



SMC Blue Hills Mungada West and East Expansion Project
Potential Impacts Study, February 2012



This document describes the results of a potential impacts study carried out by Maia Environmental Consultancy (Maia) for Sinosteel Midwest Corporation (SMC) for a proposed expansion project at its Blue Hills Mungada West and East tenements (M59/595 and M59/596).

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Summary

Introduction

- Sinosteel Midwest Corporation Limited (SMC) proposes to expand its operations at Mungada West and East within its Blue Hills mining tenements (M59/595 and M59/596).
- Maia Environmental Consultancy Pty Ltd (Maia) was commissioned by SMC to carry out a desktop study to: identify the key characteristics of the proposed expansion areas (the Study Area), and review background information on the area and comment on the local and regional conservation significance of the flora and vegetation communities occurring in the area.

Regional and Local Information

- The Study Area occurs in the Yalgoo IBRA bioregion.
- The Study Area falls on three land systems: Tallering, Tealtoo and Yowie.
- Vegetation mapping conducted by Beard, 1979 shows the Study Area as two vegetation communities: 358.5 - *Acacia ramulosa*, *Acacia quadrimarginea*, *Acacia acuminata*, *Hakea preissii* and *Dodonaea inaequifolia* tall open shrubland; and, 355.2 - *Eucalyptus loxophleba* and/or *Eucalyptus oleosa* isolated low trees with *Acacia aneura* and *Acacia ramulosa* tall open shrubland.
- Many other flora and vegetation and targeted flora surveys have been conducted in the area and information from these surveys has been used for this assessment.

Conservation Significant Flora

- No flora species protected under the *EPBC Act* have been recorded in the Study Area.
- Three species protected under the *WC Act* are known to occur within or in the vicinity of the Study Area: *Acacia woodmaniorum*, *Eucalyptus synandra* and *Styloidium* sp. Yalgoo (all vulnerable).
- Thirty-three Priority Flora taxa have been recorded in the vicinity of the Study Area.
- Four Priority Flora taxa have been recorded in the Study Area: *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468) (Priority 1), *Drummondita fulva*, *Micromyrtus trudgenii* and *Persoonia pentasticha* (all Priority 3).

Introduced Flora

- No Weeds of National Significance have been recorded in the area or Study Area.
- One Declared Plant (*Echium plantagineum*, Paterson's Curse) has been recorded in the vicinity of the Study Area during a previous survey.
- Ten environmental weeds have been recorded in the vicinity of the Study Area: *Arctotheca calendula*, *Brassica tournefortii*, *Cleretum papulosum* subsp. *papulosum*, *Cuscuta planiflora*, *Erodium cicutarium*, *Lamarckia aurea*, *Lysimachia arvensis*, *Pentastichis airoides* subsp. *airoides*, *Rostraria pumila* and *Sonchus oleraceus*.

Threatened and Priority Ecological Communities

- The Study Area does not fall within or in the vicinity of a Threatened Ecological Communities.
- Some of the Study Area lies within the Priority 1 PEC - Blue Hills (Mount Karara / Mungada Ridge / Blue Hills) vegetation complexes (banded ironstone formation).

ESA's, Conservation Estates and Schedule 1 Areas

- No ESAs occur within or close to the Study Area. The closest ESA is the Koolanooka TEC, approximately 45 km to the south-west of the Study Area.
- No conservation estates occur within or close to the Study Area; the nearest conservation estate is the Lochada Nature Reserve, approximately 10 km to the west of the Study Area.
- The nearest Schedule 1 Area is located approximately 10 km to the south-east of the Study Area adjacent to the abandoned Mt Mulga mine.

**Vegetation
Conservation
Significance and
Impacts**

- Two FCTs mapped in the Study Area (12 and 13) have high conservation significance.
- Potential impacts to these FCTs from all of SMCs combined proposed works at Blue Hills ranges from 6.3% for FCT 13 to 9.2% for FCT 12.
- The greatest impacts to these FCTs are from the Mungada East Study Area.

**Flora Conservation
Significance and
Impacts**

- *Acacia woodmaniorum*, *Lepidosperma* sp. Blue Hills and *Drummondita fulva* have high regional conservation significance.
- Overall potential impact to conservation significant flora from the Mungada West and East Study Areas range from 0.88% for *Lepidosperma* sp. Blue Hills to 18.61% for *Acacia woodmaniorum*.
- The greatest impacts to conservation significant flora are from the Mungada East Study Area.

SMC Blue Hills Mungada West and East Expansion Project

POTENTIAL IMPACTS STUDY, FEBRUARY 2012

1 INTRODUCTION

1.1 Background

Sinosteel Midwest Corporation Limited (SMC) proposes to expand its approved operations at Mungada West and East within its Blue Hills mining tenements (M59/595 and M59/596) located approximately 60 km north-east of Perenjori and 85 km east of Morawa (Figure 12.1, Section 12). SMC was granted approval to mine direct shipping ore from previously mined areas at Mungada West and East under Ministerial Statement (MS) 811 in 2009. Under Schedule 1 of MS 811 the following areas were approved (EPA, 2009):

- Mine haematite from an area of 5.3 ha on Mining Lease 59/595 at Mungada West and construct one waste dump; and
- Mine haematite from an area of 6.4 ha on Mining Lease 59/596 at Mungada East and construct one waste dump.

An application to amend this approval has been submitted to the Office of the Environmental Protection Authority (OEPA) under Section 45c of the *Environmental Protection Act 1986*. This is an application to increase the size of the pits and waste dumps and to construct additional infrastructure to support the two mine areas.

SMC is also investigating an expansion of its operations at Mungada. The proposed expansion areas would include an additional pit and waste dump at Mungada West (13.38 ha) and at Mungada East (51.87 ha). These expansion areas (Study Area) are the subject of this desktop study and they are shown on Figure 12.2, Section 12.

1.2 Project Scope of Work

Maia Environmental Consultancy Pty Ltd (Maia) was commissioned by SMC to carry out a desktop study to identify the key characteristics of the Study Area, including reviewing background information on the area and commenting on the local and regional conservation significance of the flora and vegetation communities occurring in the area.

2 BACKGROUND INFORMATION

2.1 Database and Literature Searches

To gather information on the flora species and ecological communities occurring in the Study Area the following sources were searched:

- the *EPBC Act* Protected Matters Search Tool (DSEWPaC, 2012a); and
- the DEC's NatureMap (NatureMap, 2012);

The following co-ordinates were used for the NatureMap and EPBC Protected Matters searches: - 29° 07' 35" S, 116° 52' 35" E. These coordinates were buffered by 20 km when carrying out the NatureMap search and by 10 km when using the *EPBC Act* Protected Matters Search Tool.

Available literature was also searched for conservation significant flora previously recorded in the area.

The results of these searches and records from previous surveys of the expansion and surrounding areas are discussed in Sections 3 and 4 and a list of conservation significant flora species recorded in and around the expansion areas is included as Table A1.1 (Appendix 1).

2.2 IBRA Bioregion and Subregion

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the land surface of Australia from a range of environmental attributes into bioregions. Bioregions are relatively large land areas characterised by broad, landscape-scale natural features and environmental processes that influence the functions of entire ecosystems. Bioregions are based on factors associated with climate, geomorphology, lithology, landforms and characteristic flora and fauna. The bioregions have been developed at the national level to assess and plan for the protection of biological diversity (Thackway and Cresswell, 1995). IBRA 6.1 defines 85 bioregions and 403 subregions in Australia (DSEWPaC, 2012b).

Twenty-six bioregions occur in Western Australia and the Study Area lies within the Yalgoo bioregion, an inter-zone region between the south-west and the arid interior. The Yalgoo bioregion is characterised by low woodlands to open woodlands of *Eucalyptus*, *Acacia* and *Callitris* on red sandy plains of the Western Yilgarn Craton and southern Carnarvon Basin. The Yalgoo bioregion covers 50,575 km² in Western Australia of which 11.6% is in conservation reserves. The dominant land use is pastoralism, which accounts for 76.9% of the total (Desmond & Chant, 2001).

2.3 Land Systems

Land systems (LS) are described as discreet units of land forms, soils, vegetation and geology. LS are an important tool in assessing the potential risks to biodiversity by quantifying the extent and condition of potential habitat for conservation significant species and vegetation complexes. The Department of Agriculture and Food Western Australia (DAFWA) has mapped the land systems across a large area of Western Australia. The land systems of the Sandstone-Yalgoo-Paynes Find area have been mapped and sub-divided into land units based on the landforms on which they occur.

Three LS are mapped in the Study Area and are described in Table 2.1 (information sourced from Payne *et al.*, 1998).

Table 2.1: Land Systems, Landforms and Vegetation of the Study Area

Land System	Landform and Vegetation
Tallering	Prominent ridges and hills of banded ironstone, dolerite and sedimentary rocks supporting bowgada and other acacia shrublands.
Tealtoo	Level to gently undulating loamy plains with fine ironstone lag gravel supporting dense acacia shrublands.
Yowie	Sandy plains supporting shrublands of mulga and bowgada with patchy wanderrrie grasses.

2.4 Beards Vegetation Mapping

The vegetation of the Murchison Region was mapped at a scale of 1:1 000 000 by Beard (1976). The Study Area is located in Beard's Yalgoo Subregion of the Austin Botanical District of the Eremaean Province of Western Australia (Beard, 1976). Beard's vegetation mapping has been digitised and updated by DAFWA, 2010 and the vegetation of the Study Area is mapped as two broad structural vegetation associations (Table 2.2).

Table 2.2: Vegetation Associations Mapped by Beard in the Study Area

Beard Code	Vegetation Association Code	Broad Floristic Formation (NVIS Level 3)	Sub-association Description (NVIS Level 6)
a9,14Si	358.5	<i>Acacia</i> open shrubland	<i>Acacia ramulosa</i> , <i>Acacia quadrimarginea</i> , <i>Acacia acuminata</i> , <i>Hakea preissii</i> and <i>Dodonaea inaequifolia</i> Tall Open Shrubland
e6,22Lr a9,19Si	355.2	<i>Acacia</i> open shrubland	<i>Eucalyptus loxophleba</i> and/or <i>Eucalyptus oleosa</i> Isolated Low Trees with <i>Acacia aneura</i> and <i>Acacia ramulosa</i> Tall Open Shrubland

Note: NVIS = National Vegetation Information Systems (ESCAVI, 2003).

The Austin Botanical District is dominated by low mulga (*Acacia aneura*) woodland on the plains and reduced to *Acacia* scrub on the hills (Beard, 1976). The vegetation of the hills is dominated by shrublands of *Acacia aneura*, *Acacia quadrimarginea*, *Acacia ramulosa* and *Acacia grasbyi* over *Senna* and *Eremophila* shrubs.

Government of Western Australia (2010) has calculated the pre-European extent of Beard's vegetation units, the current extent of Beard's vegetation units, how much of each association lies in reserves and how much in pastoral leases managed by the Department of Environment and Conservation (DEC). The data for the vegetation associations of the Infrastructure Areas are included in Table 2.3.

More than 50% of these two vegetation associations is currently represented in reserves or pastoral leases. More than 77% and 99% (respectively) of Beard's units a9,14Si and e6,22Lr currently remain (Government of Western Australia, 2010).

Table 2.3: Beard's Vegetation Associations of the Study Area - Past and Current Extent and Reservation Status

Beard Code (and Vegetation Association Code)	Pre-European Extent (ha)	Current Extent (ha)	Remaining (%)	IUCN class 1-4 Reserves + Former Leasehold	Pastoral Leases Managed by DEC (%)
a9,14Si (358.5)	4,945.37	3,828.23	77.41	50.50	95.81
e6,22Lr a9,19Si (355.2)	23,534.94	23,521.70	99.94	73.67	73.67

2.5 Previous Flora Surveys on and in the Vicinity of the Study Area

Maia carried out four targeted flora surveys on SMC's Blue Hills tenements between June and September 2011 for both exploration and approvals projects (Maia, 2011a, 2011b & 2012). Large polygons have been surveyed across Mungada ridge and adjacent to the existing Mungada West pit. The polygon adjacent to the existing Mungada West pit covered approximately 80% of the proposed Mungada West expansion area. A second polygon that covered the lower southern slopes and footslopes of Mungada Ridge as well as targeted transects across the ridge top and upper slopes, covered approximately 30% of the Mungada East expansion area.

In June 2011, prior to the expansion areas being finalised, transects were walked in the Mungada East and West areas to record conservation significant flora locations and numbers. Additional transects were walked in September 2011 to target the Threatened species *Stylidium* sp. Yalgoo and a portion of these were located within the Study Areas.

Bennett Consulting Ecologists (2004) (Bennett) carried out a flora and vegetation survey of SMC's Blue Hills tenements for ATA in October 2003. Bennett assessed 29 quadrats and 13 relevés and mapped 15 vegetation associations over the two tenements.

Ecologia Environment (ecologia) carried out a flora and vegetation survey of SMCs Blue Hills tenements between July, September and October 2006 and February June and August 2007. Forty two quadrats were sampled and seventeen vegetation associations were described. Bennett's vegetation mapping was amended to reflect the vegetation that was described by Ecologia (ecologia, 2007, 2008a & 2008b).

Markey & Dillon (2008) undertook a quadrat based survey on the flora and floristic communities of several ironstone ranges and outcrops on the central Talling LS as part of a series on the flora and vegetation of the banded iron formations of the Yilgarn Craton undertaken by the DEC. Twenty quadrats were assessed on Windanning Hill along with an additional 83 quadrats surveyed on other hills of the central Talling LS. Of the five main groups and eight floristic community types (FCT) described, five occur in the Mungada Ridge area.

Woodman carried out a level two flora and vegetation survey for the Karara Iron Ore Project between June and August 2006 (Woodman, 2008). The vegetation was mapped over 16,152 ha and this area also incorporated SMC's tenements. Woodman established 115 permanent quadrats and recorded 129 detailed site recordings across the survey area. Woodman's quadrat data was combined with the data collected by the DEC from 41 sites established in and around the survey area and pattern analysis was conducted to determine the final FCTs of the area.

As Woodman (2008) is the most comprehensive flora survey of the area and it incorporates regional data collected by the DEC, it has been used to assess the potential impacts on the vegetation of the Study Area. The FCT's mapped by Woodman are shown on Figure 12.3 (Section 12) and discussed in detail in Section 2.6.

2.6 Woodman's Vegetation Mapping of the Study Area

Woodman (2008) mapped three vegetation Super Groups and 23 FCTs between Mt Karara and Mungada Ridge (Table 2.4). Fourteen of the FCTs are mapped on SMC's Blue Hills tenements: FCT1a, 1b, 2, 3, 7b, 7c, 8, 10a, 11, 12, 13, 14, 15 and FCT16 (Figure 12.3, Section 12). Woodman also mapped mosaics of FCTs 1a/2, 4/17 and 11/9 within the tenements as well as degraded areas. Woodman rated the following FCTs as having the highest conservation significance (i.e. rated 5 on a scale of 1 to 5): FCT8, 11, 12 and FCT13 and the mosaic of FCT11/9. This was followed by FCT14, 10a, 10b, 9 and FCT4 and the mosaic of FCT4/17, which were ranked as 4 by Woodman. These ratings were based on the restricted habitat and the higher number of Priority species found within those FCT's. Four of the highly significant FCTs (FCT8, 11, 12 and FCT13) occur within SMC's Blue Hills tenements along with two of the next highest – FCT14 and 10a and the mosaic of FCT4/17.

Of these, FCT 13 is considered to be of high conservation significance by the EPA, as the community is regionally restricted and would be impacted by mining resulting in fragmentation of the community (EPA, 2009).

Four FCTs and two mosaics (FCT 1a, 12, 13, 14, 1a/2 and 4/17 - highlighted grey in Table 2.4) occur within the Study Area (Figure 12.3, Section 12).

Table 2.4: FCTs on SMC's Blue Hills Tenements – Woodman Environmental Consulting (2008)

Code	Floristic Community Types (FCT)
1a	Open Woodland of <i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i> with Open Shrubland dominated by <i>Acacia tetragonophylla</i> and <i>A. obtecta</i> over chenopod species including <i>Sclerolaena fusiformis</i> , <i>Sclerolaena diacantha</i> and <i>Rhagodia drummondii</i> on flats and drainage depressions.
1b	Shrubland dominated by <i>Acacia</i> species including <i>Acacia burkittii</i> , <i>A. tetragonophylla</i> and <i>A. inceana</i> subsp. <i>conformis</i> over mixed species including <i>Eremophila pantonii</i> , <i>Solanum nummularium</i> and <i>Rhagodia drummondii</i> on flats with occasional ironstone/granite gravels.
2 (in mosaic)	Open Woodland of <i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i> and/or <i>E. striatocalyx</i> subsp. <i>striatocalyx</i> over Shrubland of mixed species including <i>Acacia erinacea</i> , <i>Eremophila pantonii</i> and <i>Senna stowardii</i> over mixed species including <i>Sclerolaena fusiformis</i> and <i>Scaevola spinescens</i> on flats and rocky lower slopes with ironstone gravels.
3	Open Woodland of <i>Eucalyptus kochii</i> subsp. <i>?plenissima</i> or Shrubland of <i>Acacia tetragonophylla</i> , <i>A. burkittii</i> and <i>A. assimilis</i> subsp. <i>assimilis</i> over mixed species including <i>Rhagodia drummondii</i> , <i>Scaevola spinescens</i> , <i>Philotheca brucei</i> subsp. <i>brucei</i> and <i>Eremophila clarkei</i> on flats to mid slopes with ironstone gravels and rarely banded ironstone formations (BIF).
4 (in mosaic)	Shrubland dominated by <i>Acacia ramulosa</i> var. <i>ramulosa</i> over sparse mixed species on flats and slopes.
7b	Woodland of <i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i> over <i>Muehlenbeckia florulenta</i> , <i>Teucrium racemosum</i> and <i>Sclerolaena fusiformis</i> on open drainage depression.

Code	Floristic Community Types (FCT)
7c	Open Woodland of <i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i> or <i>Eucalyptus striatocalyx</i> subsp. <i>striatocalyx</i> or Shrubland of <i>Melaleuca lateriflora</i> over chenopod species including <i>Sclerolaena diacantha</i> , <i>Maireana carnosa</i> and <i>M. thesioides</i> on drainage depressions and lower slopes.
8	Shrubland of mixed <i>Acacia</i> species, including <i>A. assimilis</i> subsp. <i>assimilis</i> , <i>A. ramulosa</i> subsp. <i>ramulosa</i> and <i>A. burkittii</i> , and <i>Melaleuca nematophylla</i> and <i>Calycopeplus paucifolius</i> with occasional <i>Allocasuarina acutivalvis</i> subsp. <i>prinsepiana</i> and <i>Callitris columellaris</i> , over mixed species including <i>Eremophila latrobei</i> subsp. <i>latrobei</i> , <i>E. clarkei</i> , <i>Philotheca sericea</i> , <i>Prostanthera magnifica</i> and <i>Aluta aspera</i> subsp. <i>hesperia</i> on upper slopes and crests with BIF outcropping.
9 (in mosaic)	Shrubland of mixed <i>Acacia</i> species, including <i>Acacia umbraculiformis</i> ms, <i>A. tetragonophylla</i> and <i>A. assimilis</i> subsp. <i>assimilis</i> , and occasional <i>Allocasuarina acutivalvis</i> subsp. <i>prinsepiana</i> over mixed species including <i>Eremophila clarkei</i> , <i>E. latrobei</i> subsp. <i>latrobei</i> , <i>Philotheca brucei</i> subsp. <i>brucei</i> , <i>P. sericea</i> , <i>Xanthosia bungei</i> and <i>Mirbelia bursarioides</i> ms on midslopes to crests with BIF or cherty soils.
10a	Dense Shrubland of mixed <i>Acacia</i> species including <i>A. tetragonophylla</i> and <i>A. exocarpoides</i> , and <i>Allocasuarina acutivalvis</i> subsp. <i>prinsepiana</i> with occasional <i>Eucalyptus petraea</i> over mixed species including <i>Calycopeplus paucifolius</i> , <i>Dodonaea inaequifolia</i> , <i>Philotheca sericea</i> and occasional <i>Acacia woodmaniorum</i> (Threatened) on upper slopes to crests on BIF.
11	Shrubland of <i>Acacia</i> species dominated by <i>A. umbraculiformis</i> ms over mixed species including <i>Aluta aspera</i> subsp. <i>hesperia</i> , <i>Mirbelia bursarioides</i> ms, <i>Philotheca sericea</i> , <i>Micromyrtus trudgenii</i> (Priority 3) on lower slopes to upper slopes with ironstone gravels and occasional BIF.
12	Shrubland of <i>Acacia</i> species including <i>A. assimilis</i> subsp. <i>assimilis</i> , <i>Acacia ramulosa</i> subsp. <i>ramulosa</i> , <i>Acacia exocarpoides</i> and <i>Acacia sibina</i> over mixed species including <i>Hibbertia arcuata</i> , <i>Calycopeplus paucifolius</i> and <i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i> on flats to mid-upper slopes with ironstone gravels.
13	Dense Shrubland of <i>Allocasuarina acutivalvis</i> subsp. <i>prinsepiana</i> with <i>Melaleuca nematophylla</i> over <i>Grevillea paradoxa</i> , <i>Xanthosia bungei</i> and <i>Lepidosperma</i> sp. Blue Hills (A. Markey & S. Dillon 3468) (Priority 1) on mid-upper slopes on BIF.
14	Shrubland of <i>Acacia</i> species including <i>A. assimilis</i> subsp. <i>assimilis</i> and <i>Acacia ramulosa</i> subsp. <i>ramulosa</i> and <i>Allocasuarina acutivalvis</i> subsp. <i>prinsepiana</i> with emergent <i>Eucalyptus leptopoda</i> subsp. <i>elevata</i> over mixed species including <i>Aluta aspera</i> subsp. <i>hesperia</i> , <i>Prostanthera magnifica</i> and <i>Grevillea obliquistigma</i> subsp. <i>obliquistigma</i> on slopes and ridges.
15	Shrubland of mixed <i>Acacia</i> species including <i>A. burkittii</i> , <i>A. assimilis</i> subsp. <i>assimilis</i> , <i>A. latior</i> ms and <i>A. sibina</i> with <i>Melaleuca hamata</i> over <i>Eremophila</i> spp., <i>Malleostemon tuberculatus</i> and <i>Philotheca deserti</i> subsp. <i>deserti</i> on flats and lower slopes.
16	Shrubland of <i>Acacia</i> species dominated by <i>A. latior</i> ms and <i>Melaleuca leiocarpa</i> with emergent <i>Eucalyptus leptopoda</i> var. <i>arctata</i> over mixed species including <i>Wrixonia prostantheroides</i> , <i>Enekbatus stowardii</i> ms, <i>Aluta aspera</i> subsp. <i>hesperia</i> and <i>Hibbertia stenophylla</i> on flats to mid slopes.
17 (in mosaic)	Shrubland of <i>Acacia</i> species dominated by <i>A. sibina</i> and <i>A. latior</i> ms with <i>Melaleuca hamata</i> and / or <i>Melaleuca leiocarpa</i> with emergent <i>Eucalyptus ewartiana</i> on flats.

3 CONSERVATION SIGNIFICANT FLORA

This section describes the conservation significant flora that has been recorded in and around the Study Area.

3.1 Commonwealth Environment Protection and Biodiversity Act 1999

Some flora species are protected under Commonwealth legislation based on the perceived levels of threat to the species population at a national level. These species are placed within one of six conservation categories (Table A2.1, Appendix 2) and four of these categories are specially protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act (EPBC Act)* (DSEWPaC, 2012c).

- The search using the *EPBC Act* Protected Matters Search Tool (DSEWPaC, 2012a) indicated that three flora species protected by the *EPBC Act*, including the species habitat, have the potential to occur in the Infrastructure Areas and surrounds: *Eremophila viscida* (Endangered), *Hybanthus cymulosus* (Critically Endangered) and *Pityrodia axillaris* (Critically Endangered).
- None of these species have been recorded in or in the vicinity of the Study Area.

3.2 Western Australian Wildlife Conservation Act 1950

All flora species native to Western Australia are protected under the State's *Wildlife Conservation Act (WC Act)*. Under the *WC Act*, the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Schedules 1 and 2 deal with those species that are threatened and those presumed extinct respectively (DEC, 2012a).

In Western Australia the term Threatened Flora is applied to extant Declared Rare Flora (DRF) and Presumed Extinct Flora to extinct DRF (DEC, 2012a and defined in Table A2.2, Appendix 2). The most recent DRF list was published in August 2010 (Government of Western Australia, 2010(2)).

Currently, 13 records exist for Threatened Flora species in the Yalgoo Bioregion (FloraBase, 2011). Of these records, three species listed under the *WC Act* are known to occur within or in the vicinity of the SMCs tenements: *Acacia woodmaniorum* (Vulnerable), *Eucalyptus synandra* (Vulnerable) and *Stylidium* sp. Yalgoo (Vulnerable).

Acacia woodmaniorum is known from records at Blue Hills, Mungada Ridge and Windaning Hill as well as Jasper Hill to the north of the Study Area.

- *Acacia Woodmaniorum* has been recorded in high numbers on the south facing slopes of the Mungada East ridge and the existing pit and in lower numbers around the existing Mungada West pit. *A. woodmaniorum* has been recorded within the Study Area (Figure 12.4, Section 12).
- *Stylidium* sp. Yalgoo was targeted within SMC tenements by Maia during September 2011, however no plants were located and neither was the preferred habitat.

3.3 Priority Flora

Because of the large number of Western Australian flora, many species are known from only a few collections, or a few sites, and have not been adequately surveyed. Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation

status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation dependent species are placed in Priority 5 (DEC, 2012a).

Definitions for each of the categories discussed above are included in Table A2.3 (Appendix 2). The most recent Priority Flora list was published in September 2010 (Smith, 2010).

FloraBase (2012) lists 171 Priority Flora species for the Yalgoo bioregion. The NatureMap search indicated that 31 Priority species have been recorded at or in the vicinity of the areas surveyed. These records include: nine Priority 1 species, four Priority 2 species and 18 Priority 3 species.

Two additional Priority Flora species were listed in reports on other surveys carried out in the area (Table A1.1, Appendix 1) bringing the total to 33.

- Four Priority Flora taxa records fall within in the boundaries of the Study Area: *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468) (Priority 1), *Drummondita fulva*, *Micromyrtus trudgenii* and *Persoonia pentasticha* (all Priority 3).

Approximately 80% of the Mungada West and 30% of the Mungada East expansion areas have been surveyed by Maia. Priority Flora recorded by Maia as well as by Woodman within the Study Area are shown on Figure 12.5 (Section 12). Details on known recorded locations for the species are included in Table A1.1, Appendix 1.

4 INTRODUCED FLORA

4.1 Weeds of National Significance

In 1998, Australian governments endorsed a framework to identify which weed species could be considered to be Weeds of National Significance (WONS) within an agricultural, forestry and environmental context. Seventy-one weed species were nominated for ranking as WONS, 20 were accepted of which 14 occur in Western Australia (DEC, 2012b). The criteria used to determine WONS were: the invasiveness of the weed species, the weed's impact, the potential spread of the species, and the socio-economic and environmental values of the weed (Australian Government, 2011).

- The *EPBC Act* Protected Matters Search Tool and the NatureMap search indicated that no WONS have been recorded in the area.
- No WONS were located during the surveys carried out in the area.

4.2 Agriculture and Related Resources Protection Act 1976

Plants which adversely affect agriculture (or have the potential to) are known as Declared Plants and are listed as one or more of five priority category weeds under the *Agriculture and Related Resources Protection Act 1976* (DAFWA, 2012a). The priority categories (Table A3.1, Appendix 3) define the control mechanisms for these weeds.

A Declared Plants search (DAFWA, 2012b) indicated that 86 Declared Plants are listed for the Morawa and Perenjori areas.

No Declared Plants were listed in the results from the search using the *EPBC Act* Protected Matters Search Tool. The NatureMap search listed two Declared Plants that have been recorded within the search area: *Echium plantagineum* (Paterson's Curse) and *Galium aparine* (Goosegrass).

- Large numbers of *Echium plantagineum* (Paterson's Curse) were recorded by ecologia during a survey in 2006 (EPA, 2009) and by Maia in September 2011 on disturbed areas of the lower slopes of the old Mungada East mining pit.

4.3 Environmental Weeds

Environmental weeds are not known to pose a threat to agriculture, but are known to be invasive colonisers that can threaten the health of native vegetation.

The *EPBC Act* Protected Matters Search Tool indicated that one invasive species (weed) could occur in the area: *Cenchrus ciliaris* (Buffel-grass).

- The NatureMap search listed 33 weed species that have been recorded in the area.
- Ten environmental weeds (*Arctotheca calendula*, *Brassica tournefortii*, *Cleretum papulosum* subsp. *papulosum*, *Cuscuta planiflora*, *Erodium cicutarium*, *Lamarckia aurea*, *Lysimachia arvensis*, *Pentstemon airoides* subsp. *airoides*, *Rostraria pumila* and *Sonchus oleraceus*) have been recorded by Maia in the wider area.

5 ECOLOGICAL COMMUNITIES, ESA'S, CONSERVATION ESTATES AND SCHEDULE 1 AREAS

5.1 *Threatened and Priority Ecological Communities*

Some ecological communities are protected by Commonwealth and State legislation (Threatened Ecological Communities; TECs), while others are listed as Priority Ecological Communities (PECs) while their significance is being assessed prior to being listed as a TEC. The conservation significance rankings for TECs and PECs are detailed in Table A2.4 and Table A2.5 (Appendix 2). The most recent TEC list was released in August 2010 (DEC, 2010) and no TECs occur within the Yalgoo bioregion. The most recent PEC list was released on September 30, 2011 and includes 74 PECs in the mid-west.

- The Study Area does not occur in or close to a TEC.
- The Study Area falls within the Priority 1 PEC Blue Hills (Mount Karara / Mungada Ridge / Blue Hills) vegetation complexes (banded ironstone formation) (DEC, 2011).

The section of the PEC occurring within SMC's tenements is shown on Figure 12.1 (Section 12) and the location of the Study Area relative to the PEC boundary is shown on Figure 12.2 (Section 12). Approximately 80% of the Mungada East expansion area lies within the PEC while the Mungada West expansion area lies just outside of the PEC boundary.

5.2 *ESA's, Conservation Estates and Schedule 1 Areas*

Relevant databases were searched using Landgate's Shared Land Information Platform to locate any environmentally sensitive areas (ESAs) in the Study Area (Landgate, 2011).

- No ESAs occur within or close to the Study Area.
- The nearest ESA is the Koolanooka TEC, approximately 45 km to the south-west of the Study Area.

The National Reserve System is a network of protected areas managed for conservation under international guidelines.

- No conservation estates occur within the Study Area.
- The nearest conservation estate is the Lochada Nature Reserve, approximately 10 km to the west of the Study Area.

The nearest Schedule 1 Area is located approximately 10 km to the south-east of the Study Area adjacent to the abandoned Mt Mulga mine.

6 CONSERVATION SIGNIFICANCE - VEGETATION

6.1 Regional Significance

The regional significance of LSs and Beard and Woodman vegetation communities mapped in the Study Area is considered below.

6.1.1 Land Systems

The extent of each LS in the Study Area is listed in Table 6.1.

Table 6.1: Land Systems of the Study Area

Land System	Habitat Description	Area in WA (ha)	Area in SMC Tenements (ha)	Area in Study Area (ha)	Percentage of cover in SMC Tenements (%)	Percentage of cover in WA (%)
Tallering	Prominent ridges and hills of banded ironstone, dolerite and sedimentary rocks supporting bowgada and other acacia shrublands.	32,900	462.23	53.51	11.57	0.16
Tealtoo	Level to gently undulating loamy plains with fine ironstone lag gravel supporting dense acacia shrublands.	69,300	116.18	3.24	2.80	0.005
Yowie	Sandy plains supporting shrublands of mulga and bowgada with patchy wanderrie grasses.	918,900	396.98	10.69	2.70	0.001

The extent of the LSs in the Sandstone-Yalgoo-Paynes Find area ranges from 32,900 ha to 918,900 ha. The Tallering LS is therefore one of the least extensive mapped in that area. While the Tallering LS is mapped over a relatively small area it has a fairly wide distribution (from Yalgoo in the north almost to Paynes Find in the south and from, Karara Station in the west to just east of Warriedar Station in the east). Therefore, the Tallering LS in the Study Area has moderate regional significance.

The Tealtoo LS is mapped over two relatively small areas between Rothsay and Minjar Hill in the west and nearly 300 km to the south-east between the Windarling Range in the Mount Manning Nature Reserve and the abandoned Diemal mine. Based on its limited distribution and small mapped area, the Tealtoo LS in the Study Area is of moderate to high regional significance.

The Yowie LS is the largest mapped in that area and it has a widespread distribution in the Sandstone-Yalgoo - Paynes Find area. As a result the Yowie LS in the Study Area is of low regional significance.

6.1.2 Beard's Vegetation Mapping

The Study Area occurs in two of Beard's mapped units and these are listed in Table 6.2.

Table 6.2: Beard's Vegetation Mapping in the Study Area

Vegetation Association (and Code)	Sub-Association Description (NVIS Level 6)	Current Area in WA (ha)	Area in SMC Tenements (ha)	Area in Study Area (ha)	Percentage of SMC Tenements in Study Area (%)	Percentage of WA Extent in Study Area (%)
a9,14Si (358.5)	<i>Acacia ramulosa</i> , <i>Acacia quadrimarginea</i> , <i>Acacia acuminata</i> , <i>Hakea preissii</i> and <i>Dodonaea inaequifolia</i> Tall Open Shrubland	3,828	548	46.6	8.50	1.22
e6,22Lr a9,19Si (355.2)	<i>Eucalyptus loxophleba</i> and/or <i>Eucalyptus oleosa</i> Isolated Low Trees with <i>Acacia aneura</i> and <i>Acacia ramulosa</i> Tall Open Shrubland	23,522	571	20.85	3.65	0.09

Note: NVIS = National Vegetation Information Systems (ESCAVI, 2003).

Vegetation association a9,14Si is mapped over a relatively small area of the Murchison and it has a narrow distribution. Because of this and its cover in the Study Area it is rated as having moderate regional significance.

Vegetation association e6,22Lr a9,19Si is mapped over a larger area of the Murchison. It has a wider distribution and because of its size and distribution the regional conservation significance of its cover in the Study Area is rated as low.

6.1.3 Woodman's Vegetation Mapping

Of the FCT's and mosaics recorded in the Study Area, Woodman ranked two as being of high conservation significance (12 and 13) and two as moderate (14 and 4 which was also mapped as a mosaic with 17).

FCT 12 was mainly mapped across the Tallering LS which has limited regional distribution and is generally restricted to BIF ridges and associated landforms. *Acacia woodmaniorum* has also been recorded on this FCT at Blue Hills. Because of its apparent restricted distribution, FCT 12 is considered to be of high regional significance. When Woodman compared the DEC's data with that collected during its Gindalbie mapping survey, FCT 12 was found to group statistically with Markey and Dillon's FCT 1b. Markey and Dillon found FCT 1b to be the most common and widespread community type across the central Tallering LS survey area on hillslopes and isolated ridges, however Markey and Dillon did not map the FCTs and therefore its distribution cannot be gauged accurately.

FCT 13 was found to be the equivalent to Markey and Dillon's FCT 2 which was only recorded on very steep rocky slopes of Mount Karara and Windaning Ridge. FCT 13 was also mainly mapped on the Tallering LS which has limited regional distribution. *Acacia woodmaniorum* was also recorded in this FCT. Because of its apparent restricted distribution, FCT 13 is considered to be of high regional significance.

FCTs 14 and 4 were ranked by Woodman as having moderately high conservation significance based on the regionally restricted habitats that they occur on but with some regional representation across the Tallering LS. FCT 14 grouped with Markey and Dillon's FCT 1 which was described as having a relatively wide

distribution across the Tallering LS from Karara to the BIF ridges north of Minjar Hill east to the footslopes of Warriedar Hill (Markey and Dillon, 2008). Whilst carrying out targeted surveys across a sub-set of SMC tenements, Maia did not encounter FCT 4 (based on the dominant and associated species) but did observe areas of FCT 17 which was rated as having low conservation significance and is believed to have a broad regional distribution.

6.2 Local Significance

Local significance is based on the cover of the land systems / vegetation associations in the Study Area compared with that in SMC's tenements as a whole. Local significance is rated as high, moderate or low.

6.2.1 Land Systems

Given the small percentage of the Tallering, Tealtoo and Yowie LSs that occur in the Study Area compared with that mapped in the surrounding area (less than 12%; Table 6.1) the local significance of these LS in the Study Area is rated as low.

6.2.2 Beard's Vegetation Mapping

Given the small percentage of the two vegetation associations mapped by Beard that occur in the Study Area compared with that mapped in SMC's tenements (less than 10%; Table 6.2) the local significance of these vegetation associations in the Study Areas is rated as low.

6.2.3 Woodman's Vegetation Mapping

The local significance of the FCTs of the Study Area is based on; the FCT's cover in the Study Area, the proportion of the FCT's area that occurs within the Study Area and SMC's tenement, the number of significant species located within each FCT, and the regional significance of the FCT (Table 6.3).

Table 6.3: Local Significance of FCTs in the Study Area

FCT	Area Mapped in Study Area (ha)	Area Mapped in SMC Tenements (ha)	Study Area FCTs as a Proportion of Area Mapped in SMC Tenements (%)	Aw (T)	LsB (P1)	Df (P3)	Mt (P3)	Pp (P3)	Total No. Significant Flora Species	Local Significance
1a	0.92	38.63	2.38						0	Low
1a/2	10.99	195.68	5.62					Yes	1	Low
4/17	12.46	132.55	9.40			Yes	Yes		2	Low
12	30.02	359.48	8.35	Yes	Yes	Yes	Yes	Yes	5	Moderate
13	10.69	35.41	30.19	Yes	Yes	Yes	Yes	Yes	5	High
14	0.17	11.09	1.53	Yes	Yes	Yes	Yes		4	Moderate
Total	65.25	772.84		3	3	4	4	3		

Note: FCT = floristic community type, Aw = *Acacia woodmaniorum*, LsB = *Lepidosperma* sp. Blue Hills, Df = *Drummondita fulva*, Mt = *Micromyrtus trudgenii*, Pp = *Persoonia pentasticha*.

The proportional representation of the FCTs of the Study Area in SMC's tenements ranges from 1.53% to 30.19% and the local significance rating ranges from low to high. Five significant species, including a Threatened species, were recorded in two of the FCTs (12 and 13). FCT 12 has a relatively low proportional representation and therefore moderate local significance while FCT 13 has a relatively high proportional representation (30.19%) and high local significance. Four significant species have been recorded in FCT 14

in the Study Area including a Threatened species. While this FCT has a low proportional representation in the Study Area the presence of the Threatened species has prompted the moderate local significance rating.

6.3 Ecological Communities

Approximately 79% of the Mungada East Study Area lies within the Priority 1 PEC at Blue Hills and it is therefore regionally significant. As the PEC covers a large area (approximately 2,195 ha), and the Mungada East Study Area intersecting the PEC is relatively small (approximately 41 ha) the local significance of the area of the PEC in the Study Area is considered to be moderate to high.

7 FLORA CONSERVATION SIGNIFICANCE

Significance ratings (low, moderate or high) are based on the bioregional distribution and the number and spread of FloraBase records for each species.

Sixteen *Acacia woodmaniorum* (Threatened) records are listed on FloraBase and its distribution is limited to the Blue Hills (BH) Range in the Murchison (FloraBase, February 2012). This species is found in large numbers primarily on the rocky crests and southern slopes of the Blue Hills Range. However, it also grows in disturbed areas inside and adjacent to the existing Mungada West and East pits.

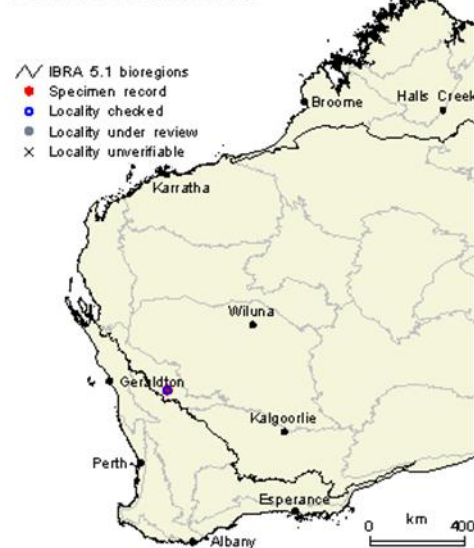
As a Threatened (Vulnerable) species *A. woodmaniorum* is considered to be facing a high risk of extinction in the wild.

Given its limited distribution (Yalgoo Bioregion) and listing as a Threatened Flora species its regional significance is high.

Six *Lepidosperma* sp. Blue Hills (Priority 1) records are listed on FloraBase and its distribution is limited to Charles Darwin Reserve NE of Wubin and Mt Karara at BH Range (FloraBase, February 2012). The species is found in relatively large numbers and it tends to be habitat specific to the rocky hills and midslopes.

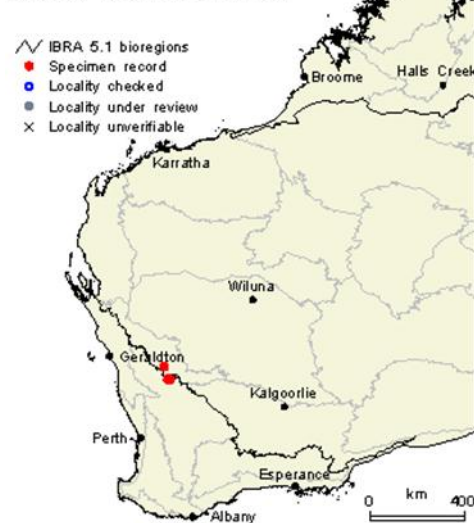
As a Priority 1 species *L. sp. Blue Hills* is poorly known. Given its limited regional distribution (Yalgoo and Avon Wheatbelt bioregions) and habitat specificity it has high regional conservation significance.

Acacia woodmaniorum



Map by Paul Gioia, WA Herbarium. Current at August 04, 2011

Lepidosperma sp. Blue Hills (A. Markey & S. Dillon 3468)



Map by Paul Gioia, WA Herbarium. Current at August 04, 2011

Fifteen *Drummondita fulva* (Priority 3) records are listed on FloraBase and its distribution is limited to Windaning Hill, Oxiana Golden Grove, Blue Hills Range, BH Range Minjar Hill, Warriedar Hill, BH Range Jasper Hill (FloraBase, February 2012).

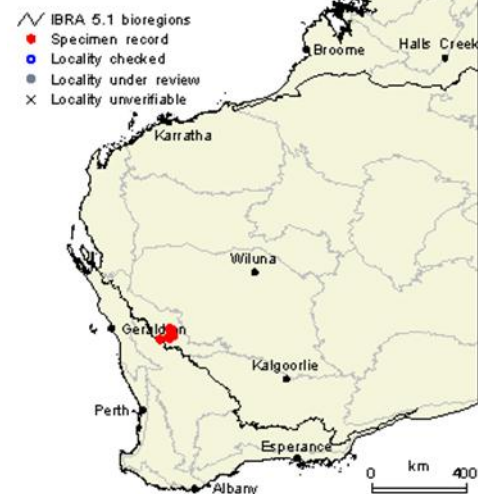
This species is found in relatively large numbers and occurs across a number of habitats at Blue Hills (low lateritic hills, rocky ironstone outcrops, minor rocky gullies and on the flats). As a Priority 3 species *D. fulva* is poorly known and as it has a limited distribution (appears to be only Yalgoo Bioregion) is rated as having high regional conservation significance.

Twenty-nine records for *Micromyrtus trudgenii* (Priority 3) are listed on FloraBase and its distribution is limited to Damperwah Hills Karara Station, Mt Mulgine, Warriedar Station, St Patricks, Arsenic Hill, Bentley, Riley, near Mungada, Mungada Ridge, BH Range, BH Range Minjar Hill, BH Range Warriedar Hill, BH Range Jasper Hill, BH Range Windaning Hill, 20 km south of Golden Grove Mine, Golden Grove mine site and Gossan Hill (FloraBase, February 2012).

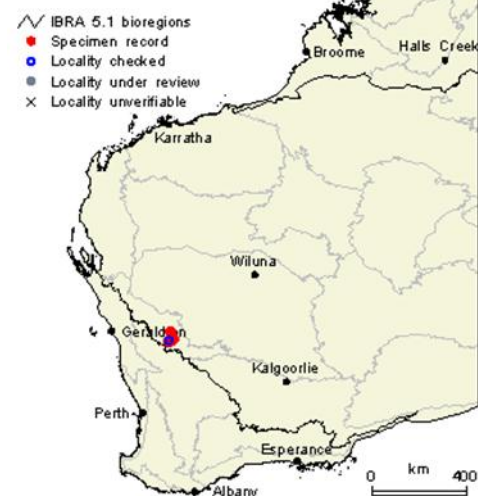
M. trudgenii occurs in high numbers and is generally found on rocky slopes and hill crests but is also recorded in lower numbers on the outwash flats. As a Priority 3 species *M. trudgenii* is poorly known.

While it has a limited distribution (Yalgoo Bioregion) it is recorded in high numbers across the BH Range and is considered to be moderately conservation significant regionally.

Drummondita fulva



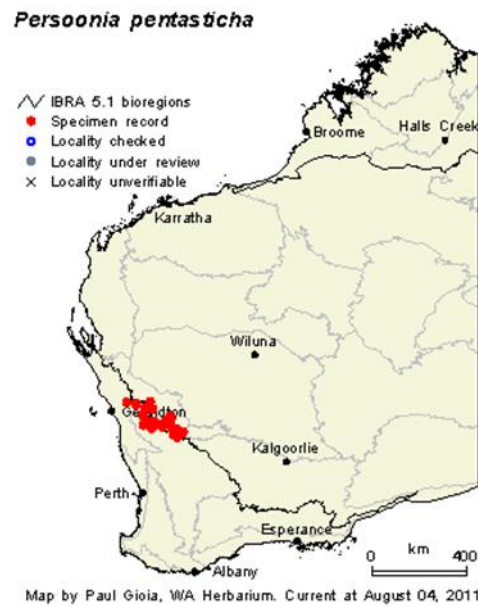
Micromyrtus trudgenii



Forty-one records for *Persoonia pentasticha* (Priority 3) are listed on FloraBase and localities include Koolanooka Hills, Charles Darwin Reserve, Barrabarra Nature Reserve, Mt Gibson, Damperwah Hills, Perenjori Hills, Billerangera Hills, Mugga Mugga Hill, Mungada Ridge, BH Range, Extension Hill, Warriedar Station, Mt Gibson Station, 70 km NE of Wubin, East Yuna Nature Reserve and West Perenjori Nature Reserve (FloraBase, February 2012).

P. pentasticha has a scattered distribution and is found in low numbers on the flats and footslopes of the hills of the Range.

P. pentasticha has a relatively wide distribution in the Midwest (in the Yalgoo, Avon Wheatbelt and Geraldton Sandplains bioregions) and is considered to have low regional conservation significance.



Mapping by Paul Gioia. Image used with the permission of the Western Australian Herbarium, Department of Environment and Conservation (<http://florabase.dec.wa.gov.au/help/copyright>). Accessed on Wed, 22 February 2012.

8 IMPACTS

8.1 Impacts to Conservation Significant Species

Impacts estimated for the five conservation significant flora species recorded within the Study Area are summarised in Table 8.1.

The calculations in this section use both Maia's data from previous exploration and approvals surveys combined with Woodman's data collected across both Gindalbie and SMC tenements. Maia and Woodman significant species locations were plotted together and when two points overlapped only one set of data was used in the counts for that location.

The distribution of *Acacia woodmaniorum* in the wider area is shown in Figure 12.6 (Section 12) and the four Priority Flora in the wider area on Figure 12.7 (Section 12).

Estimated impact to each of the conservation significant flora species located within the Study Area is less than 20% and ranges from 0.88% (*Lepidosperma* sp. Blue Hills) to 18.61% (*Acacia woodmaniorum*) (Table 8.1). The greatest impact to *A. woodmaniorum* is from the Mungada East Study Area with 18.57% compared to 0.04% from the Mungada West Study Area.

Cumulative impacts estimated to *Acacia woodmaniorum* and *Lepidosperma* sp. Blue Hills from the pre-approved areas, additional proposed infrastructure areas (currently being assessed by the Office of the EPA under a Section 45c application), the Study Area and Gindalbie's operations are listed in Table 8.2. The counts for *Acacia woodmaniorum* in this table are based on both Maia's and Woodman's data. The counts for *Lepidosperma* sp. Blue Hills are based on Maia's and Woodman's data (records inside the Study Area) and the total counts data provided in Gindalbie's Public Environmental Review (PER) because Woodman's data included substantially fewer individuals than listed in the PER document.

The cumulative impact estimated for *Acacia woodmaniorum* from SMC's operations is 27.79%. When combined with the impacts from Gindalbie's current operations the overall impact to *A. woodmaniorum* is 31.15%. Cumulative impact estimated for *Lepidosperma* sp. Blue Hills from SMC's operations is 0.89%. When combined with the impacts from Gindalbie's current operations, the overall impact is estimated to be 69.70%.

Table 8.1: Estimated Impacts to Conservation Significant Flora Recorded in the Study Area

Species	<i>Acacia woodmaniorum</i> (T)	<i>Lepidosperma</i> sp. Blue Hills (P1)	<i>Drummondita fulva</i>	<i>Micromyrtus trudgenii</i>	<i>Persoonia pentasticha</i>
No. of Plants in the Study Area (ME)	5,589	464	132	473	10
No. of Plants in the Study Area (MW)	12	0	2	324	0
Total No. of Plants in the Study Area (ME and MW)	5,601	464	134	599	10
Total No. of Plants Recorded by Woodman & Maia	30,103	52,769*	4,118	14,391	225
Impact ME (%)	18.57	0.88	3.21	3.86	4.44
Impact MW (%)	0.04	0.00	0.05	2.25	0.00
Total Impact (%)	18.61	0.88	3.25	6.11	4.44

T = Threatened Flora species; P1 and P3 = Priority 1 and Priority 3 Flora species.

* This count includes Woodman's data from the PER report as it differs markedly from the numbers supplied to Maia by Gindalbie.

ME = Mungada East extension, MW = Mungada West extension.

Table 8.2: Estimated Cumulative Impacts to *Acacia woodmaniorum* and *Lepidosperma* sp. Blue Hills

Species	ME Impacts		MW Impacts	
	<i>Acacia woodmaniorum</i> (T)	<i>Lepidosperma</i> sp. Blue Hills (P1)	<i>Acacia woodmaniorum</i> (T)	<i>Lepidosperma</i> sp. Blue Hills (P1)
(A) No. of Plants in the SMC Study Area	5,589	464	12	0
(B) No. of Plants in SMC Approved Areas (ecologia, 2008a)	811	2	811	2
(C) No. of Plants in SMC Infrastructure Areas** (Maia, 2012)	1,966	5	1,966	5
(D) No. of Plants to be Impacted by Gindalbie	1,012	36,310	1,012	36,310
Total A+B+C+D	9,378	36,310	3,801	36,317
Total No. of Plants Recorded by Woodman & Maia	30,103	52,769*	30,103	*52,769
Cumulative Impact (%) - SMC	27.79	0.89	9.26	0.01
Cumulative Impact (%) - SMC & Gindalbie	31.15	69.70	12.63	68.82

T = Threatened Flora species; P1 = Priority 1 Flora species.

*This count includes Woodman's data from the PER report as it differs markedly from the numbers supplied to Maia by Gindalbie.

**Additional infrastructure areas currently being assessed by the OEPA under Section 45c of the *Environmental Protection Act 1986*.

ME = Mungada East extension, MW = Mungada West extension.

8.2 Impacts to Vegetation

A summary of the impacts to the land systems and Beard's vegetation association is provided in Table 8.3.

Table 8.3: Impacts to Land Systems and Beard Vegetation Associations of the Study Area

	Description	Area in the Study Area (ha)	Area in SMC Tenements (ha)	Area in WA (ha)	% of the SMC Tenements Area in the Study Area (%)	% of the WA Area in the Study Area (%)
Land System	Tallering	53.51	462.23	32,900	11.57	0.16
	Tealtoo	3.24	116.18	69,300	2.80	0.005
	Yowie	10.69	396.98	918,900	2.70	0.001
Beard	a9,14Si (358.5)	46.6	548	3,828	8.50	1.22
	e6,22Lr a9,19Si (355.2)	20.85	571	23,522	3.65	0.09

8.2.1 Impacts to Land Systems

Estimated impacts to the three LS of the Study Area are listed in Table 8.3. Local impact has been calculated using LS cover in the Study Area and in SMC's tenements while regional impact has been calculated using LS cover in the Study Area and in WA.

Local impacts to two of the three LS of the Study Area are estimated to be low (< 3%) with the highest local impact to the Tallering LS with 11.57%. Regional impacts are considered to be very low (< 1%).

8.2.2 Impacts to Beard's Vegetation Mapping

Estimated impacts to Beard's vegetation associations of the Study Area are detailed in Table 8.3. Local impact has been calculated using Beard vegetation association cover in the Study Area and in SMC's tenements while regional impact has been calculated using Beard vegetation association cover in the Study Area and in WA.

Local impacts are estimated to be low (< 9%) while regional impacts are very low (< 2%).

Currently, 77.41% of association a9,14Si remains (see Table 2.3, Section 2) and the proposed expansion works within the Study Area would reduce this to 76.46%. Similarly, 99.94% of e6,22Lr a9,19Si remains and this would reduce to 99.85% as a result of the proposed expansion works.

8.2.3 Impacts to Woodman's Vegetation Mapping

Impacts to the vegetation units of the area have been estimated using Woodman's vegetation mapping over SMC tenements alone and over both SMC and Gindalbie's tenements (the wider area) (Table 8.4). Cumulative impacts from SMC's operations (the pre-approved areas, proposed new Infrastructure Areas and the new Study Area) and Gindalbies operations are listed in Table 8.5.

Impacts to the FCTs of the Study Area range from 0% (Degraded) to 30.02% (FCT 12).

Total impact to the FCTs mapped within SMC's tenements ranges from 4.78% (FCT 14) to 46.06% (FCT 13), however when calculations are based on the wider area mapped, impacts are much lower and range from 0.16% (FCT 14) to 9.2% (FCT 12). Cumulative impact to FCT 13 (the most significant) based on the wider mapped area is 6.32% and based on SMC's tenements is 46.06%.

When the impacts from both SMC and Gindalbie operations are taken into consideration, the cumulative impacts are higher and range from 8.98% (FCT 4/17) to 65.13% (FCT 14). Cumulative impact to FCT 13 (the most significant) is estimated to be 60.24%.

Table 8.4: Impacts to FCTs by SMC's Approved and Proposed Projects and Gindalbie's Current Operations

	FCT	1a	1a/2	4/17	12	13	14	Degraded	Total Area (ha)
Mapped Area	Extent in SMC Tenements (ha)	38.63	195.68	132.55	359.48	35.41	11.09	14.44	787.28
	Total Mapped Extent in the Wider Area (ha)	796.21	3488.35	472.35	643.33	258.11	324.1	14.44	5996.89
Impact Areas	(A) Extent in SMC ME Study Area (ha)	0	10.99	0	30.02	10.69	0.17	0	51.87
	(B) Extent in SMC MW Study Area (ha)	0.92	0	12.46	0	0	0	0	13.38
	(C) Extent in SMC proposed Infrastructure Areas (ha)	0.51	18.1	6.4	15.53	2.02	0.25	1.42	44.23
	(D) Extent in SMC Pre-Approved Areas (ha)	2.31	5.74	14.08	13.65	3.6	0.11	11.86	51.35
Total Impacts	Total Area to be Impacted by SMC (ha) (A+B+C+D)	3.74	34.83	32.94	59.20	16.31	0.53	13.28	160.83
	Total Area to be Impacted Within SMC Tenements (%)	9.71	17.80	26.50	16.47	46.06	4.78	91.97	n/a
	Total Impact to the Wider Area by SMC (%)	0.47	1.00	7.44	9.20	6.32	0.16	91.97	n/a
Cumulative Impacts	Total Area Impacted by Gindalbie (ha)*	77.1	606.2	7.28	40.59	139.18	210.57	0	1080.92
	Cumulative Impact of SMC & Gindalbie (ha)	80.85	641.03	42.40	99.79	155.49	211.10	13.28	1243.94
	Cumulative Impact of SMC & Gindalbie to the Wider Area (%)	10.15	18.38	8.98	15.51	60.24	65.13	91.97	n/a

Note: Rows highlighted orange indicate FCTs ranked as most highly conservation significant by Woodman and those highlighted green as next highest conservation significant. ME = Mungada East extension, MW = Mungada West extension.

8.2.4 Impacts to PEC

Impacts to the PEC from the proposed works will be 40.88 ha from the Mungada East Study Area. The total area of the PEC is 2194.5 ha and therefore the estimated impact to the PEC is 1.9%. The cumulative impact from SMC's pre-approved areas, proposed new Infrastructure Areas and proposed expansion areas is 75.9 ha (3.5%). The cumulative impacts from SMC and Gindalbie operations cannot be assessed as this was not discussed in the Karara Iron Ore Project PER.

9 CONCLUSIONS

Based on the results of the impact assessment in Section 8, the greatest impact to conservation significant flora, FCT's and the Priority 1 PEC will be from the Mungada East Study Area. The larger area of the proposed expansion is focussed on the southern lower to upper slopes of Mungada Ridge which supports large populations of the Threatened species *Acacia woodmaniorum* and contains the highly conservation significant FCTs 12 and 13.

Impact to *Acacia woodmaniorum* from the Mungada East Study Area is relatively high (18.57%) and this increases to 31.15% when the cumulative impacts from both SMC and Gindalbie operations are taken into consideration.

Impacts from the Mungada East Study Area to the two highly conservation significant FCTs -12 and 13 - are relatively low (4.6% and 4.14% respectively). However, impacts increase substantially when the cumulative effects of SMC's and Gindalbie's operations are taken into consideration (FCT 12, 15.51% and FCT 13, 60.24%). Neither of these FCTs occurs within the Mungada West Study Area.

Impacts to the PEC from the Mungada East Study Area are relatively low (<2%). When the cumulative impacts from all approved and proposed SMC operations are taken into consideration, this increases to 3.5%. There is no impact from the Mungada West Study Area.

10 PROJECT TEAM

This study was carried out by the botanists listed in Table 10.1.

Table 10.1: Project Team

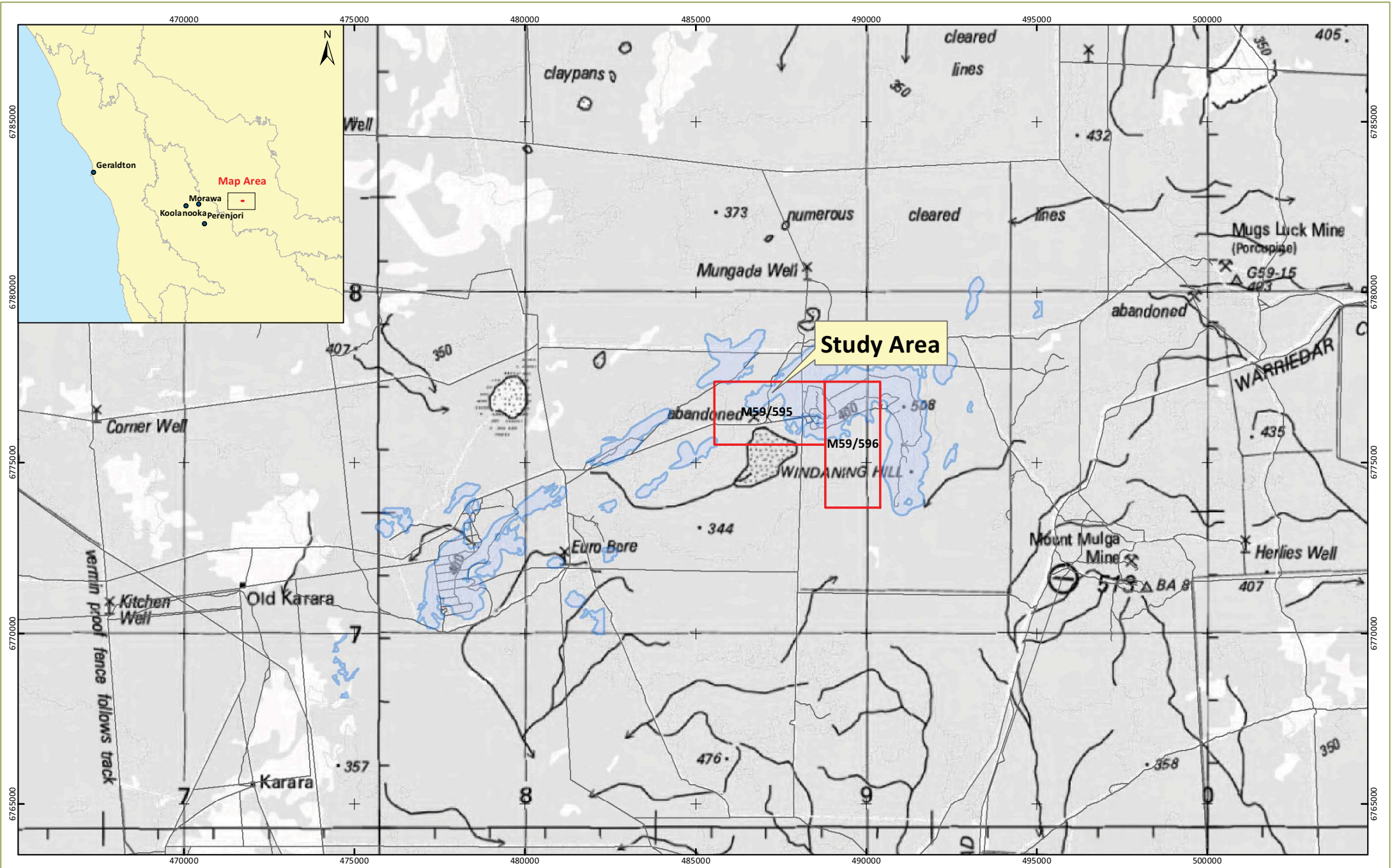
Project Team		
Name	Qualification	Project Role
Christina Cox	PhD	Botanist – report
Scott Hitchcock	BSc	Botanist – report
Melissa Hay	BSc	Botanist – report

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12 FIGURES



General Location of Blue Hills Study Area

- SMC Tenements
- Blue Hills PEC (P1) Boundary

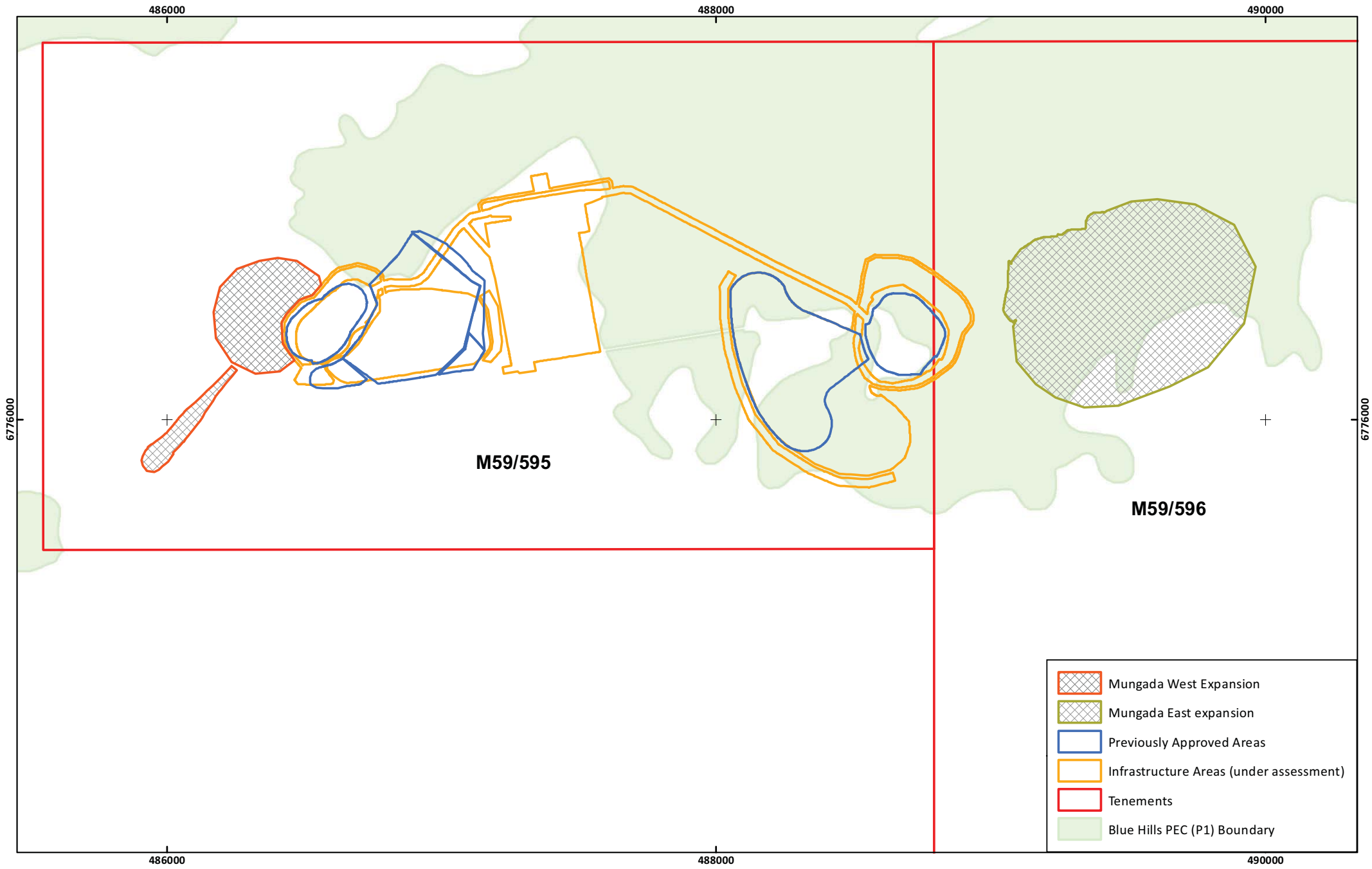
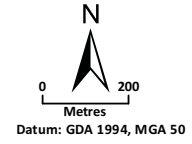
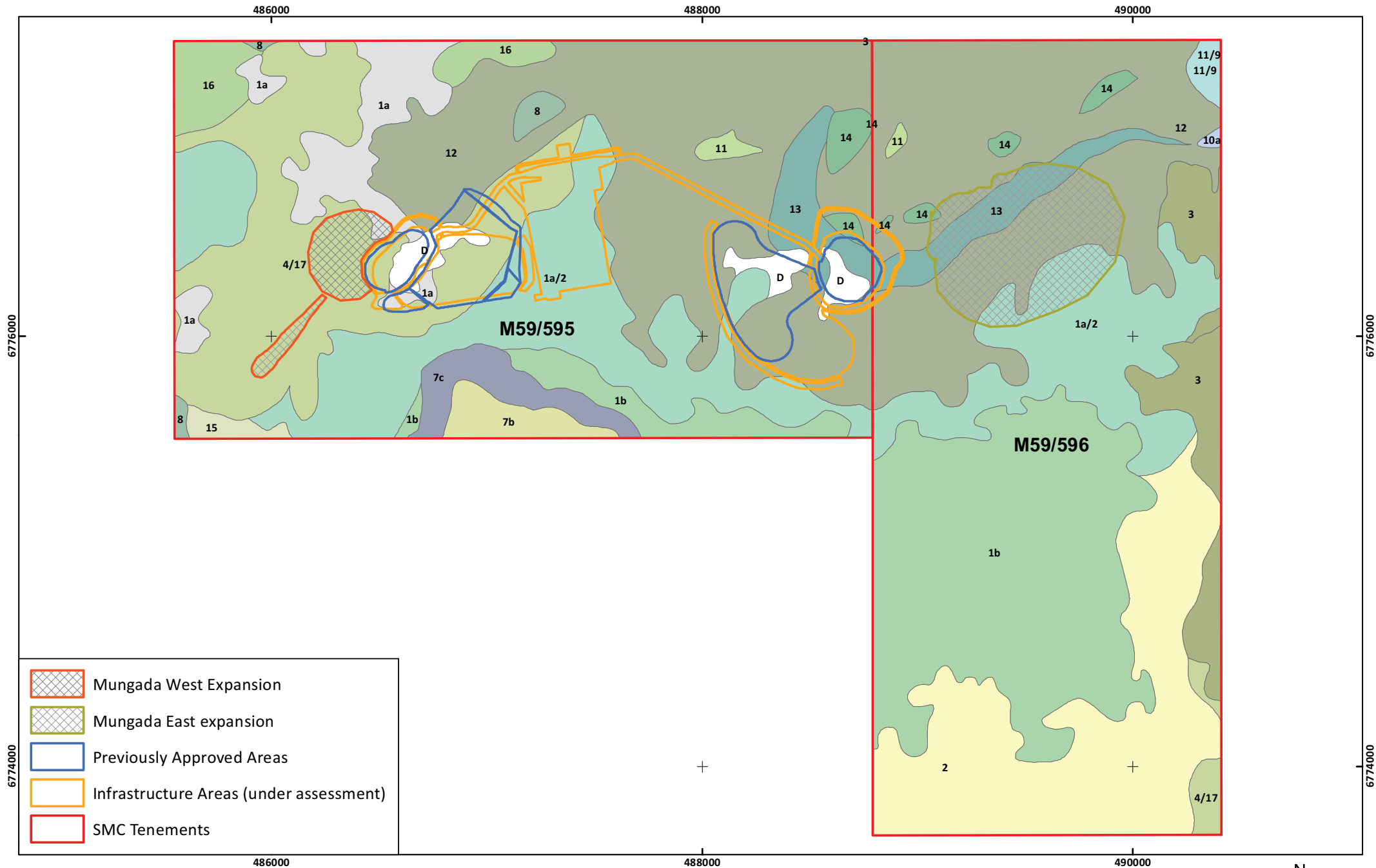


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 Prepared for: SMC
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 Version: 1

Blue Hills Mungada West and East Study Areas

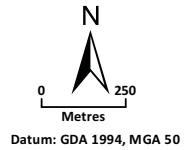




**Woodman's Vegetation Mapping
on SMC Tenements**

Figure: 12.3
Prepared for: SMC
Drawn by: SH
Version: 1

(See Table 2.4, Section 2 for descriptions of the vegetation codes)



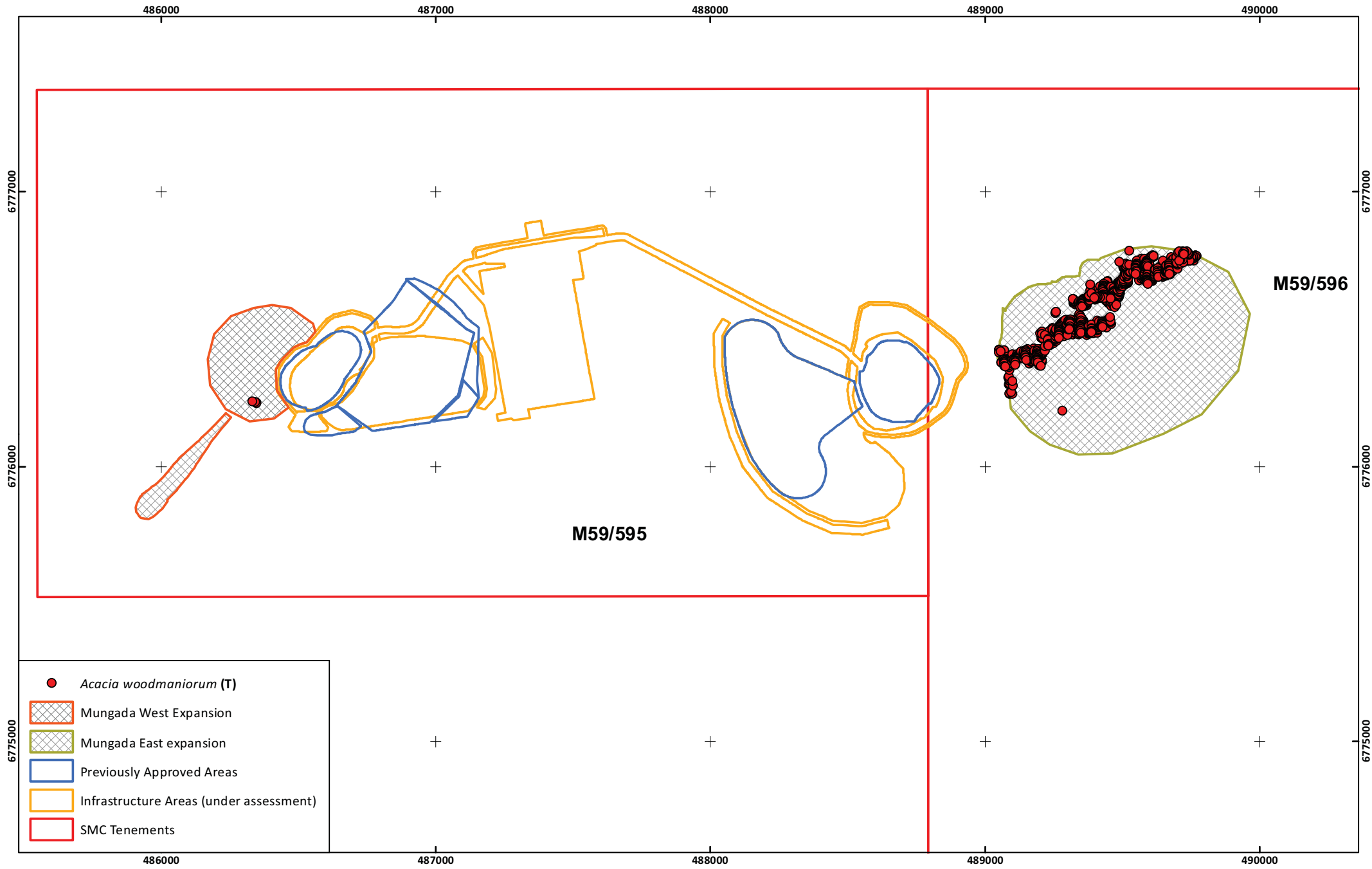
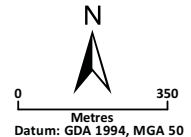
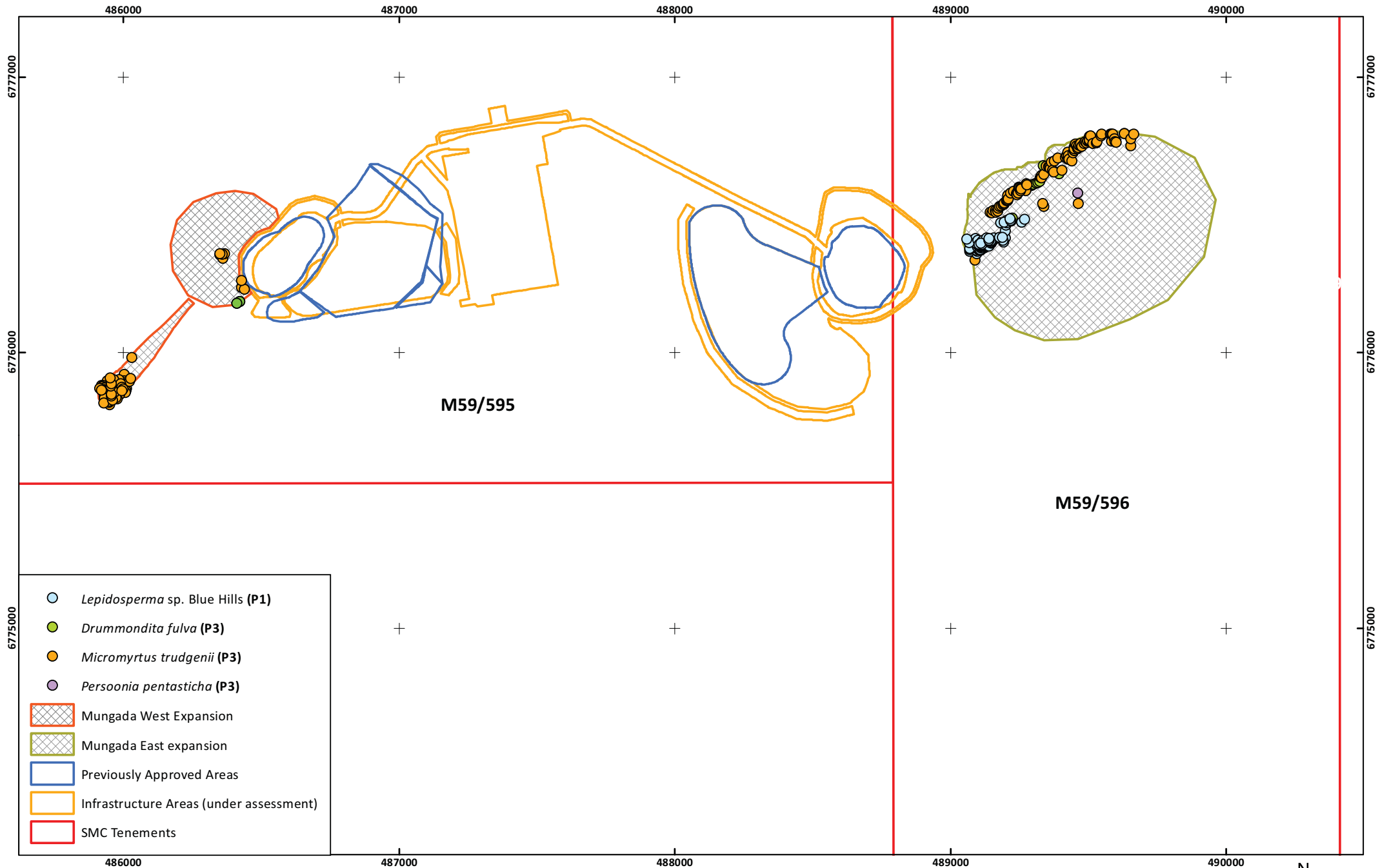


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 Prepared for: SMC
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 Version: 1

***Acacia woodmaniorum* Recorded in Study Areas**





M59/595

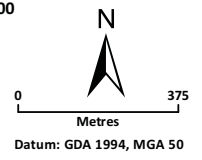
M59/596

- Lepidosperma* sp. Blue Hills (P1)
- Drummondita fulva* (P3)
- Micromyrtus trudgenii* (P3)
- Persoonia pentasticha* (P3)
- Mungada West Expansion
- Mungada East expansion
- Previously Approved Areas
- Infrastructure Areas (under assessment)
- SMC Tenements



Figure: 12.5
 Prepared for: SMC
 Drawn by: SH
 Version: 1

Priority Flora Recorded Inside the Study Areas



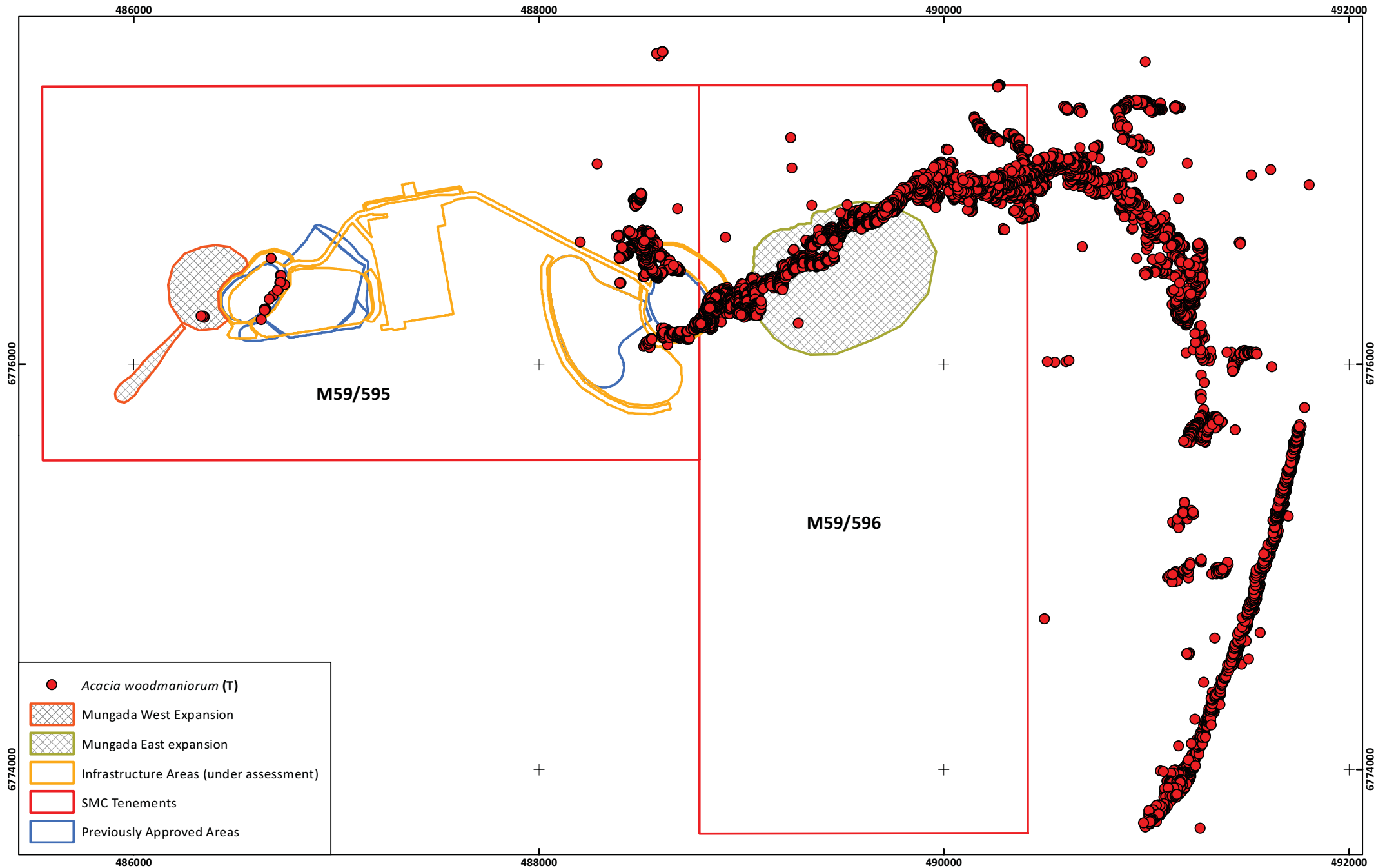
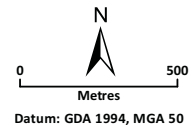
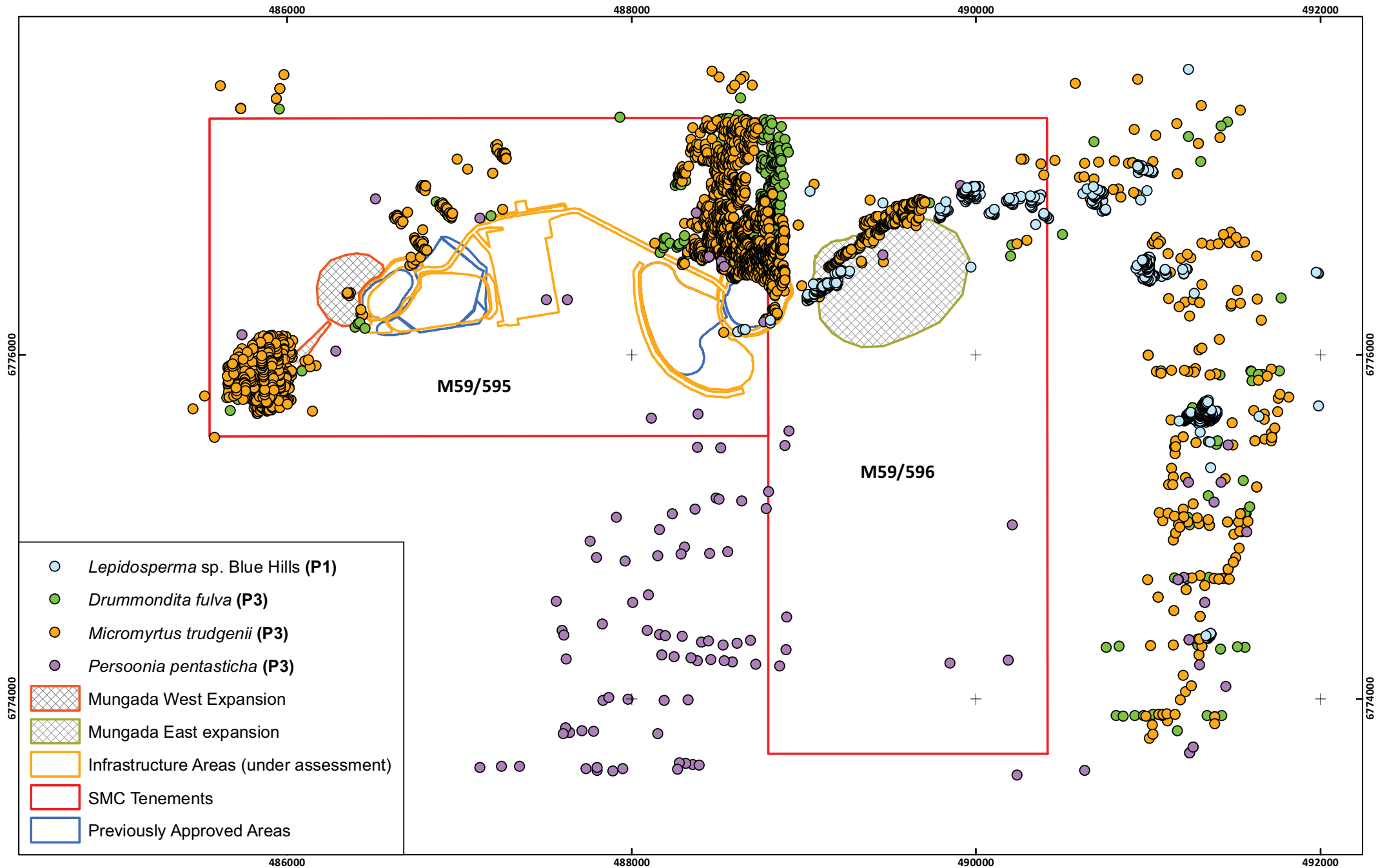


Figure: 12.6
Prepared for: SMC
Drawn by: SH
Version: 1

***Acacia woodmaniorum* Recorded in the Wider Area**

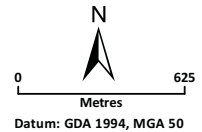




- *Lepidosperma* sp. Blue Hills (P1)
- *Drummondita fulva* (P3)
- *Micromyrtus trudgenii* (P3)
- *Persoonia pentasticha* (P3)
- Mungada West Expansion
- Mungada East expansion
- Infrastructure Areas (under assessment)
- SMC Tenements
- Previously Approved Areas

Figure: 12.7
Prepared for: SMC
Drawn by: SH
Version: 1

Four of the Priority Flora Species Recorded in the Wider Area



Appendix 1: Database Search Results

Table A1. 1: Conservation Significant Flora Species at and in the Vicinity of Blue Hills (Mungada West and East)

Species	Rank	Flowering	Habitat	Nearest Recorded Locations (FloraBase, 2012)	Likelihood of Occurrence	Source
<i>Eremophila viscida</i>	EPBC Act Endangered and WC Act Schedule 1	September to November	Granitic soils, sandy loam. Stony gullies, sandplains.	North of Wongan Hills, Chiddarcooping Nature Reserve, Barnong Conservation Park, West of Mullewa –Wubin Road, Pindar, South-East of Pithara, Geelakin Rock, South of and Mukinbudin, West-North-West Bullfinch, North of and Westonia, West of Merredin, North-North-West of Latham, North-East of Carnamah, between Tardun and Wilroy, Baandee, Koorda, Kondut, Nungarin, Ballidu, Boodarockin, Kununoppin,	Unlikely	<i>EPBC Act Protected Matters Search Tool</i>
<i>Hybanthus cymulosus</i>	EPBC Act Critically Endangered and WC Act Schedule 1	May to July	Clay, rocky loam clay. Small dry creekline with rocky red/brown loam over greenstone. Drainage line on slope to rocky hills, dolerite, banded ironstone. Loamy soil on plain.	Mount Gibson, Mount Singleton, Ninghan, Wubin.	Unlikely	<i>EPBC Act Protected Matters Search Tool</i>
<i>Pityrodia axillaris</i>	EPBC Act Critically Endangered and WC Act Schedule 1	July to December	Sandy soils. Plains.	North of Wubin, West of Bunjil, West of Mullewa-Wubin Road, Maya, Buntine, Caron Nature Reserve, South-South-East of Perenjori, Latham, Lake Moore, Pithara, Gngalara.	Unlikely	<i>EPBC Act Protected Matters Search Tool</i>
<i>Acacia woodmaniorum</i>	WC Act Schedule 1, T	July	Skeletal red silt, red-brown soil, banded ironstone, laterite. Slopes, sides of hills, crests of ridges, ranges, disturbed overburden of mine sites.	Mungada Ridge (Karara Station, Lochada Station), Jasper Hill, Windaning Hill (Blue Hills Range).	Numerous locations recorded within the Study Area	NM, ecologia (2007), Markey & Dillon (2008), Woodman Environmental Consultants (2008)

Species	Rank	Flowering	Habitat	Nearest Recorded Locations (FloraBase, 2012)	Likelihood of Occurrence	Source
<i>Eucalyptus synandra</i>	WC Act Schedule 1, T	August and December to March	Sandy & lateritic soils.	Wialki, John Forest Lookout, Badja Station, Ninghan, Morawa, Beacon, North of Koorda, N Kadji Kadji, Emu Fence Track (Karara Station), Mount Gibson, Mount Marshall, Karroun Hill, Jingymia, Gutha.	Unlikely	NM
<i>Stylidium</i> sp. Yalgoo (D. Coultas et al. Opp 01)	WC Act Schedule 1, T	September to October	Granite outcrop, possibly on shalestone/ironstone outcrops.	Karara Station, Warriedar Station, Badja Station, Mungada Ridge, Golden Grove.	Possible	NM, Woodman (2008)
<i>Acacia sulcaticaulis</i>	P1	Not Available	Slopes of brown clay loam over granite and quartz, greenstone. Rocky creekline.	Mount Mulgine, Warriedar Station.	Unlikely	NM
<i>Chamelaucium</i> sp. Warriedar (A.P. Brown & S. Patrick APB 1100)	P1	Not Available	Plain – red clay, slopes of brown clay loam over basalt, rocky hill with skeletal silty clay loam over granite/greenstone, dolerite hill slope.	Mount Mulgine, Warriedar Station, Karara Station, North-West of Paynes Find, North-East of Perenjori.	Possible	NM
<i>Chamelaucium</i> sp. Yalgoo (Y. Chadwick 1816)	P1	Not Available	Granite outcrops.	Yalgoo, South of Yalgoo, Wurarga.	Unlikely	NM, Woodman Environmental Consultants (2008)
<i>Eucalyptus jutsonii</i> subsp. <i>kobela</i>	P1	Not Available	Deep yellow to orange sand. Broad and subdued rises high in the landscape.	Karara Station.	Unlikely	NM
<i>Gunniopsis divisa</i>	P1	August	Banded ironstone slopes, laterite, loam, quartz. Roadsides.	Mount Barloweerie, Wooleen Station, South of Murchison River (Mullewa-Murchison Settlement Road), Mungada, Jack Hills, Mount Karara, Woolgorong Station, Murgoo Station, Meeberrie.	Possible	NM, Markey & Dillon (2008), Woodman Environmental Consultants (2008)
<i>Hydrocotyle</i> sp. Warriedar (P.G. Wilson 12267)	P1	September	Red loam. Along creek embankment, rocky valley floor.	Warriedar-Coppermine Road, Yalgoo, Blue Hills, Mount Gibson Sanctuary, Warriedar Station.	Unlikely	NM

Species	Rank	Flowering	Habitat	Nearest Recorded Locations (FloraBase, 2012)	Likelihood of Occurrence	Source
<i>Lepidosperma</i> sp. Blue Hills (A. Markey & S. Dillon 3468)	P1	Not Available	Breakaway, laterite and sandstone. Creek bank. Granite outcrop. Slope of laterised haematite and banded ironstone.	Charles Darwin Reserve, Mount Karara.	Located within the Study Area	NM, Woodman Environmental Consultants (2008)
<i>Millotia dimorpha</i>	P1	September	Red loamy soils. Dolerite, haematite and banded ironstone slope.	Koolanooka Hills, Perenjori Hills, Mount Karara, Kadji Kadji,	Likely, Previously recorded on the flats between hills	NM, Markey & Dillon (2008), Woodman Environmental Consultants (2008)
<i>Rhodanthe collina</i>	P1	August to October	Loam. Rocky hills. Banded ironstone slopes, haematite, quartz, laterite.	Mungada, Koolanooka Hills, Blue Hills Range, Yandanoo Hills, Jasper Hill, Windaning Hill, Warriedar Station, Mongers Lake, Mount Gibson, Mingenew Hill.	Likely, previously recorded in the area	NM, Markey & Dillon (2008), Woodman Environmental Consultants (2008)
<i>Acacia diallaga</i>	P2	Not Available	Hillslopes, basalt outcropping.	Mount Mulgine, Warriedar Station, Karara Station.	Possible	NM
<i>Acacia karina</i>	P2	Not Available	Red-brown silty clay loam with ironstone pebbles, banded ironstone, shalestone. Rocky slopes.	Mount Gibson, Karara Ridge, Mount Mulgine, Karara Station, Damperwah Hills, John Forrest Lookout, Warriedar Station, Mungada Ridge, Windaning Hill, Wylacoppin Hill, Mount Singleton.	Likely, located in the vicinity of the Study Area on the southern slopes of Mungada East	NM, Markey & Dillon (2008), Woodman Environmental Consultants (2008)
<i>Calandrinia kalanniensis</i>	P2	November to January	Shallow brown clay, often gritty, derived from eroded granite. Rocky outcrops, herb fields.	Mungada, North-East of Mukinbudin, Yanneymooring Nature Reserve, Petrudor Rocks, Hughden Rock, Xantippe Rock.	Unlikely	NM, Woodman (2008)
<i>Calandrinia</i> sp. Warriedar (F. Obbens 04/09)	P2	Not Available	Gentle slope. Red brown clay loam (shallow gritty with some lateritic stones). Granite basement rock.	South of Mt Warriedar, Warriedar Station, Karara Station.	Possible	NM

Species	Rank	Flowering	Habitat	Nearest Recorded Locations (FloraBase, 2012)	Likelihood of Occurrence	Source
<i>Austrostipa blackii</i>	P3	September to November	Granite breakaway. Hillcrest of banded ironstone, haematite and sedimentary rocks. Seasonal creekline. Plain with brown loam. Basalt Hill.	Charles Darwin Reserve, Yandanoo Hills, Windaning Hill, Koolanooka Hills, Beverley Airfiels Reserve, Dalwallinu Town Reserve, Tutanning Nature Reserve, Widgiemooltha, Ennuin Station, Hunt Range, Jaurdi Station.	Possible	NM, Markey & Dillon (2008), Woodman Environmental Consultants (2008)
<i>Bossiaea</i> sp. Jackson Range (G. Cockerton & S. McNee LCS 13614)	P3	Not Available	Granite breakaway. Laterite/duricrust breakaway. Red sandy loam soil. Banded ironstone hill.	Emu Fence Road, Kawana Homestead, Crown reserve between Karara and Warriedar Stations, Charles Darwin Reserve, Mt Jackson Range, White Wells Homestead.	Unlikely	NM
<i>Calotis</i> sp. Perrinvale Station (R.J. Cranfield 7096)	P3	Not Available	Banded ironstone outcrop, slope and hillcrest. Granite slope.	Mount Richardson, Karara Station, Charles Darwin Reserve, Golden Grove, Gnows Nest Range, Badja Station (Blue Hills Range), Minjar Hill, Mount Karara, Jasper Hill, Windaning Hill, Perrinvale Station, Cue.	Possible	NM, Markey & Dillon (2008), Woodman Environmental Consultants (2008)
<i>Calytrix uncinata</i>	P3	August to November	White or red sand, sandy clay. Granite or sandstone breakaways, rocky rises. Banded ironstone and laterite.	Bulga Downs Station, Wanjarri Nature Reserve, Leinster, Gnows Nest Range, South-West of Wiluna, Murdaburia Hill, Booylgoo Range, Joyners Find Greenstone Belt, Yakabindie Station, Blue Hills Range, North of Meekatharra, Golden Grove, Cogla Downs Station, Maranalgo Station, Mount Keith, Nambi Station, Youno Downs, Teutonic, Mount Magnet.	Possible	Markey & Dillon (2008)
<i>Cyanicula fragrans</i>	P3	August to September	Red loam. Flat granite outcrops. Creekline.	Badja Station, Moonagin Hills, Bimbijj Station, Mourobra, Mount Singleton, Lake Moore, West-South-West of Paynes Find.	Unlikely	NM

Species	Rank	Flowering	Habitat	Nearest Recorded Locations (FloraBase, 2012)	Likelihood of Occurrence	Source
<i>Dicrastylis linearifolia</i>	P3	November to December	Red sand. Yellow sand. Sandplain.	Mount Mulgine, Warriedar Station, Shark Bay, Muggon Station, Eurardy Station, East of Pindar, Byro Station, Burnerbinmah Station, North-West of Murchison Settlement, Toolonga Nature Reserve, Meka Station, Iona Station, South of Billabong Roadhouse, Meadow Station, North of Overlander Roadhouse, Binnu,	Unlikely	NM
<i>Drummondita fulva</i>	P3	September to October	Skeletal, shallow, acidic soils of orange-red or red-brown sandy loams and clayey silts. Footslopes, lower to upper slopes and hillcrests.	Windaning Hill, Oxiana Golden Grove, Badja Station, Minjar Hill, Warriedar Station, Jasper Hill, Lochada Station.	Located in the Study Area.	NM, Markey & Dillon (2008), Woodman Environmental Consultants (2008)
<i>Grevillea globosa</i>	P3	January, June and November	Red loam, yellow sand.	Damperwah Hills, Fields Find, Mungada, Mt Karara, Golden Grove, Gossan Hill, Wuraga Road, Yuin, South-West of Paynes Find, Pindar, South-West of Yalgoo.	Unlikely	ecologia (2007), NM, Woodman Environmental Consultants (2008)
<i>Grevillea scabrida</i>	P3	July	In gravelly soil, or loam, or clay; occupying ironstone gravelly plain, winter-wet areas.	Bullajungadeah Hills, Mt Gibson, Mungada, Minjar, Ninghan Station, Mount Singleton, Fields Find, Karara Station, Mount Mulgine, North of Wubin,	Possible	ecologia (2007), NM, Woodman Environmental Consultants (2008)
<i>Grevillea subtiliflora</i>	P3	April and July to September	Red-brown loam. Bouldery slope. Valley floor. Brown loam over dolerite slope. Undulating plain with red clay loam.	Warriedar Station, Minjar, Mount Singleton, Mount Gibson Station, South-West of Paynes Find, North of Wubin, Paynes Find.	Unlikely	NM, Woodman Environmental Consultants (2008)

Species	Rank	Flowering	Habitat	Nearest Recorded Locations (FloraBase, 2012)	Likelihood of Occurrence	Source
<i>Gunniopsis rubra</i>	P3	September	Sandy loam. Slope. Hillcrest of haematite and quartz. Hillslope and crest of banded ironstone. Close to valley bottom. Base of granitic breakaway. White sandy soils.	Charles Darwin Reserve, Badja Station, Perenjori Hills, Mount Karara, Red Hill, North-East of Narembeen, North-West of Bencubbin, East of Nungarin, North of Cunderdin, Kalannie, Quairading Shire Reserve, Dalwallinu Town Reserve, Buntine Nature Reserve, Snake Gully Nature Reserve, Lake Champion Nature Reserve, Ennuin.	Possible	NM, Markey & Dillon (2008), Woodman (2008)
<i>Melaleuca barlowii</i>	P3	April	Yellow-brown sand or red-brown clay loam. Roadside reserves, shrubland. Hillslope of banded ironstone and dolerite.	Mullewa, West of Dalwallinu, Perenjori Hills, Mungada, Koolanooka Hills, West of Pindar, East of Latham, West-North-West of Morawa, Yandanooka, Tardun, Karara Station, Kalannie, Carnamah.	Possible	Woodman Environmental Consultants (2008)
<i>Micromyrtus acuta</i>	P3	July to October	Grey-tan silty fine to coarse sand, laterite, granite. Rock outcrops. Ironstone and banded ironstone hillslopes.	Mount Mulgine, Pinyalling Hill, Damperwah Hills, Warriedar Station, Jasper Hill, Windaning Hill, Lake Monger Lookout, White Wells Station, South-West of Paynes Find.	Likely, recorded in large numbers on the crest and weathered slopes of Mungada East.	ecologia (2007), Markey & Dillon (2008), NM, Woodman Environmental Consultants (2008)
<i>Micromyrtus trudgenii</i>	P3	June to October	Red-brown loamy clay, yellow-brown soils, gravel, siltstone, quartz, basalt, banded ironstone, dolerite. Tops and slopes of hills and ridges.	Karara Station, Mt Mulgine, St Patricks, Arsenic Hill, Mungada, Badja Station, Minjar Hill, Warriedar Station, Jasper Hill, Golden Grove, Gossan Hill, West of Paynes Find.	Located in the Study Area.	ecologia (2007, 2008), NM, Markey & Dillon (2008), Woodman Environmental Consultants (2008)
<i>Persoonia pentasticha</i>	P3	August to November	Sand, loam. Base of granite outcrops. Rocky slopes of haematite and laterite. Drainage line. Hillslope of banded ironstone and laterite.	Morawa, Charles Darwin Reserve, Barrabarra Nature Reserve, Mt Gibson, Damperwah Hills, Mugga Mugga Hill, Mungada, Badja Station, Koolanooka Hills, Extension Hill, Warriedar Station, Minjar, East Yuna Reserve, West Perenjori Nature Reserve, Pindar, Morawa, North of Wubin.	Located in the Study Area.	Bennett (2004), ecologia (2007), Markey & Dillon (2008), NM, Woodman Environmental Consultants (2008)

Species	Rank	Flowering	Habitat	Nearest Recorded Locations (FloraBase, 2012)	Likelihood of Occurrence	Source
<i>Petrophile pauciflora</i>	P3	September	Decaying & dissected granite breakaways.	Yilgarn, Damperwah Hills, Karara Station, Lochada Station, North of Cue, Woolgorong, North of Mount Magnet, Kalli Station, Pindarbunna Station, Bimbijy Station, South-East of Mileura.	Unlikely	NM
<i>Polianthion collinum</i>	P3	May to July	Red clay loam between blocks of banded ironstone. Low hills and slopes.	Warriedar Station, Arsenic Hill, Mungada, Windaning Hill, Karara Station, Gossan Hill.	Possible	Markey & Dillon (2008), NM, Woodman Environmental Consultants (2008)
<i>Psammomoya implexa</i>	P3	August to October	Stony rises. Banded ironstone and laterite slope.	Charles Darwin Reserve, Karara Station, Jasper Hill, Mullewa, Pintharuka, Lake Mollerin Nature Reserve, Gabyon Station, Ninghan, Wilroy.	Possible	ecologia (2007), Markey & Dillon (2008), NM
<i>Spartothamnella</i> sp. Helena & Aurora Range (P.G. Armstrong 155-109)	P3	Not Available	Plain with orange sandy loam. Slope of banded ironstone, calcrete and quartz. Ironstone range. Sandplain.	Hospital Rocks, Diemals Station, Pigeon Rocks, Koolyanobbing RRange, North Yerilgee Greenstone Belt, Johnston Range, Jackson Range, Die Hardy Range, Helena and Aurura Range, Remlap Station, Blue Hills Range.	Possible	NM, Woodman Environmental Consultants (2008)
<i>Stenanthemum poicilum</i>	P3	May to June and September to November	Red clay or sandy clay, loam. Yellow sandy loam flat. Creekline. Slope of basalt. Banded ironstone and chert outcrop. Haematite.	Charles Darwin Reserve, Mount Mulgine, Canna Reserve, Warriedar Station, Perenjori Hills, Koolanooka Hills, White Wells Station. Jasper Hill. Wilroy Reserve.	Possible	Bennett (2004), NM, Woodman Environmental Consultants (2008)

Appendix 2: Conservation Significance – Flora and Ecological Communities

Commonwealth *Environment Protection and Biodiversity Act 1999*

Table A2.1: Categories and Definitions for Rare Flora

Category	Definition
Extinct*	A native species is eligible to be included in the extinct category if there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category if: it is only known to survive in cultivation, in captivity or as a naturalized population well outside its past range; or if it has not been recorded in its known and/ or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically endangered	A native species is eligible to be included in the critically endangered category if it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	A native species is eligible to be included in the endangered category if: if it is not critically endangered; and it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	A native species is eligible to be included in the vulnerable category if: if it is not critically endangered or endangered; and it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation dependent*	A native species is eligible to be included in the conservation dependent category if: the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or the following subparagraphs are satisfied; the species is a species of fish; the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; the plan of management is in force under a law of the Commonwealth or of a State or Territory; cessation of the plan of management would adversely affect the conservation status of the species.
*Note: Species listed as 'conservation dependent' and 'extinct' are not matters of national environmental significance and therefore do not trigger the <i>EPBC Act</i> .	

Source: DSEWPaC (2012c)

Western Australian *Wildlife Conservation Act 1950*

Table A2.2: Categories and Definitions for Rare Flora

Category	Definition
T: Threatened Flora (Declared Rare Flora – Extant)	<p>Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the <i>Wildlife Conservation Act 1950</i>).</p> <p>Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria:</p> <p>CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild</p> <p>EN: Endangered – considered to be facing a very high risk of extinction in the wild</p> <p>VU: Vulnerable – considered to be facing a high risk of extinction in the wild.</p>
X: Presumed Extinct Taxa (Declared Rare Flora – Extinct)	<p>Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the <i>Wildlife Conservation Act 1950</i>).</p> <p>Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.</p>

Source: DEC (2012c)

Table A2.3: Categories and Definitions for Priority Flora

Category	Definition
1: Priority One: Poorly-known species	Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
2: Priority Two: Poorly-known species	Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
3: Priority Three: Poorly-known species	Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
4: Priority Four: Rare, Near Threatened and other species in need of monitoring	<p>a. Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.</p> <p>b. Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</p> <p>c. Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>
5: Priority Five: Conservation Dependent species	Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Source: DEC (2012a)

Table A2.4: Categories, Definitions and Criteria for Threatened Ecological Communities (TECs)

Category	Definition and Criteria
Presumed Totally Destroyed (PD)	<p>An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.</p> <p>An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B):</p> <p>A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats; or</p> <p>B) All occurrences recorded within the last 50 years have since been destroyed.</p>
Critically Endangered (CR)	<p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.</p> <p>An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):</p> <p>A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii):</p> <p>(i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);</p> <p>(ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.</p> <p>B) Current distribution is limited, and one or more of the following apply (I, ii or iii):</p> <p>(i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years);</p> <p>(ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;</p> <p>(iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.</p> <p>C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).</p>
Endangered (EN)	<p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.</p> <p>An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C):</p> <p>A) The geographic range, and/or total area occupied, and/or number of discrete</p>

Category	Definition and Criteria
	<p>occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii):</p> <p>(i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);</p> <p>(ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.</p> <p>B) Current distribution is limited, and one or more of the following apply (i, ii or iii):</p> <p>(i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);</p> <p>(ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;</p> <p>(iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.</p> <p>C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).</p>
Vulnerable (VU)	<p>An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.</p> <p>An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C):</p> <p>A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.</p> <p>B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.</p> <p>C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.</p>

Source: DEC, 2010

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Table A2.5: Categories, Definitions and Criteria for Priority Ecological Communities (PECs)

Category	Definition and Criteria
Priority One: Poorly-known ecological communities	Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two: Poorly-known ecological communities	Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority Three: Poorly-known ecological communities	<p>(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:</p> <p>(ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;</p> <p>(iii) Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.</p> <p>Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>
Priority Four: Adequately known ecological communities	<p>Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened or that have been recently removed from the threatened list. These communities require regular monitoring.</p> <p>(a) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.</p> <p>(b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</p> <p>(c) Ecological communities that have been removed from the list of threatened communities during the past five years.</p>
Priority Five: Conservation Dependent ecological communities	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Source: DEC (2011)

Appendix 3: Declared Weeds and Control Codes

Table A3.1: Codes and Controls for Declared Plants

Code	Controls
Priority One – Prohibits movement	The movement of plants or their seeds is prohibited within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
Priority Two – Aims to eradicate infestation	Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and /or machinery.
Priority Three - Aims to control infestation by reducing area and/or density of infestation	<p>The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery.</p> <p>Treat to destroy and prevent seed set all plants:</p> <ul style="list-style-type: none"> within 100 m inside of the boundaries of the infestation; within 50 m of roads and high water mark on waterways; within 50 m of sheds, stock yards and houses. <p>Treatment must be done prior to seed set each year.</p> <p>Of the remaining infested area:</p> <ul style="list-style-type: none"> Where plant density is 1-10 per ha treat 100% of infestation. Where plant density is 11-100 per ha treat 50% of infestation. Where plant density is 101-1000 per ha treat 10% of infestation. <p>Properties with less than 2 ha of infestation must treat the entire infestation.</p> <p>Additional areas may be ordered to be treated.</p>
Priority Four - Aims to prevent infestation spreading beyond existing boundaries of infestation	<p>The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery.</p> <p>Treat to destroy and prevent seed set all plants:</p> <ul style="list-style-type: none"> -within 100 m inside of the boundaries of the infested property; -within 50 m of roads and high water mark on waterways; -within 50 m of sheds, stock yards and houses. <p>Treatment must be done prior to seed set each year. Properties with less than 2 ha of infestation must treat the entire infestation.</p> <p>Additional areas may be ordered to be treated.</p>
Priority Five - Control on public land	Infestations on public land must be controlled.

Source: DAFWA (2012a)