areas of the quadrat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fire Age</strong></td>
<td>Unburnt for more than 4-5 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>Elevation at NW point 513 m. Some portions of the quadrat (~ up to 40%) are in the areas which have been recently burnt; remainder unburnt for at least 3 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Yandi Expansion Site</strong></td>
<td>YEX39</td>
<td>Raimond</td>
<td>5/09/2004</td>
<td>50 x 50 m</td>
</tr>
<tr>
<td><strong>AMG Zone</strong></td>
<td>50730021mE, 7478436mN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Habitat</strong></td>
<td>Braided channel of Yandicoogina Creek, including the vegetated islands within the channel.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Soil</strong></td>
<td>Red ironstone pebbles deposited through alluvial action over sandy loam, with a small amount of clay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rock Type</strong></td>
<td>Ironstone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vegetation</strong></td>
<td>Eucalyptus camaldulensis woodland over Acacia coriacea subsp. pendens low open woodland over mixed open tussock grassland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Veg Condition</strong></td>
<td>Very good; only a few weed species present; Sisymbium sp. and Argemone ochreola.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fire Age</strong></td>
<td>No evidence of burn / fire scars on mature trees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>Elevation at NW point 513 m. Some portions of the quadrat (~ up to 40%) are in the areas which have been recently burnt; remainder unburnt for at least 3 years</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Rock Type: Ironstone
Vegetation: Eucalyptus victrix open woodland over Stemodia grossa, Pluchea dentex low open shrubland over Themeda triandra very open tussock grassland

Notes: Vegetation at base of cliff is low open shrubland of Abutilon lepidum and Sida sp.spiciform panicles (E.Leyland s.n.14/8/1990 over very open tussock grassland of Themeda triandra and Eulalia aurea)

Yandi Expansion Releve

YEX-G
Described by: Kelli
Date: 4/09/2004 releve
AMG Zone: 5073248mE, 7477355mN 732547mE, 7477389mN
Habitat: Very minor drainage off a hillslope
Soil: Red skeletal detrital sandy clay-loam with >80% coarse fraction
Vegetation: Grevillea wickhamii shrubland over Acacia hilliana, A. adoxa var. adoxa low shrubland over Triodia aff. basedowii, T. pungens hummock grassland

Notes: Corymbia hamersleyana lower down slope and Acacia hilliana in adjacent creeks (5-10 % cover)

YEX-J
Described by: Brian Morgan
Date: 4/09/2004 releve
AMG Zone: 50730149mE, 7478437mN
Habitat: Rocky gully on side of ridge
Vegetation: Eucalyptus leucophloia low open woodland over Senna glutinosa subsp. glutinosa open shrubland over Triodia pungens open hummock grassland and Eriachne mucronata, Cymbopogon ambiguus, Themeda triandra open grassland

YEX-K
Described by: Brian Morgan
Date: 5/09/2004 releve
AMG Zone: 5073102mE, 7473352mN
Habitat: Rockly gully on side of ridge
Vegetation: Opportunistic collections along a riverine transect
Notes: Releve along Marillana Creek from site YEX39, heading west along the creek for about 1.5 km and return to YEX39.

YEX-M
Described by: Brian Morgan
Date: 5/09/2004 releve
AMG Zone: 50732442mE, 7478522mN
Habitat: Small flowline at base of steep ridge slope
Soil: Red-brown sandy loam
Vegetation: Acacia citrinoviridis (A. coriacea subsp. pendens) low woodland to low open forest over Triodia pungens very open hummock grassland and mixed grassland

Notes: Releve along a riverine transect

YEX-N
Described by: Raimond
Date: 5/09/2004 releve
AMG Zone: 50732297mE, 7478137mn 732276mE, 7478284mN
Habitat: Rocky, alluvial, very mildly sloping plain
Soil: Red alluvial clay with ironstone pebbles on soil surface
Vegetation: Acacia aneura var. aneura, A. ayersiana, Corymbia hamersleyana scattered low trees over Triodia lanigera mid-dense hummock grassland

Notes: Eucalyptus victrix in flow line 100m to northwest

Fire Age: Not burnt for quite a while. No fire scars.

Notes: Vegetation at base of cliff is low open shrubland of Abution leptidum and Sida sp.spiciform panicles (E.Leyland s.n.14/8/1990 over very open tussock grassland of Themeda triandra and Eulalia aurea)

Notes: Corymbia hamersleyana lower down slope and Acacia hilliana in adjacent creeks (5-10 % cover)

Notes: Releve along Marillana Creek from site YEX39, heading west along the creek for about 1.5 km and return to YEX39.

Notes: Releve along a riverine transect

Notes: Releve along a riverine transect

Notes: Releve along a riverine transect

Notes: Eucalyptus victrix in flow line 100m to northwest

Notes: Adjacent area around hill burnt in last year
| Name                                      | Year 16 | Year 18 | Year 20 | Year 22 | Year 24 | Year 26 | Year 28 | Year 30 | Year 32 | Year 34 | Year 36 | Year 38 | Year 40 | Year 42 | Year 44 | Year 46 | Year 48 | Year 50 | Year 52 | Year 54 | Year 56 | Year 58 | Year 60 | Year 62 | Year 64 | Year 66 | Year 68 | Year 70 | Year 72 | Year 74 | Year 76 | Year 78 | Year 80 | Year 82 | Year 84 | Year 86 | Year 88 | Year 90 | Year 92 | Year 94 | Year 96 | Year 98 | Year 100 |
|------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Name                                                                 | YEX 01 | YEX 02 | YEX 03 | YEX 04 | YEX 05 | YEX 06 | YEX 07 | YEX 08 | YEX 09 | YEX 10 | YEX 11 | YEX 12 | YEX 13 | YEX 14 | YEX 15 | YEX 16 | YEX 17 | YEX 18 | YEX 19 | YEX 20 | YEX 21 | YEX 22 | YEX 23 | YEX 24 | YEX 25 | YEX 26 | YEX 27 | YEX 28 | YEX 29 | YEX 30 | YEX 31 | YEX 32 | YEX 33 | YEX 34 | YEX 35 | YEX 36 | YEX 37 | YEX 38 | YEX 39 | YEX 40 | YEX 41 | YEX 42 | YEX 43 | YEX 44 | YEX 45 | YEX 46 | YEX 47 | YEX 48 | YEX 49 | YEX 50 | YEX 51 | YEX 52 | YEX 53 | YEX 54 | YEX 55 | YEX 56 | YEX 57 |
| Name | YEX 01 | YEX 02 | YEX 03 | YEX 04 | YEX 05 | YEX 06 | YEX 07 | YEX 08 | YEX 09 | YEX 10 | YEX 11 | YEX 12 | YEX 13 | YEX 14 | YEX 15 | YEX 16 | YEX 17 | YEX 18 | YEX 19 | YEX 20 | YEX 21 | YEX 22 | YEX 23 | YEX 24 | YEX 25 | YEX 26 | YEX 27 | YEX 28 | YEX 29 | YEX 30 | YEX 31 | YEX 32 | YEX 33 | YEX 34 | YEX 35 | YEX 36 | YEX 37 | YEX 38 | YEX 39 | YEX 40 | YEX 41 | YEX 42 | YEX 43 |
|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Name                                      | YEX 01 | YEX 02 | YEX 03 | YEX 04 | YEX 05 | YEX 06 | YEX 07 | YEX 08 | YEX 09 | YEX 10 | YEX 11 | YEX 12 | YEX 13 | YEX 14 | YEX 15 | YEX 16 | YEX 17 | YEX 18 | YEX 19 | YEX 20 | YEX 21 | YEX 22 | YEX 23 | YEX 24 | YEX 25 | YEX 26 | YEX 27 | YEX 28 | YEX 29 | YEX 30 | YEX 31 | YEX 32 | YEX 33 | YEX 34 | YEX 35 | YEX 36 | YEX 37 | YEX 38 | YEX 39 | YEX 40 |
| Name                                                      | YE1 | YE2 | YE3 | YE4 | YE5 | YE6 | YE7 | YE8 | YE9 | YE10 | YE11 | YE12 | YE13 | YE14 | YE15 | YE16 | YE17 | YE18 | YE19 | YE20 | YE21 | YE22 | YE23 | YE24 | YE25 | YE26 | YE27 | YE28 | YE29 | YE30 | YE31 | YE32 | YE33 | YE34 | YE35 | YE36 | YE37 | YE38 | YE39 | YE40 |
|-----------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Tribulus macrocarpus                                      |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Tribulus subminus                                          | 1   |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Trichodesa azylancium var. azylancium                     | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |
| Trichodesa aff. bawodiinii                                 | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |
| Trichodesa taliangae                                       |     | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |
| Trinaxa kongiapsi                                          | 1   |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Trinaxa jungera                                           |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Trinaxa pungens                                           |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Trinaxa virgata                                           |     | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |
| Triaudia mollii                                             |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Triaudia massimichaeliana                                  |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Typha domingensis                                          |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Vigna lanceolata var. lanceolata                          |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Wahlenbergia tumidiflora                                   |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |

"1" indicates species presence
Plate 4.1: Type 1a: *Hakea chordophylla* scattered low trees over *Triodia aff. basedowii*. Site YEX35.

Plate 4.2: Type 1b: *Eucalyptus leucophloia* low open woodland over *Acacia hilliana, A. adoxa* low open shrubland over *Triodia aff. basedowii*. Site YEX13.

Plate 4.3: Type 1c: Exposed ridgeline, vegetation variable; *Themeda* sp. Mt. Barricade dominant here, with herb *Rhodanthe margarethae*.

Plate 4.4: Type 1d: *Eucalyptus gamophylla* low open woodland over *Triodia aff. basedowii*. Site YEX05.

Plate 4.5: Type 1e: Scattered *Acacia inaequilatera* over *Triodia wiseana*. Site YEX22.

Plate 4.6: Type 1f: Scattered *Corymbia hamersleyana* over *Triodia aff. basedowii*; burnt 1-2 years ago. Site YEX18.
Plate 4.7: Type 1g: *Acacia pruinocarpa* and *aneura* (flat curved; MET 15 548) over *Eremophila fraseri* over *Triodia aff. basedowii*. Site YEX12.

Plate 4.8: Type 2a: Scattered *Corymbia hamersleyana* over *Triodia lanigera* or *T. aff. basedowii* on low stony plains. Site YEX31.

Plate 4.9: Type 2b.1: *Eucalyptus xerothermica* and *Acacia aneura* woodland over *Themeda triandra* and *Paraneurachne muelleri*. Site YEX04.

Plate 4.10: Type 2b.2: Low woodland of *Acacia* species over *Aristida contorta*, *A. holathera*, *Enneapogon polyphyllus* tussock grassland. Site YEX09.

Plate 4.11: Type 2b.3: *Acacia aneura*, *A. pruinocarpa* and *A. synchronica* over *Triodia wiseana* and patches of *Aristida contorta*. Site YEX03.

Plate 4.12: Type 2c: Tall open shrubland of *Acacia* species over *Triodia lanigera* and mixed tussock grasses. Site YEX33.
Plate 4.13: Type 3a: Shrubland in stony creeks over *Triodia* *aff. basedowii* with some *T. wiseana* and *T. pungens*. Site YEX26.

Plate 4.14: Type 3b: Secondary creeks with *Corymbia hamersleyana* over shrubland over *Triodia pungens* and tussock grasses. Site YEX11.

Plate 4.15: Type 3c: Major creek bank - *Eucalyptus camaldulensis* over *Cenchrus ciliaris* at Weeli Wolli Creek. Site YEX02.

Plate 4.16: Type 3d: Major creek - *Eucalyptus camaldulensis* over scoured river bed in Yandicoogina Creek. Site YEX28.

Plate 4.17: Type 3e: Major creek – *Eucalyptus victrix* over *Acacia coriacea*, *Atalaya hemiglauca* tall open shrubland at Yandicoogina Creek. YEX21.

Plate 4.18: Type 3f: Major creek bank – *Acacia citrinoviridis* and *A. coriacea* subsp. *pendens* at Yandicoogina Creek. Site YEX17.
Plate 4.19: Type 3g: *Corymbia hamersleyana*, *Acacia citrinoviridis* over *Cenchrus ciliaris* on floodplain of Weeli Wolli Creek. Site YEX38.

Plate 4.20: Area burnt in August 2004; central expansion area, looking west along conveyor corridor.