



Mining Area C Southern Flank Flora and Vegetation Impact Assessment

Prepared for BHP Billiton Iron Ore Pty Ltd
March 2017



Document Status						
Rev No.	Authors	Reviewer/s	Date	Approved for Issue		
				Name	Distributed To	Date
1	D.Brearley	J.Waters	07/06/16	D.Brearley	S.Williamson, B.Barnett	24/06/16
2	D.Brearley	S.Williamson, B.Barnett	28/07/16	D.Brearley	S.Williamson	02/08/16
3	D.Brearley	S.Williamson, B.Barnett	16/08/16	D.Brearley	S.Williamson	18/09/16
4	D.Brearley	S.Williamson, B.Barnett	20/09/16	D.Brearley	S.Williamson	25/09/16
5	D.Brearley	S.Williamson, B.Barnett	22/11/16	D.Brearley	S.Williamson	09/12/16
6	D.Brearley	B.Barnett	15/03/17	D.Brearley	S.Williamson, B.Barnett	17/03/17
7	D.Brearley, B.Menezies	OEPA	21/03/17	D.Brearley	S.Williamson, B.Barnett	24/03/17



Onshore Environmental Consultants Pty Ltd
ACN 095 837 120
PO Box 227
YALLINGUP WA 6282
Telephone / Fax (08) 9756 6206
E-mail: info@ onshoreenvironmental.com.au

COPYRIGHT: The concepts and information contained in this document are the property of Onshore Environmental Consultants Pty Ltd. Use or copying of this document in whole or in part without the written permission of Onshore Environmental Consultants Pty Ltd constitutes an infringement of copyright.

DISCLAIMER: This report has been undertaken solely for BHP Billiton Iron Ore Pty Ltd. No responsibility is accepted to any third party who may come into possession of this report in whatever manner and who may use or rely on the whole or any part of this report. If any such third party attempts to rely on any information contained in this report such party should obtain independent advice in relation to such information.

EXECUTIVE SUMMARY

BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) is preparing Public Environmental Review documentation for submission to the Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986* (EP Act) to seek approval for Mining Area C (MAC) Southern Flank (the Proposal). The Proposal includes the development of a new satellite orebody at Southern Flank, along with indicative overburden storage areas (OSAs), infrastructure areas and topsoil storage areas; together this is referred to as the 'Indicative Additional Impact Assessment Area' (Figure 1). The current operations at MAC were approved under Ministerial Statement 491 and together with the proposed Southern Flank development envelope form the 'Proposed MAC Development Envelope' (Figure 1). Ministerial Statement 491 will be superseded if the current Proposal is approved.

Onshore Environmental Consultants Pty Ltd (Onshore Environmental) was commissioned by BHP Billiton Iron Ore to undertake the Flora and Vegetation Environmental Impact Assessment (EIA) required as part of the Proposal. Extensive baseline surveys have been undertaken within the Proposed MAC Development Envelope (Figure 1) and surrounds, with a consolidation of the existing baseline data recently completed.

None of the plant taxa recorded from the Proposed MAC Development Envelope are gazetted as Threatened Flora under the *Wildlife Conservation Act (1950)* (WC Act) or listed under the *Environment Protection and Biodiversity Conservation Act (1999)* (EPBC Act). Ten Priority flora taxa have been recorded within the Proposed MAC Development Envelope:

- *Acacia bromilowiana* (Priority 4);
- *Aristida jerichoensis* var. *subspinulifera* (Priority 3);
- *Aristida lazaridis* (Priority 2);
- *Eremophila magnifica* subsp. *magnifica* (Priority 4);
- *Grevillea saxicola* (Priority 3);
- *Nicotiana umbratica* (Priority 3);
- *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3);
- *Rostellularia adscendens* var. *latifolia* (Priority 3);
- *Sida* sp. Barlee Range (S. van Leeuwen 1642) (Priority 3); and
- *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (Priority 3).

The ten Priority flora taxa were recorded from 15 vegetation associations within the Proposed MAC Development Envelope, with eight of these taxa occurring within the Indicative Additional Impact Assessment Area. *Grevillea saxicola* (P3) and *Nicotiana umbratica* (P3) were not recorded from within the Indicative Additional Impact Assessment Area, and hence these taxa will not be directly impacted by the Proposal. The impact on the eight Priority flora taxa occurring within the Indicative Additional Impact Assessment Area was determined to be *low* or *very low*, with all Priority flora taxa well represented both locally and regionally.

Twenty three introduced (weed) species have been recorded within the Proposed Mining Area C Development Envelope, predominantly from vegetation on plains and drainage lines which were subject to higher grazing pressure from domestic stock, and disturbed areas situated close to existing mining operations and infrastructure. None are listed as Declared Pests under the *Biosecurity and Agriculture Management Act (2007)* (BAM Act).

A total of 34 vegetation associations were described and mapped within the Proposed MAC Development Envelope. Twenty-nine of the 34 vegetation associations are represented within the Indicative Additional Impact Assessment Area. None of the vegetation associations

recorded within the Proposed MAC Development Envelope are considered to be a Threatened Ecological Community (TEC) or Priority Ecological Community (PEC).

Sixteen vegetation associations are considered to have local significance¹, of which 15 occur within the Indicative Additional Impact Assessment Area. Ten of the 15 vegetation associations are determined to have *very low* local conservation significance, as they are well represented² outside the Indicative Additional Impact Assessment Area and support Priority flora that occur in multiple vegetation associations within the Proposed MAC Development Envelope and wider Pilbara bioregion. The remaining five vegetation associations occurring within the Indicative Additional Impact Assessment Area are determined to have *low* local conservation significance. Three of these five associations occur in gorges and support Priority flora that are restricted to the gorges, noting that all three vegetation associations are well represented regionally. The remaining two vegetation associations have greater than 50 percent of their extent within BHP Billiton Iron Ore's Pilbara tenure occurring within the Indicative Additional Impact Assessment Area. This triggered a review of the regional representation, which confirmed that both associations are well represented across the wider Pilbara bioregion.

Proposed changes to surface hydrology may impact on downstream Mulga vegetation by reducing surface water flows. However, the total extent of Mulga vegetation on lowlands within the Proposed Additional Development Envelope is relatively small, and vegetation does not occur in large dense stands. Any impact on the representation of 'Valley Floor Mulga'¹ within the Pilbara would be negligible.

The potential for increased fire frequency, weed invasion and dust levels resulting from the revised Proposal are not considered to pose any significant risks to vegetation within the Indicative Additional Impact Assessment Area. However, the close proximity of Great Northern Highway will require specific consideration with future weed management planning.

Dust generated in the Pilbara is likely to be both short-lived and transported for relatively short distances of 100 to 200 m (Grierson 2015). Long-term observations of vegetation in close proximity to other mine sites across the Hamersley Ranges have demonstrated repeatedly the overall resilience of vegetation to extremely high levels of dust exposure (Grierson 2015). There is a low risk of increased dusting to vegetation forming the two sub-types of the Coolibah-lignum Flats PEC situated outside the south-west corner of the Proposed MAC Development Envelope. This is unlikely to cause any significant long term impact on vegetation health.

¹ Determined where a vegetation association supports conservation significant flora, or has previously been identified as 'an ecosystem at risk' (Kendrick 2001).

² 'Well represented' on the basis that less than 30 percent of the known extent of each vegetation association previously mapped within BHP Billiton Iron Ore's Pilbara tenure occurs within the Additional Impact Assessment Area.

ABBREVIATIONS

Abbreviation	Definition
BAM Act	<i>Biosecurity and Agriculture Management Act (2007)</i>
BHP Billiton Iron Ore	BHP Billiton Iron Ore Pty Ltd
BoM	Bureau of Meteorology
CID	channel iron deposit
DPaW	Department of Parks and Wildlife
DotE	Department of the Environment
EIA	environmental impact assessment
EC	electrical conductivity
EP Act	<i>Environmental Protection Act (1986)</i>
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act (1999)</i>
EPS	Environmental Protection Statement
ha	hectares
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for Conservation of Nature
km	kilometre
LOM	Life of Mine
m	metre
bgl	below ground level
MAC	Mining Area C
MS	Ministerial Statement of Approval
Mt	million tonnes
Mtpa	million tonnes per annum
OSAs	Overburden Storage Areas
P1	Priority 1
P2	Priority 2
P3	Priority 3
P4	Priority 4
PECs	Priority Ecological Communities
T	Threatened Flora
TECs	Threatened Ecological Communities
WA	Western Australia
WAH	Western Australian Herbarium
WC Act	<i>Wildlife Conservation Act (1950)</i>

TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	I
ABBREVIATIONS.....	III
TABLE OF CONTENTS.....	IV
1 INTRODUCTION.....	1
1.1 PREAMBLE.....	1
1.2 PROJECT DESCRIPTION	1
1.3 APPROVALS HISTORY	2
2 BACKGROUND.....	5
2.1 CLIMATE	5
2.2 BIOGEOGRAPHIC REGIONS.....	5
2.3 EXISTING LAND USE	5
2.4 LANDFORMS.....	6
2.5 SOILS	6
2.6 GEOLOGY	7
2.7 FLORA AND VEGETATION	8
2.8 LAND SYSTEMS	9
3 SUMMARY OF BASELINE SURVEYS	12
3.1 LEGISLATION AND GUIDANCE STATEMENTS	12
3.2 FIELD SURVEY CONSTRAINTS	12
3.3 DESKTOP REVIEW	13
3.3.1 Previous Flora Surveys within the Proposed Mining Area C Development Envelope	13
3.3.2 Threatened Flora listed under the EPBC Act and the WA Wildlife Conservation (Rare Flora) Notice ..	32
3.3.3 Threatened Flora listed under the IUCN Red List database	32
3.3.4 Priority Flora recognised by the DPaW	32
3.3.5 TECs listed under State and Federal Legislation	36
3.3.6 PECs recognised by DPaW.....	36
3.4 FLORA SPECIES.....	40
3.5 CONSERVATION SIGNIFICANT FLORA SPECIES.....	40
3.5.1 Threatened Flora listed under the WC Act and EPBC Act.....	40
3.5.2 Priority Flora.....	40
3.6 INTRODUCED FLORA.....	53
3.7 VEGETATION	65
3.8 VEGETATION CONDITION	76
3.9 SIGNIFICANCE OF VEGETATION ASSOCIATIONS	79
3.9.1 National Significance	79
3.9.2 State Significance.....	79
3.9.3 Local Significance on Basis of Specialised Landform	79
3.9.4 Local Significance on Basis of Supporting Significant Flora.....	82
4 EVALUATION OF IMPACTS.....	84
4.1 DIRECT CLEARING.....	84
4.1.1 Vegetation Complex Mapping	84
4.1.2 Vegetation Association Mapping	84
4.1.3 Significant Vegetation Associations.....	85
4.1.4 Impacts to Significant Flora	90
4.2 CUMULATIVE IMPACTS.....	94
4.2.1 Significant Flora.....	94
4.2.2 Vegetation	95

4.3	SURFACE WATER FLOWS	96
4.4	FIRE	98
4.5	INTRODUCED SPECIES	98
4.6	DUST	99
5.0	CONCLUSION.....	101
6.0	STUDY TEAM.....	102
7.0	REFERENCES	103
APPENDIX 1		
	Conservation categories for flora described under the EPBC Act.....	108
APPENDIX 2		
	Conservation Codes for Western Australian Flora	110
APPENDIX 3		
	State wide distribution of significant flora represented within the Proposed MAC Development Envelope	113
APPENDIX 4		
	Significant flora populations defined within the Proposed MAC Development Envelope	121
APPENDIX 5		
	Vegetation Classifications for the Pilbara based on Specht (1970), as modified by Aplin (1979) and Trudgen (2009) 131	
APPENDIX 6		
	Vegetation condition scale (as developed by Keighery 1994).....	133
APPENDIX 7		
	State-wide distribution of significant flora represented within the Indicative Additional Disturbance Areas in relation to BHPBIO and Third Party cumulative impacts.....	143
APPENDIX 8		
	Distribution of vegetation associations (as mapped by Beard, 1975) represented within the Proposed MAC Development Envelope	143
APPENDIX 9		
	Distribution of land systems (as mapped by van Vreeswyk <i>et al.</i> 2004) represented within the Proposed MAC Development Envelope	145

LIST OF TABLES

Table 1	Pre-European extent of vegetation associations occurring within the Proposed MAC Development Envelope (Shepherd <i>et al.</i> 2002).....	8
Table 2	Land systems occurring within the Proposed MAC Development Envelope (descriptions from van Vreeswyk <i>et al.</i> 2004).....	9
Table 3	Relevance of constraints, as identified by EPA (2004), to the flora and vegetation survey.	12
Table 4	Summary of results from previous flora and vegetation surveys within, or partly within, the Proposed MAC Development Envelope.	17
Table 5	Summary of results from previous flora and vegetation surveys completed in close proximity to the Proposed MAC Development Envelope.	25
Table 6	Significant flora previously recorded from a 25 km search radius around the Proposed MAC Development Envelope (DPaW 2016a).....	33
Table 7	PECs occurring within a 50 km radius of the Proposed MAC Development Envelope.	36
Table 8	Presence of significant flora within the Proposed MAC Development Envelope, Indicative Additional Impact Assessment Area, and Additional Development Envelope.....	41
Table 9	Priority flora recorded from the Indicative Additional Impact Assessment Area.	42
Table 10	Presence of introduced flora within the Proposed MAC Development Envelope, Indicative Additional Impact Assessment Area, and Additional Development Envelope.....	53
Table 11	Introduced weed species recorded from the Proposed MAC Development Envelope.....	55
Table 12	Vegetation associations mapped within the Proposed MAC Development Envelope, Indicative Additional Impact Assessment Area and Additional Development Envelope.....	66
Table 13	Vegetation condition within the Proposed MAC Development Envelope, Additional Development Envelope, and Indicative Additional Impact Assessment Area. Note: percentages provide proportional representation of the total area.....	77

Table 14	Number of Priority flora records (locations) within each of the 15 vegetation associations supporting significant flora, with comparison between the Proposed MAC Development Envelope (left column) and the Indicative Additional Development Envelope (right column).	83
Table 15	Representation of 34 vegetation associations occurring within the Proposed MAC Development Envelope and Indicative Additional Impact Assessment Area, with reference to the extent recorded from consolidated vegetation mapping across BHP Billiton Iron Ore’s Pilbara tenements. Shaded cells represent vegetation associations where >30 percent of the current mapped extent within BHP Billiton Iron Ore’s Pilbara tenure is within the Indicative Additional Impact Assessment Area.	87
Table 16	Impact assessment for locally significant vegetation associations within the Indicative Additional Impact Assessment Area.....	89
Table 17	Number of Priority flora populations occurring within the Proposed MAC Development Envelope and Indicative Additional Impact Assessment Area.....	93
Table 18	Location of Priority flora within the Indicative Additional Impact Assessment Area. Number of records represented.	94
Table 19	Number of DPaW records with Western Australia, number of records within cumulative BHPBIO disturbance footprint, and number of records within cumulative third party disturbance footprint for each of eight Priority flora occurring within the Indicative Additional Impact Assessment Area.....	95
Table 20	Current Pre-European extent of vegetation associations occurring within the Proposed MAC Development Envelope (Shepherd <i>et al.</i> 2002), and area represented within the Proposed MAC Development Envelope, cumulative BHPBIO disturbance footprint, and cumulative Third Party disturbance footprint. Percentages a proportion of the current Pre-European extent for each vegetation association.	95
Table 21	Current extent of land systems occurring within the Proposed MAC Development Envelope (descriptions from van Vreeswyk <i>et al.</i> 2004), and area represented within the Proposed MAC Development Envelope, cumulative BHPBIO disturbance footprint, and cumulative Third Party disturbance footprint. Percentages a proportion of the total extent of each land system.	96

LIST OF FIGURES

Figure 1	Mining Area C – Proposed General Arrangement.....	3
Figure 2	Mining Area C regional location.....	4
Figure 3	Beard (1975) vegetation complexes represented within the Proposed MAC Development Envelope. 10	
Figure 4	Land systems occurring within the Proposed MAC Development Envelope (descriptions from van Vreeswyk <i>et al.</i> 2004).....	11
Figure 5	Previous flora and vegetation surveys undertaken wholly or partially within the proposed Mining Area C Development Envelope.....	15
Figure 6	Location of sampling sites formally assessed during previous flora and vegetation surveys within the proposed Mining Area C Development Envelope.....	16
Figure 7	Location of the PECs in relation to the Proposed MAC Development Envelope.....	38
Figure 8	Perimeter mapping of the Coolibah-lignum flats PEC at Coodenwanna Flats.	39
Figure 9	Location of significant flora within the Proposed MAC Development Envelope.	52
Figure 10	Location of introduced (weed) species within the Proposed MAC Development Envelope.	54
Figure 11	Vegetation map for the Proposed MAC Development Envelope.....	73
Figure 12	Vegetation condition map for the Proposed MAC Development Envelope.	78
Figure 13	Distribution of Mulga vegetation on floodplains and stony plains, and vegetation associations classified as having 'low' local conservation significance within the Indicative Additional Impact Assessment Area.	81

1 INTRODUCTION

1.1 Preamble

BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) is preparing public environmental review documentation for submission to the Environmental Protection Authority (EPA) under Section 38 of the Environmental Protection Act 1986 (EP Act) to develop what will be known as the Mining Area C Southern Flank (the Proposal). The Proposal includes the development of a new satellite orebody at Southern Flank (Figure 1). The current operations at Mining Area C were approved under Ministerial Statement 491.

Mining Area C (MAC) is located approximately 90 km north west of Newman in the Pilbara region of Western Australia (Figure 2). The Proposed MAC Development Envelope is positioned on the eastern side of the Great Northern Highway and includes a number of deposits extending east along Packsaddle Range. The Southern Flank satellite ore body occurs in the southern sector of the Proposed MAC Development Envelope and north of Mount Robinson (Figure 1).

Several other BHP Billiton Iron Ore exploration tenements occur in close proximity to the Proposed MAC Development Envelope including Tandanya to the west, Mudlark to the south and south west, and Jinidi to the east. The eastern boundary of Karijini National Park lies approximately 20 km west of the Proposed MAC Development Envelope (Figure 2). Other mining operations in the vicinity include Rio Tinto's West Angelas Mine to the south-west, Hope Downs 1 Mine and Baby Hope Project to the east and Yandicoogina Mine to the north.

Onshore Environmental Consultants Pty Ltd (Onshore Environmental) was commissioned by BHP Billiton Iron Ore to compile a desktop review of the flora and vegetation of the Proposed MAC Development Envelope and carry out an Environmental Impact Assessment (EIA) to assess the potential impacts of the Proposal on those identified flora and vegetation values. The aim of the impact assessment was to clearly articulate the cumulative impacts of all operations within the Proposed MAC Development Envelope, third party operations, and the additional impacts associated with the development of the Southern Flank satellite ore body.

1.2 Project Description

MAC is one of four mining hubs in BHP Billiton's Western Australian Iron Ore (WAIO) business. The Southern Flank project is proposing to develop a mixture of brownfield and greenfield facilities with an annual production capacity of approximately 80 Mtpa in addition to the current mining activity at MAC. This will increase annual production to approximately 150 Mtpa. This increase will substitute the ore generation of Yandi mining hub whilst providing no increase to BHP Billiton's total annual production. Mining activities will be extended to the Southern Flank project area, approximately 8 km south of existing processing facilities, within Mining Lease ML281SA.

Incremental mining activity will be supported with construction of new processing facilities as follows:

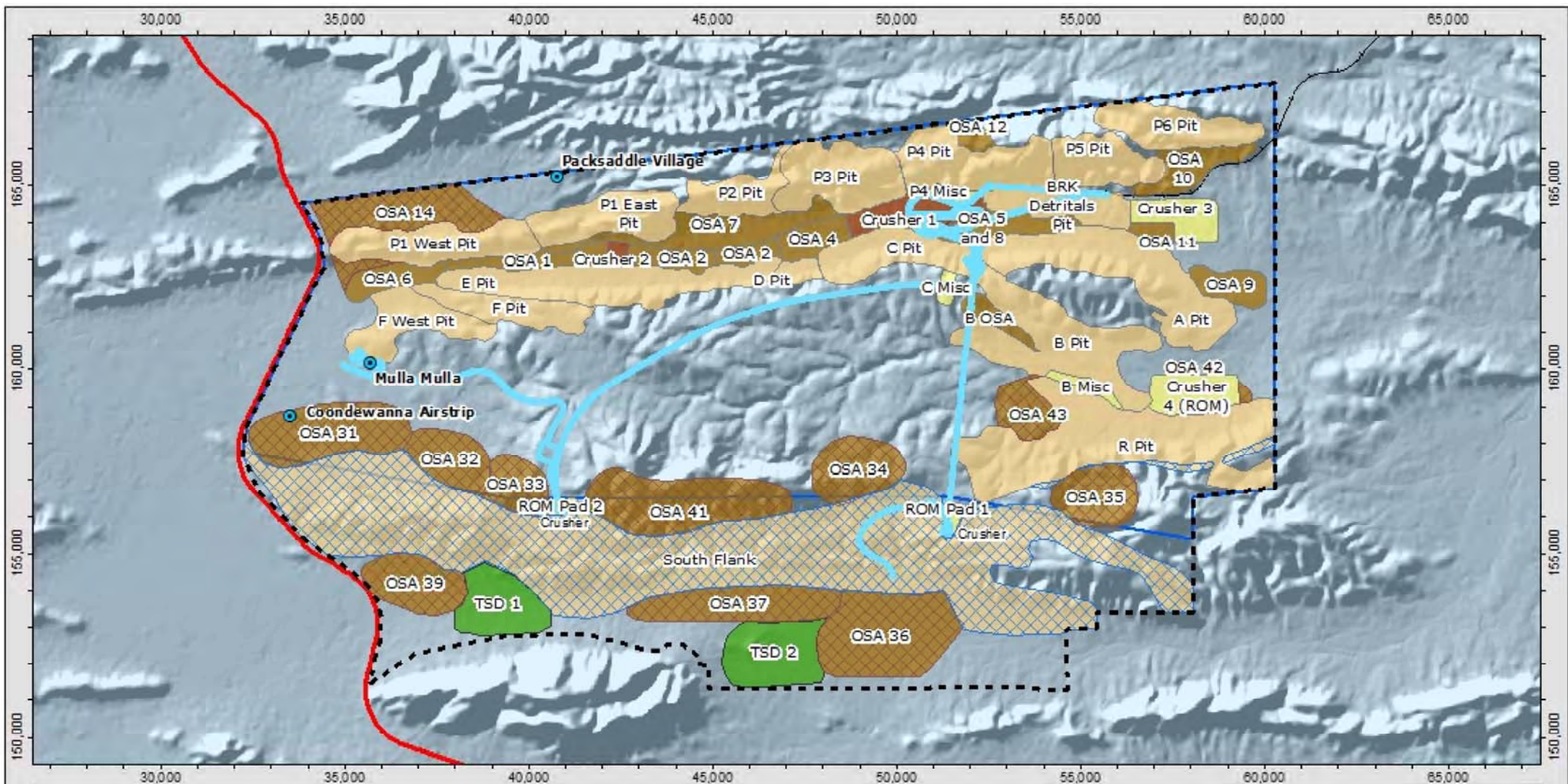
- A minimum of two Primary Crushing (PC) facilities located approximately 8 km and 16 km south of existing infrastructure;

- Run of Mine (ROM) pads;
- Topsoil Storage Areas;
- Overland conveyors;
- Coarse Ore Stockpile (COS);
- Ore Handling Plant (OHP) within existing MAC lease area;
- Significant upgrade to the existing stockyards and outflow facilities;
- Duplication of the existing rail loop and addition of a second Train Loadout (TLO);
- Advanced mine de-watering to support mining at Southern Flank;
- Expansion of Mulla Accommodation Village capacity to approximately 1500 beds;
- Installation of supporting non-processes infrastructure (e.g. power lines, access roads) to support new mining area: and
- Expansion of existing non-processing infrastructure (NPI) and industrial facilities to support production.

1.3 Approvals History

An Environmental Impact Assessment (EIA) for Mining Area C was conducted in 1997 via the Public Environmental Review (PER) process. The PER presented BHP Billiton Iron Ore's proposal to mine 14 iron ore deposits identified in the Northern Flank Valley at Mining Area C (i.e. deposits A, B, C, D, E, F, R, P1, P2, P3, P4, P5, P6 and the Brockman Detrital Deposit) and also noted but did not approve further deposits at Southern Flank.

The PER was assessed by WA Environmental Protection Authority (EPA) Bulletin No. 913 in 1998 and a Ministerial Statement of Approval (MS 491) was issued by the Minister for the Environment in December 1998 under Part IV of the *Environmental Protection Act 1986* (EP Act) which approved mining of two deposits - Deposit C and the Brockman Detrital Deposit. Additional mining for the remaining 14 deposits has been approved via a revision of the Environmental Management Plan (EMP). In 2015, all deposits within the Current Approved Development Envelope were assessed under a Life of Asset revision of the EMP (Rev 6) (Figure 1).



Health, Safety and Environment
BHP BILLITON IRON ORE

MINING AREA C Proposed General Arrangement

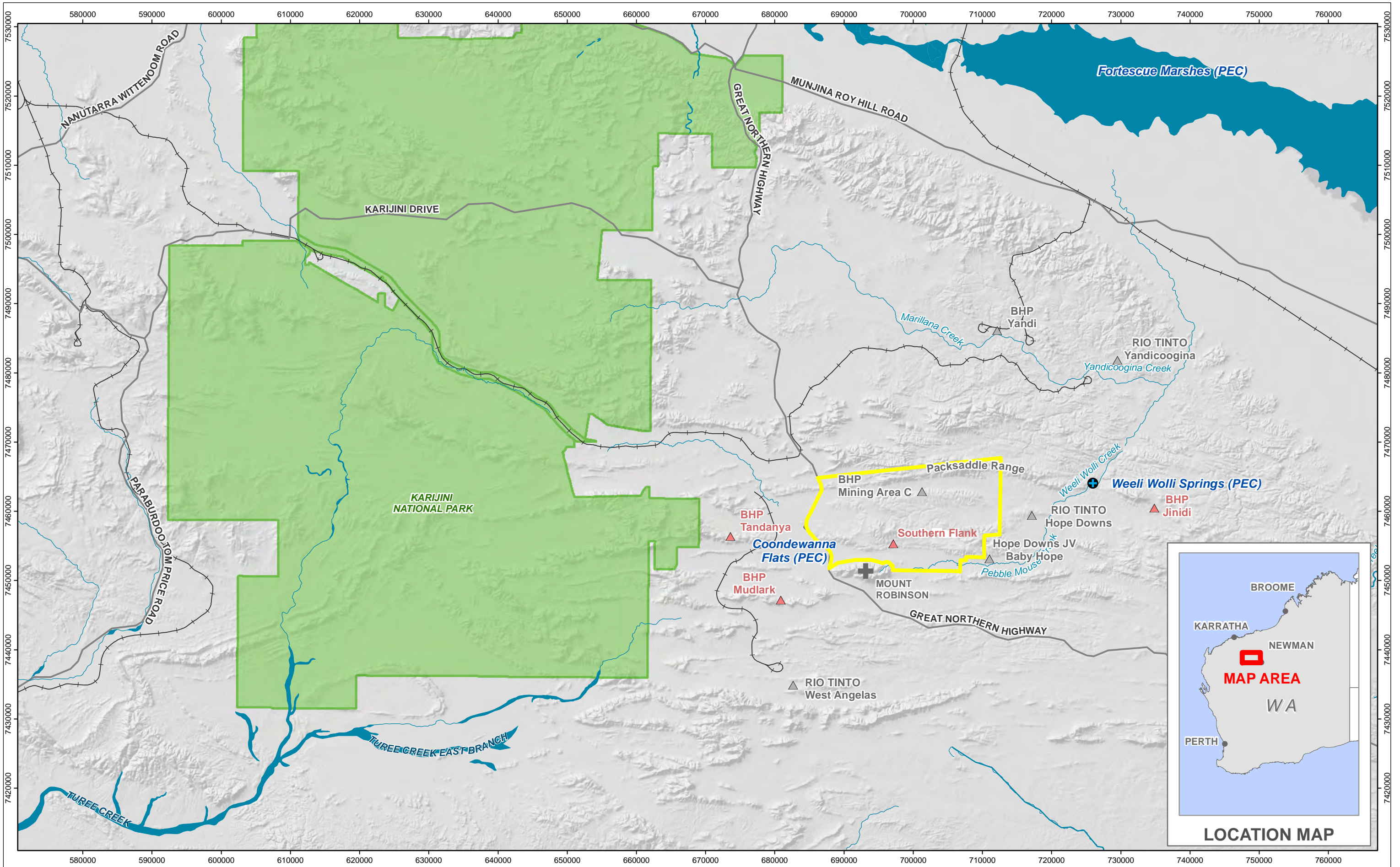
Scale @ A4: 1:150,000	Prepared: J. Roberts	Project No: A780/06
Date: 25/05/2016	Checked: P. Gant	Figure: 1
Revision: DRAFT	Reviewed: E. Drain	

LEGEND

- Mine Accommodation
- Ministerial Statement 491 (Northern Flank)
- Indicative Additional Infrastructure Areas
- Indicative Additional OSA
- Indicative Additional Pits
- Proposed Mining Area C Development Envelope
- Indicative South Flank Overall Arrangement
- Proposed Indicative General Arrangement (Rev B)
- Indicative Infrastructure
- Existing Infrastructure
- Indicative OSA Area
- Indicative Pit Area
- Topsoil

BHP Billiton and its related entities, including BHP Billiton Iron Ore, do not warrant the accuracy of the information contained in this map. This map is intended for use as a guide only and should not be used for any purpose other than that for which it was prepared. BHP Billiton Iron Ore is not responsible for any errors or omissions in this map. This map is intended for use as a guide only and should not be used for any purpose other than that for which it was prepared. BHP Billiton Iron Ore is not responsible for any errors or omissions in this map.





ONSHORE ENVIRONMENTAL

Figure:	2	Date:	02/08/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference		MAC_Location	

N

0 2.5 5 10 15 20

Kilometers
1:500,000

Datum: GDA94
Projection: MGA Zone 50

BHP BIO
MINING AREA C
Revised Proposal - Regional Location
Figure 2

Legend

Proposed Mining Area C Development Envelope	Watercourses	Deposit
Nature Conservation Reserve	Roads	Operating Mine
	Railways	
	Mountain	

GRIFFIN
SPATIAL & MAPPING

PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

2 BACKGROUND

2.1 Climate

The climate of the Central Pilbara is arid-tropical with hot summers extending from October to April and mild winters from May to September. The climate is dry and rainfall is variable and unreliable. Rainfall occurs in both summer and winter months with the major falls received during summer. Cyclones that develop over the Indian Ocean bring heavy summer rainfall, especially between January and March. Winter rainfall is generally lighter and typically associated with cold fronts extending from southern parts into the Pilbara region. Annual average rainfall for the Pilbara ranges from 180 millimeters (mm) to over 400 mm (Beard 1975), with a long-term average of 330 mm for the town of Newman (Bureau of Meteorology, 2016).

Average maximum summer temperatures are typically between 35°C to 40°C, and winter maximum temperatures are between 22°C and 34°C. Summer temperatures can reach 49°C with frosts occurring occasionally during winter months. The prevailing wind direction for Newman is east south-east between May and August, with stronger west north-west winds dominant between September and March.

2.2 Biogeographic Regions

The Interim Biogeographic Regionalisation for Australia (IBRA) describes a system of 85 'biogeographic regions' (bioregions) and 403 subregions covering the entire Australian continent (Thackway and Cresswell 1995). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna. The Proposed MAC Development Envelope is situated in the Hamersley subregion (PIL3) of the Pilbara bioregion (Thackway and Cresswell 1995), which is located in the southern section of the Pilbara Craton (Kendrick 2001). The PIL3 subregion is 6,215,095 hectares (ha) in size and is described as:

"Mountainous area of proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges. The climate is semi-desert tropical, average 300 mm rainfall, usually in summer cyclonic or thunderstorm events. Winter rain is not uncommon. Drainage into either the Fortescue (to the north), the Ashburton to the south, or the Robe to the west."

The Hamersley subregion (PIL3) is characterised by mountain ranges and plateaux of Proterozoic sedimentary rock, dissected by gorges (Kendrick 2001; Australian Natural Resource Atlas [ANRA] 2008). Beard (1975) described the Hamersley subregion as "rounded hills and ranges, mainly of jaspilite and dolomite with some shale, siltstone and volcanics". This plateau supports mulga (*Acacia aneura*) low woodland over bunch grasses on fine textured soils and snappy gum (*Eucalyptus leucophloia*) over hummock grass (*Triodia brizoides*) on skeletal sandy soils of the ranges.

2.3 Existing Land Use

The current use of lands surrounding MAC and associated infrastructure is predominantly for mineral exploration, iron ore mining and dry land agriculture, specifically pastoralism, cattle grazing and rangelands. Conservation lands amount to less than ten percent of the total area of the Pilbara bioregion, with the major reserves being Karijini (approximately 20 km to the west) and Millstream-Chichester

National Parks. These Parks are supplemented by lesser conservation estates such as Cane River and Meentheena Conservation Parks. Wetlands of National significance include the permanent pools of Millstream and Karijini National Parks and the Fortescue Marsh (approximately 50 km to the north).

2.4 Landforms

The Proposed MAC Development Envelope lies within the Hamersley Range on the Hamersley Plateau, which is surrounded to the north, east and west by escarpments. Rounded hills and ranges dominate the landscape in the area. The Hamersley and Ophthalmia Ranges are characterised by long strike ridges rising from valley floors reaching a height of up to 300 m. The flat valley floors consist of Cainozoic sediments.

The Proposed MAC Development Envelope encompasses the Packsaddle Range which runs along the northern boundary, while the south west sector comprises flat plains adjacent to the Coondewanna Flats PEC. Mount Robinson (1158 m AHD) fringes the south west boundary of the Proposed MAC Development Envelope.

Site assessment undertaken during previous flora and vegetation surveys within the Development Envelope and consolidated as part of BHP Billiton Iron Ore's Pilbara tenement mapping (Onshore Environmental 2014a) recorded the nine major landforms:

- Hill crests;
- Gorges and gullies;
- Hill slopes;
- Foot Slopes;
- Calcrete plains;
- Flood plains;
- Major drainage lines;
- Medium drainage lines; and
- Minor drainage lines.

2.5 Soils

The soils of the Pilbara region have been defined and mapped at a scale of 1:2,000,000 by Bettanay *et al.* (1967). The Proposed MAC Development Envelope is mainly covered by coherent and porous loam soils with weak pedologic development.

Tille (2006) collated the most recent and detailed mapping of Western Australia's Rangelands and Arid interior into a hierarchy of soil-landscape mapping units. The Proposed MAC Development Envelope falls within the Fortescue Province, an area that occupies approximately 160,050 km² (6.3 percent of Western Australia) and includes the towns of Port Hedland, Karratha, Dampier, Roebourne, Newman, Tom Price, Paraburdoo, Pannawonica, Marble Bar, Nullagine and Jigalong. Soils and landform for the Fortescue Province are described as "Hills and ranges (with stony plains and some alluvial plains and sandplains) on the volcanic, granitic and sedimentary rocks of the Pilbara Craton. Stony soils with red loamy earths and red shallow loams (and some red/brown non-cracking clays, red deep sandy duplexes and red deep sands)" (Tille 2006). The Fortescue Province is divided into ten soil-landscape zones:

- Nullagine Hills Zone;
- De Grey-Roebourne Lowlands Zone;

- Chichester Ranges Zone;
- Abydos Plains and Hills Zone;
- Fortescue Valley Zone;
- Hamersley Plateaux Zone;
- Karratha Coast Zone;
- Warrawagine Hills Zone;
- Jigalong Plains Zone; and
- Harding Hills and Plains Zone

The Proposed MAC Development Envelope occurs within the Hamersley Plateaux Zone. The dominant landform features within this zone are rocky ranges / hills and stony plains and some hard pan wash plains (Tille 2006). Rugged hills, ridges, dissected plateaux and mountains occur on the basalt, banded iron formation and sandstone of the Hamersley Basin, the most notable examples being the Chichester and Hamersley Range. The Proposed MAC Development Envelope occurs within the central Hamersley Ranges, which together with the Ophthalmia Range comprise the majority of the Hamersley Plateau. The soils here are generally stony soils with red shallow loams and some red/brown non-cracking clays and some red loamy earths (Tille 2006).

Hills and ridges occurring within the Proposed MAC Development Envelope support areas with shallow or in some cases complete lack of soil cover. These regions are the surface expression of the Robe Pisolite. Where soils are present they are generally stony and consist of red shallow loams and sands. Hard cracking clays are sometimes found on basaltic plateau surfaces. Soils formed in these hilly areas are generally transported to lower valleys and plains due to the lack of vegetation cover and erosion from heavy rainfall events. The hill slopes support uniform or fine textured soils consisting of loams and sands that are generally shallow, stony and lack nutrients. On the plains soils are better developed and deeper, represented most commonly as hard alkaline red loams. A layer of quartz and jaspilite gravel may cover the surface in some areas. The soils in the major drainage channels are alluvial sands with banks formed by a combination of alluvial sands and duplex soils. Minor drainage channels have soil consisting primarily of duplex soils (Tille 2006).

2.6 Geology

The ancient continental Western Shield dominates the geology of Western Australia. The Pilbara region makes up a portion of the Western Shield and consists of pre-Cambrian, Proterozoic and Archaean rocks. The area contains some of the earth's oldest rock formations, thought to be around 3.5 billion years old (ANRA 2008). Important mineral reserves, including iron ore, which is prevalent in the Pilbara, are associated with these rock formations.

The Pilbara Craton lies beneath the Proterozoic rocks of the Hamersley and Bangemall Basins. The Hamersley Basin covers the majority of the southern part of the Pilbara Craton and is separated into three stratigraphic groups; the Fortescue, Hamersley and Turee Creek rock groups.

The Fortescue Group consists mainly of basalt with beds of siltstone, mudstone, shale, dolomite and jaspilite. These rocks form the Chichester Plateau, which lies beneath the Hamersley Plateau. The Turee Creek Group consists of interbedded mudstone, siltstone, sandstone, conglomerate and carbonate. These rocks are the youngest of the three groups and are exposed mainly in the Ashburton Valley.

The Hamersley Group is the most relevant to the Proposed MAC Development Envelope as it contains both the Brockman Iron Formation and the Marra Mamba Iron Formation, which together provide most of the major iron ore deposits in the Pilbara (O'Brien and Associates 1992). This group forms the Hamersley Range and Plateau and consists of jaspilite and dolomite. The jaspilite produces deposits of haematite and limonite, which are mined for iron ore.

The Jirrpulpar Range at MAC dominated by the Marra Mamba Iron Formation, with younger tertiary hematite residual comprising the main detrital iron ore deposit at MAC. The Brockman Iron Formation deposits in the Packsaddle Range are residual hematite deposits (Tille 2006). The Southern Flank deposit is geologically simple with gently south dipping Mount Newman Member with a deepening alluvial cover to the south (Kneeshaw 2008).

2.7 Flora and Vegetation

Historical systematic flora surveys of the Pilbara are limited to work completed by Burbidge (1959) and Beard (1975), and further refining of the original Beard mapping by Shepherd *et al.* (2002). Beard (1975) mapped vegetation of the Pilbara at a scale of 1:1,000,000. Vegetation within the local area was defined broadly as *Eucalyptus leucophloia* (snappy gum) and *Triodia wiseana* (hard spinifex) tree steppe occurring on hills, and tall woodlands of *Eucalyptus camaldulensis*, *Eucalyptus victrix* and *Melaleuca argentea* along major drainage lines.

The original vegetation mapping undertaken by Beard (1975) has been refined by Shepherd *et al.* (2002). There were two vegetation associations present within the Proposed MAC Development Envelope (Figure 3). While the Pre-European extent for each vegetation association is close to 100 percent, less than 10 percent of each association occurs within formal or informal reserves (Table 1).

Table 1 Pre-European extent of vegetation associations occurring within the Proposed MAC Development Envelope (Shepherd *et al.* 2002).

Vegetation Sub-Association	Description	Pre-Euro. Extent Remaining	% remaining IUCN Class I-IV Reserves	% remaining Other Reserves	% remaining DPaW Managed PL
Hamersley 18	Low woodland; mulga (<i>Acacia aneura</i>)	99.9	2.0	0.3	2.5
Hamersley 82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>	100.0	8.9	0.2	1.0

In recent years there has been numerous small-scale surveys completed throughout the Pilbara region, predominantly associated with mining approvals. A literature review confirmed 20 previous flora and vegetation surveys covering at least part of the Proposed MAC Development Envelope were completed between 1997 and 2014. An additional 26 surveys have been completed at surrounding exploration areas between 1994 and 2014.

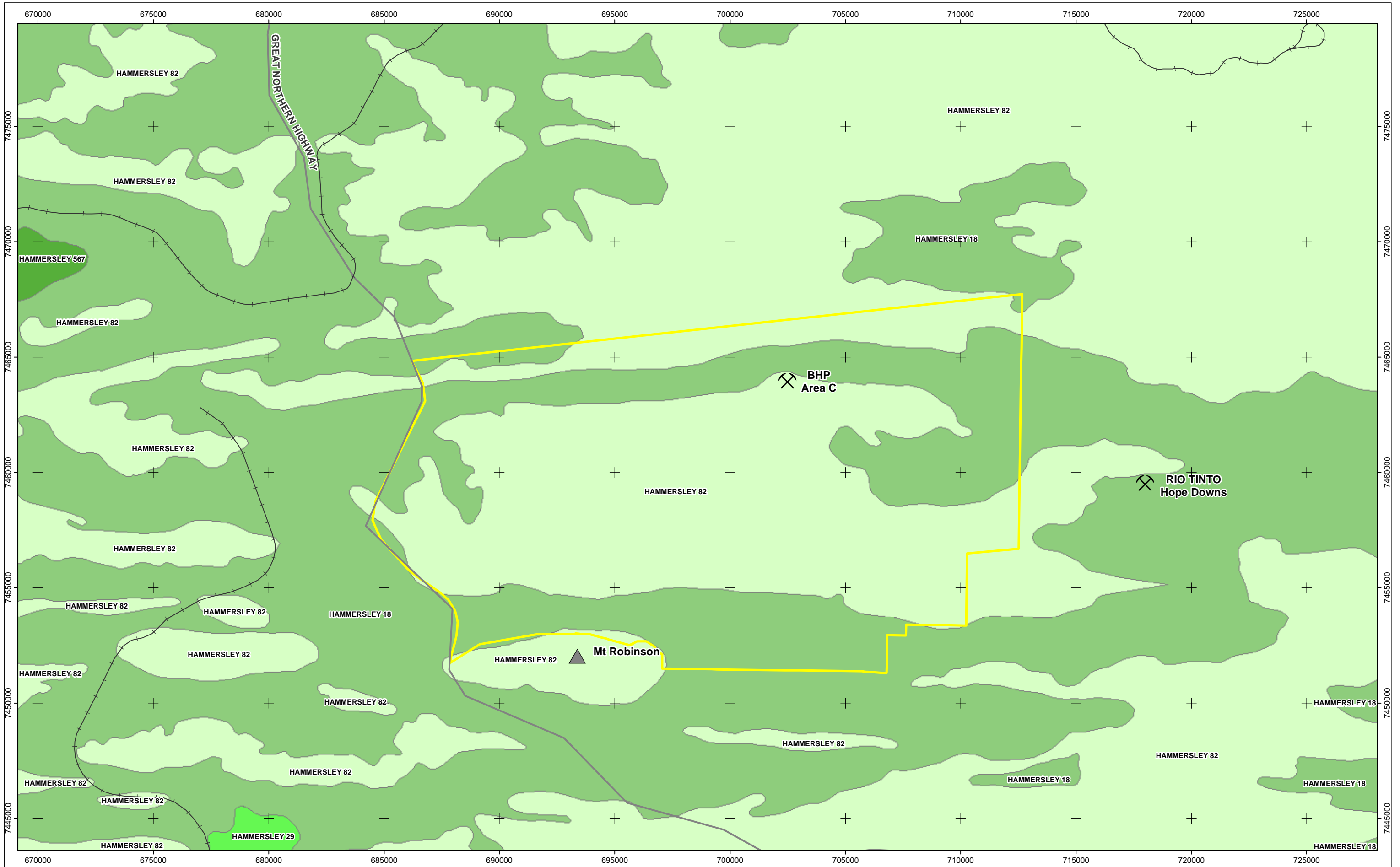
2.8 Land Systems

The Department of Agriculture has conducted inventory and condition surveys of the Pilbara (van Vreeswyk *et al.* 2004) using an integrated survey method involving the land system approach to rangeland description evaluation. The primary objective of the surveys was to provide comprehensive descriptions and mapping of the biophysical resources of the region as well as an evaluation on the condition of soils and vegetation. The mapping is based on patterns in topography, soils and vegetation.

A total of 102 land systems were defined in the Pilbara at scale of 1:250,000 (van Vreeswyk *et al.* 2004), with five land systems occurring within the Proposed MAC Development Envelope (Table 2, Figure 4). The dominant land systems represented were the Newman and Boolgeeda Land Systems comprising the plateaux, ridges, mountains and hills and their associated drainage zones of this section of the Hamersley Range.

Table 2 Land systems occurring within the Proposed MAC Development Envelope (descriptions from van Vreeswyk *et al.* 2004).

Land System	Representation in the Pilbara	Description
Boolgeeda	7,748 km ² or 4.3%	Stony plains with hard Spinifex grasslands or Mulga shrublands. The geology is quaternary colluvium.
Newman	14,580 km ² or 8%	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.
Pindering	351 km ² or 0.2%	Gravelly hardpan plains supporting groved mulga shrublands with hard and soft spinifex.
Platform	1570 km ² or 0.9%	Narrow, raised plains and highly dissected slopes on partly consolidated colluvium below the footslopes of hill systems such as Newman, relief mostly up to about 30 m but occasionally considerably greater.
Wannamunna	577 km ² or 0.3%	Level alluvial plains with prominent grove patterns of vegetation and shallow loamy soils over hardpan and broad internal drainage plains with deeper more clayey soils, relief up to 5 m. The system is found in south central parts of the survey area as broad flats within the Hamersley Ranges (Newman land system).



ONSHORE ENVIRONMENTAL

Figure:	3	Date:	14/06/2015
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
		GSM Reference:	MAC_beard

N

0 1 2 4 6 8
Kilometers
1:150,000
Datum: GDA94
Projection: MGA Zone 50

**BHPBIO
MINING AREA C**

Vegetation of the Proposed MAC Development
Envelope, as mapped by Beard (1975)

Figure 3

Legend

MAC Development Envelope	HAMMERSLEY, 29	Mine Site	Railways
Pre-European Vegetation (Beard 1975)	HAMMERSLEY, 567	Mt Range	Roads
System, Vegetation Association	HAMMERSLEY, 82		
HAMMERSLEY, 18			

GRIFFIN
SPATIAL & MAPPING

PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

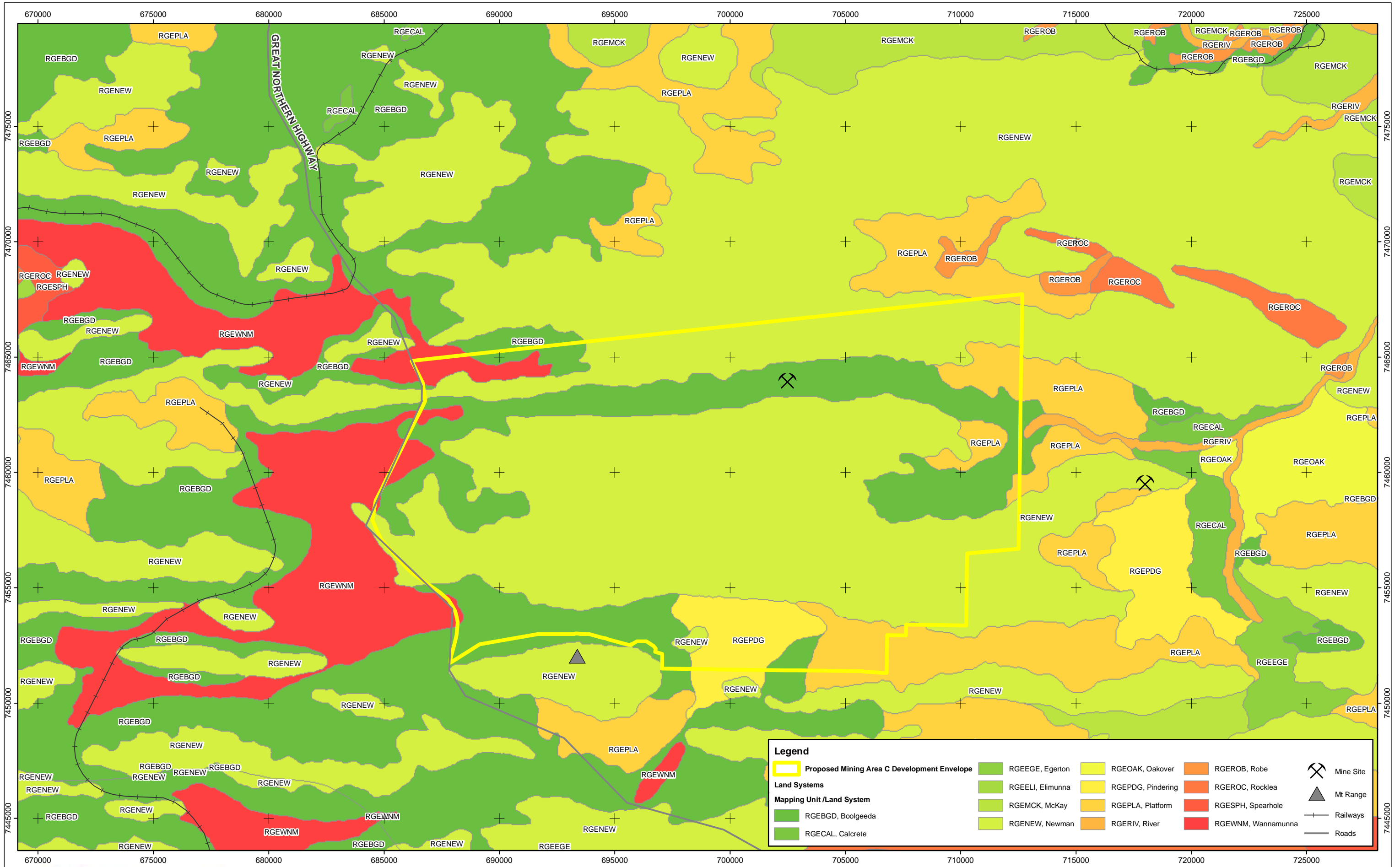


FIGURE 4
 Land systems represented within the
 Proposed MAC Development Envelope
 (as mapped by van Vreeswyk *et al.* 2004).

3 SUMMARY OF BASELINE SURVEYS

3.1 Legislation and Guidance Statements

The previous flora and vegetation surveys were carried out in a manner that was compliant with Environmental Protection Authority (EPA) requirements for the environmental surveying and reporting of flora and vegetation in Western Australia:

- *Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas. Position Statement No. 2* (EPA 2000);
- *Terrestrial Biological Surveys as an Element of Environmental Protection. Position Statement No. 3* (EPA 2002); and
- *EPA Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia No. 51* (EPA 2004).

Although most surveys pre-date the EPA and DPaW's *Technical Guide - Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA and DPaW 2015), survey methods and intensity are generally consistent with this document.

All surveys post 2010 were conducted in accordance with BHP Billiton Iron Ore's *Guidance for Flora and Vegetation Surveys in the Pilbara* (BHP Billiton Iron Ore 2016).

3.2 Field Survey Constraints

The EPA Guidance Statement No. 51 for Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004) list twelve potential constraints that field surveys may encounter. These constraints are addressed in Table 3.

Table 3 Relevance of constraints, as identified by EPA (2004), to the flora and vegetation survey.

Constraint	Relevance
Scope	The scope of work for baseline flora and vegetation surveys completed within the Additional Development Envelope was established by BHP Billiton Iron Ore in consultation with DPaW, and is compliant with relevant EPA Guidance Statements.
Proportion of flora collected and identified	A total of 479 plant taxa were recorded from all flora and vegetation surveys completed within the Proposed MAC Development Envelope between 1997 and June 2011. A large proportion of the total flora present is likely to have been recorded owing to the high level of survey intensity across multiple seasons. It is estimated that greater than 95 percent of specimens collected by Onshore Environmental between November 2009 and June 2011 were positively identified, with some sterile material resulting from seasonal conditions.
Sources of information	A total of 20 flora and vegetation surveys have previously been completed within sectors of the Proposed MAC Development Envelope. Numerous additional surveys have been undertaken in close proximity, providing an extensive local database.

Constraint	Relevance
The proportion of the task achieved and further work which might be needed	There has been a high level of survey intensity over an extended period. All required tasks relating to compliance with Level 2 flora and vegetation survey have been achieved and there are no recommendations for any further work.
Timing / weather / season / cycle	The baseline survey completed at Southern Flank included a specific ephemeral species survey following good summer rainfall and seasonal conditions were not determined to be a limiting factor.
Disturbances, e.g. fire, flood	There were no disturbances within the Additional Development Envelope that impacted on baseline flora and vegetation results.
Intensity	The entire Additional Development Envelope has been surveyed at approximately one quadrat per square kilometer, equating to high survey intensity.
Completeness	A total of 20 previous surveys have been completed covering the entire extent of the Proposed MAC Development Envelope. The survey is determined to be complete.
Resources	Appropriate resources have been applied to the survey over a long period of time. Two comprehensive flora and vegetation surveys have been completed that cover the Additional Development Envelope providing intensive baseline survey coverage.
Access problems	The entire Additional Development Envelope was accessed on foot walking from established vehicular tracks.
Availability of contextual information	A total of 20 flora and vegetation surveys have previously been completed within, or partly within, the Proposed MAC Development Envelope. Numerous additional surveys have been undertaken in close proximity, providing an extensive local database (see Section 3.3).
Experience levels	The two Senior Botanists working on the two most recent surveys of the Additional Development Envelope (Onshore Environmental 2011a, 2012a) each have over 15 years Pilbara experience. Both have completed numerous surveys at, and in close proximity to MAC They also completed much of the previous field survey work, working as sub-contractors to Ecologia Environment and ENV Australia.

3.3 Desktop Review

3.3.1 Previous Flora Surveys within the Proposed Mining Area C Development Envelope

A total of 20 flora and vegetation surveys were completed within, or partly within, the boundary of the Proposed MAC Development Envelope between 1997 and 2014 (Table 4), with a further 26 surveys completed in close proximity (Table 5) between 1994 and 2014. The previous survey work represents an intensive survey effort (Figures 5 and 6). Onshore Environmental completed the two most recent surveys covering the entire Proposed MAC Development Envelope and extending into surrounding areas;

- Onshore Environmental (2011a) *Area C and Surrounds Level 2 Flora and Vegetation Survey*; and

- Onshore Environmental (2012a) *Level 2 Flora and Vegetation Survey Southern Flank*.

The Area C and Surrounds survey (Onshore Environmental 2011a) covered the northern half of the Proposed MAC Development Envelope and extended further east (outside the Development Envelope) to include the eastern fringe of Packsaddle Range and adjacent Weelli Wollli Creek. The Southern Flank survey (Onshore Environmental 2012a) covered the southern half of the Proposed MAC Development Envelope and extended further south (outside the Development Envelope) to include the summit of Mount Robinson.

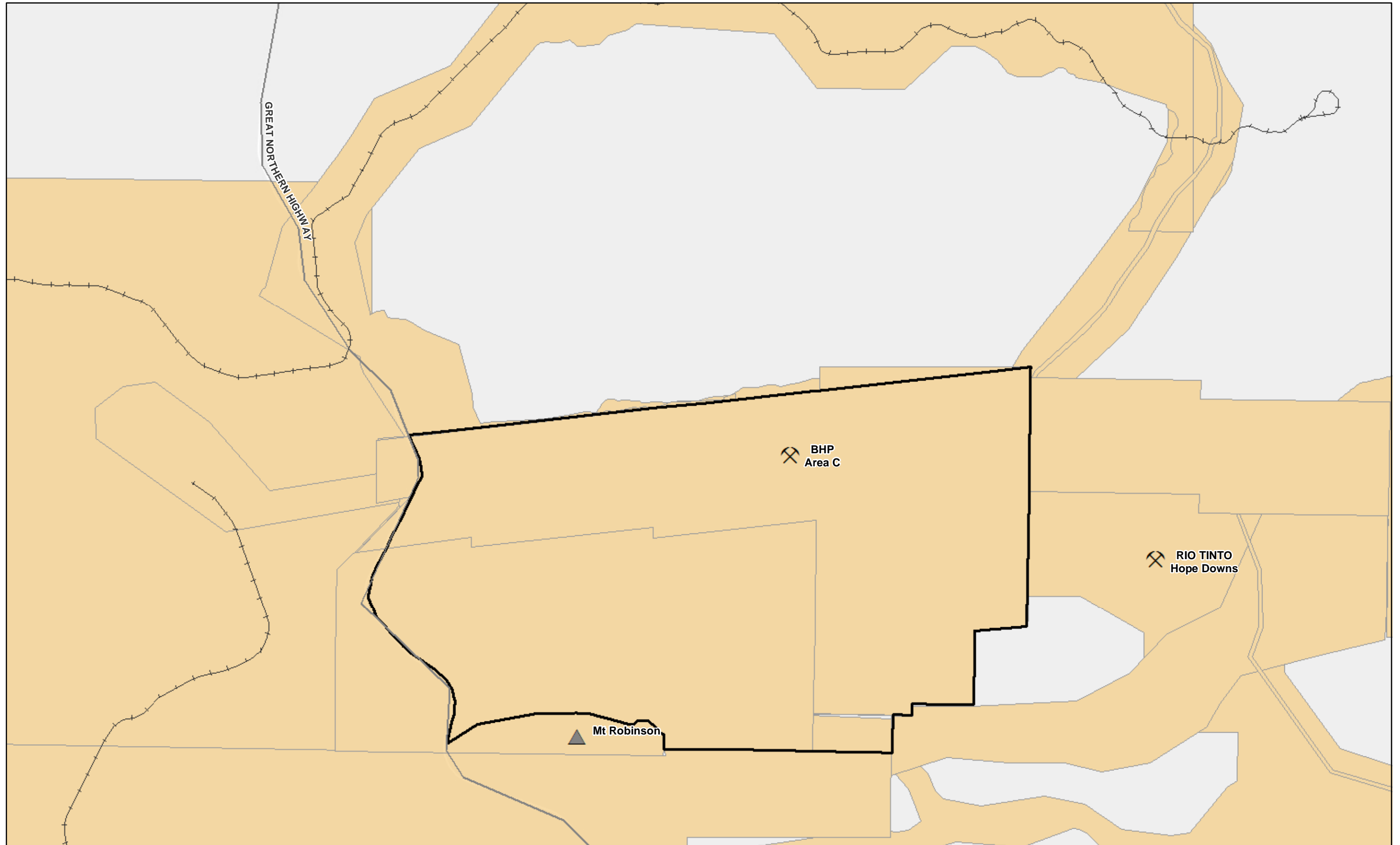




Figure:	5	Date:	02/08/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference:		MAC_previous surveys	

N



Kilometers
1:150,000



Datum: GDA94
Projection: MGA Zone 50

**BHPBIO
MINING AREA C**

Previous flora and vegetation surveys undertaken
wholly or partially within the Proposed Mining Area C
Development Envelope

Figure 5

Legend

-  Proposed Mining Area C Development Envelope
-  Previous Level 2 flora and vegetation surveys commissioned by BHPBIO that intersect the Proposed MAC Development Envelope



PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

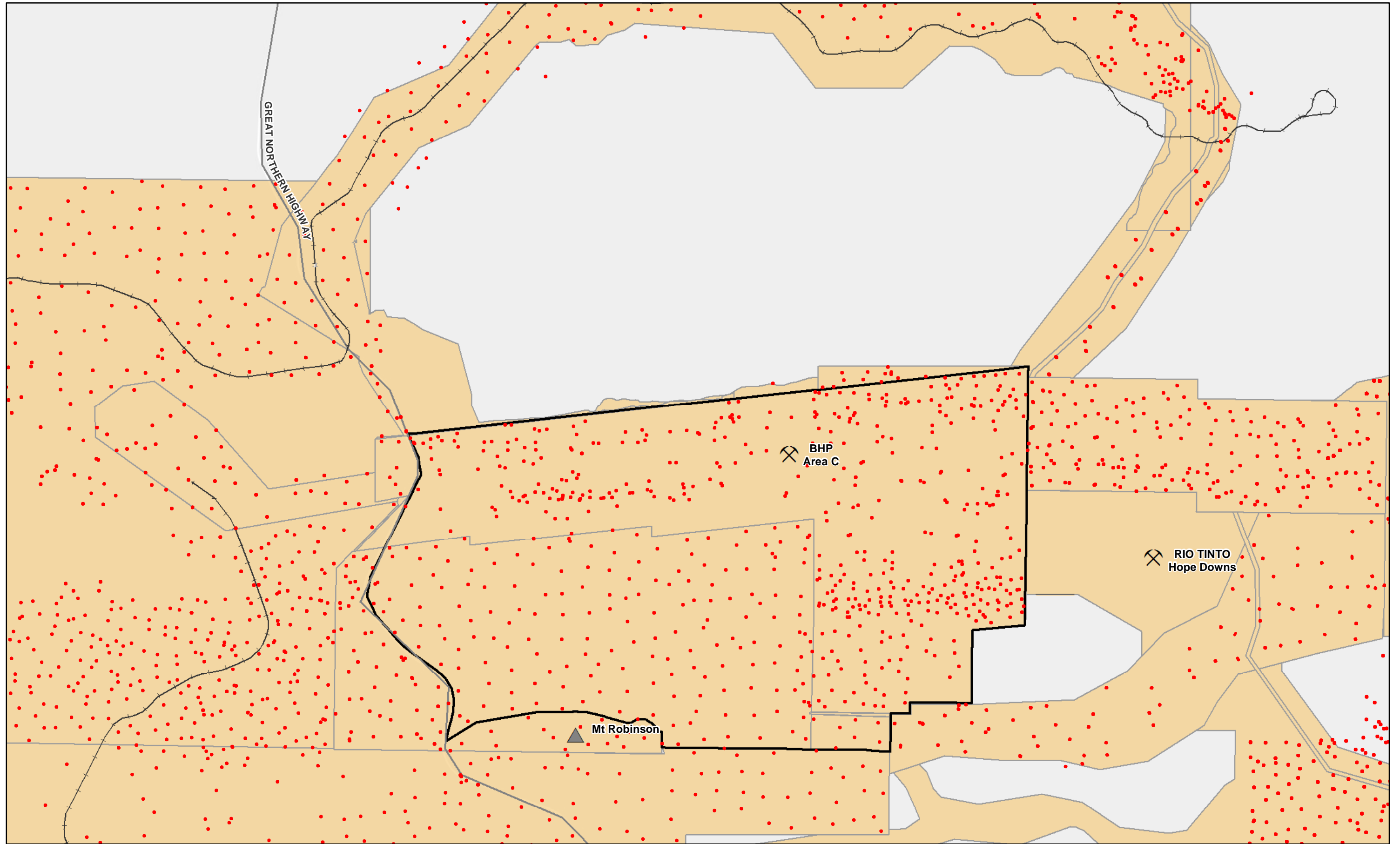




Figure:	6	Date:	02/08/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference:		MAC_Sample Locations	

N



Kilometers
1:150,000

Datum: GDA94
Projection: MGA Zone 50

FIGURE 6

Location of sampling sites formally assessed during previous flora and vegetation surveys within the Proposed Mining Area C Development Envelope and surrounds

Legend

- Sample Locations
- Proposed Mining Area C Development Envelope
- Previous Level 2 Surveys Intersecting Proposed MAC Development Envelope



PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

Table 4 Summary of results from previous flora and vegetation surveys within, or partly within, the Proposed MAC Development Envelope.

Report	Survey Type / Seasonal Conditions	Survey Area	Survey Date	Survey Effort	Experience of Personnel	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Mine, Port & Rail Operations Weed Control - Area C June 2014 (Astron Environmental 2014a)	Targeted weed Good	Not relevant	12- 17 June 2014	No quadrats, targeted searches	Experienced environmental technicians for weed identification and control	Infrastructure areas within existing MAC operations; not within the Indicative Additional Impact Assessment Area	Not recorded	<i>*Rumex vesicaria</i> , <i>*Cenchrus ciliaris</i> , <i>*Chloris barbata</i> , <i>*Chloris virgata</i> , <i>*Citrullus colocynthis</i> , <i>*Citrullus lanatus</i> , <i>*Conyza bonariensis</i> , <i>*Cynodon dactylon</i> , <i>*Echinochloa colona</i> , <i>*Euphorbia hirta</i> , <i>*Lactuca serriola</i> , <i>*Lycopersicon esculentum</i> , <i>*Solanum nigrum</i> , <i>*Sonchus oleraceus</i> , <i>*Tridax procumbens</i> , <i>*Malvastrum americanum</i>
Mine, Port & Rail Operations Weed Control- Area C, March 2014 (Astron Environmental 2014b)	Targeted weed Good	Not relevant	11-15 March 2014	No quadrats, targeted searches	Experienced environmental technicians for weed identification and control	Infrastructure areas within existing MAC operations; not within the Indicative Additional Impact Assessment Area	Not recorded	<i>*Rumex vesicaria</i> , <i>*Bidens bipinnata</i> , <i>*Cenchrus ciliaris</i> , <i>*Cenchrus setiger</i> , <i>*Chloris barbata</i> , <i>*Chloris virgata</i> , <i>*Citrullus colocynthis</i> , <i>*Citrullus lanatus</i> , <i>*Conyza bonariensis</i> , <i>*Conyza sumatrensis</i> , <i>*Digitaria ciliaris</i> , <i>*Echinochloa colona</i> , <i>*Euphorbia hirta</i> , <i>*Malvastrum americanum</i> , <i>*Solanum nigrum</i> , <i>*Sonchus oleraceus</i> , <i>*Vachellia farnesiana</i>

Report	Survey Type / Seasonal Conditions	Survey Area	Survey Date	Survey Effort	Experience of Personnel	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Level 2 Flora and Vegetation Survey Mudlark Leases (Onshore Environmental 2013c)	Level 2	36,601 ha	4-24 February 2011, 17-26 June 2011, 9-20 July 2011, 1-9 July 2012, 20-29 July 2012	259 quadrats (50x50m) 7 quadrats within MAC Development Envelope	Highly experienced Pilbara botanists	Southwest of the Additional Development Envelope, incorporating the southern half of Mount Robinson (south from peak)	<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Eragrostis</i> sp. Mt Robinson (S. van Leeuwen 4109) (P1), <i>Eremophila</i> sp. West Angelas (S. van Leeuwen 4068) (P1), <i>Grevillea</i> sp. Turee (J. Bull & G. Hopkinson ONS JJ 01.01) (P1) ³ , <i>Triodia</i> sp. Karijini (S. van Leeuwen 4111) (P1), <i>Aristida lazaridis</i> (P2), <i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2), <i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725) (P2), <i>Pilbara trudgenii</i> (P2), <i>Acacia effusa</i> (P3), <i>Dampiera metallorum</i> (P3), <i>Indigofera</i> sp. Gilesii (M.E. Trudgen 15869) (P3) ⁴ , <i>Olearia mucronata</i> (P3), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3), <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P3), <i>Solanum kentrocaule</i> (P3), <i>Themeda</i> sp. Hamersley Station (M.E Trudgen 11431) (P3), <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3), <i>Acacia bromilowiana</i> (P4), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Goodenia nuda</i> (P4), <i>Ptilotus mollis</i> (P4)	<i>*Bidens bipinnata</i> , <i>*Cenchrus ciliaris</i> , <i>*Cenchrus setiger</i> , <i>*Chloris virgata</i> , <i>*Citrullus colocynthis</i> , <i>*Flaveria trinervia</i> , <i>*Malvastrum americanum</i> , <i>*Setaria verticillata</i> , <i>*Sigesbeckia orientalis</i> , <i>*Sonchus oleraceus</i> , <i>*Vachellia farnesiana</i>

Report	Survey Type / Seasonal Conditions	Survey Area	Survey Date	Survey Effort	Experience of Personnel	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Level Two Flora and Vegetation Survey Southern Flank (Onshore Environmental 2012a)	Level 2 Poor (2010) Good (2011)	18,631 ha	22 March - 1 April 2010, 12 th - 24 th May 2010, 16 th - 29 th September 2010, 22-27 th June 2011	220 quadrats (50x50m) 169 quadrats within MAC Development Envelope	Highly experienced Pilbara botanists	Including the Additional Development Envelope and extending outside (south) to include northern half of Mt Robinson	<i>Lepidium catapycnon</i> (V, P4), <i>Dampiera metallorum</i> ms (P3), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Sida</i> sp. Barlee Range (S van Leeuwen 1642) (P3), <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Aristida lazaridis</i> (P2), <i>Pilbara trudgenii</i> (P2), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3), <i>Triodia</i> sp. Mt. Ella (ME Trudgen 12739) (P3), <i>Themeda</i> sp. Hamersley Station (M. E. Trudgen 11431) (P3), <i>Acacia bromilowiana</i> (P4), <i>Ptilotus mollis</i> (P4)	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Vachellia farnesiana</i> , * <i>Cucumis melo</i> subsp. <i>agrestis</i> , * <i>Stylosanthes hamata</i>

¹ Revised name is *Grevillea saxicola* (Priority 3)

² Revised name is *Indigofera gilesii* (Priority 3)

Report	Survey Type / Seasonal Conditions	Survey Area	Survey Date	Survey Effort	Experience of Personnel	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Area C and Surrounds Study Area, Level 2 Flora and Vegetation Survey (Onshore Environmental 2011a)	Level 2 Poor	29,414 ha	26 Nov - 6 Dec 2009, 9-18 Feb 2010, 14-21 June 2010	221 quadrats (50x50m) 152 quadrats within MAC Development Envelope	Highly experienced Pilbara botanists	Covering the Current Approved Development Envelope	<i>Lepidium catapycnon</i> (V, P4), <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Aristida lazaridis</i> (P2), <i>Stylidium weeliwoilli</i> (P2), <i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684) (P1), <i>Acacia subtiliformis</i> (P3), <i>Fimbristylis sieberiana</i> (P3), <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (P3), <i>Nicotiana umbratica</i> (P3), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3), <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642), (P3), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Goodenia nuda</i> (P4)	<i>*Bidens bipinnata</i> , <i>*Cenchrus ciliaris</i> , <i>*Chloris barbata</i> , <i>*Chloris virgata</i> , <i>*Cynodon dactylon</i> , <i>*Datura leichhardtii</i> , <i>*Malvastrum americanum</i> , <i>*Setaria verticillata</i> , <i>*Sigesbeckia orientalis</i> , <i>*Vachellia farnesiana</i>
Southern Flank NVCP Extension Flora, Vegetation and Fauna Survey (ENV Australia 2010a)	Level 1 Good	1,800 ha	16 th -20 th November 2009, 2 nd December 2009	42 quadrats (50x50m) 37 quadrats within MAC Development Envelope	Highly experienced Pilbara botanists accompanied with experienced Pilbara biologists	Within the Additional Development Envelope	<i>Rhagodia</i> sp. Hamersley (M. Tridgen 17794) (P3)	<i>*Cenchrus ciliaris</i> , <i>*Malvastrum americanum</i>

Report	Survey Type / Seasonal Conditions	Survey Area	Survey Date	Survey Effort	Experience of Personnel	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Newman to Yandi Transmission Line Flora and Vegetation Assessment (ENV Australia 2009)	Level 2 Good	2,076 ha	5-15 May 2009	151 quadrats (50x50m) 8 quadrats within MAC Development Envelope	Experienced Pilbara botanists accompanied with experienced Pilbara biologists	Fringes the northeast corner of the Current Approved Development Envelope	<i>Goodenia</i> sp. East Pilbara (AA Mitchell PRP 727) (P1), <i>Euphorbia</i> sp. Bruce Rock (S. van Leeuwen 3861, <i>Acacia subtiliformis</i> (P3), <i>Goodenia nuda</i> (P3), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3)	* <i>Rumex vesicaria</i> , * <i>Aerva javanica</i> , * <i>Argemone ochroleuca</i> subsp. <i>ochroleuca</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Chloris virgata</i> , * <i>Citrullus colocynthis</i> , * <i>Cucumis melo</i> subsp. <i>agrestis</i> , * <i>Cynodon dactylon</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Solanum nigrum</i> , * <i>Vachellia farnesiana</i>
Flora and Vegetation Assessment Area C Mining Operations Environmental Management A, D, P1 and P3 Deposits (Woodman Environmental Consulting 2009a)	Level 2 Good	17,805 ha	12 th April - 16 th May, 9 th - 13 th June and 23 rd -27 th June 2008	62 quadrats (50x50m) 56 quadrats within MAC Development Envelope	Experienced Pilbara botanists and accompanied with experienced botanists	Extends east towards Weeli Wolli Creek from the northeast sector of the Current Approved Development Envelope	<i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3)	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i> , * <i>Sigesbeckia orientalis</i>
Field Survey for Priority and Rare Flora Area C Southern Flank (Pilbara Flora 2008a)	Targeted Good	4,351 ha	15 -20 May 2008	No quadrats, targeted searches	Experienced Pilbara botanists and biologist	Within the Additional Development Envelope	<i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4)	* <i>Bidens bipinnata</i>

Report	Survey Type / Seasonal Conditions	Survey Area	Survey Date	Survey Effort	Experience of Personnel	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Southern Flank Deposit Flora and Vegetation Assessment (ENV Australia 2008a)	Level 2 Poor	7,627 ha	16 th - 23 rd November 2007, 5 th - 11 December 2007	109 quadrats (50x50m) 108 quadrats within MAC Development Envelope	Highly experienced Pilbara botanists	Within the Additional Development Envelope	<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P3), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4)	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Setaria verticillata</i>
Area C - R Deposit Flora and Vegetation Assessment (ENV Australia 2007)	Level 2 Poor	1,428 ha	24 th - 30 th October 2006	72 quadrats (50x50m) 72 quadrats within MAC Development Envelope	Highly experienced Pilbara botanists	Southeast corner of the Current Approved Development Envelope	<i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4)	* <i>Bidens bipinnata</i> , * <i>Sigesbeckia orientalis</i>
Packsaddle Wastewater Treatment Plant (Ecologia Environment 2005a)	Level 1 Good	11 ha	13 th July 2005	No quadrats completed; transects surveyed	Experienced Pilbara botanist and biologist	Adjacent to Packsaddle Village within Current Approved Development Envelope	<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3)	* <i>Malvastrum americanum</i>
Area C Deposits D, E and F Biological Survey (Ecologia Environment 2004b)	Level 2 Good	6,485 ha	21 st -24 th May 2004	35 quadrats (100x100m) 35 quadrats within MAC Development Envelope	Highly experienced Pilbara botanists	MAC pits within Current Approved Development Envelope	None	* <i>Bidens bipinnata</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Sigesbeckia orientalis</i>

Report	Survey Type / Seasonal Conditions	Survey Area	Survey Date	Survey Effort	Experience of Personnel	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Packsaddle Range Biological Survey (Ecologia Environment 2004a)	Level 2 Good	5,093 ha	29 th - 4 th May 2004	52 quadrats (100x100m) 48 quadrats within MAC Development Envelope	Highly experienced Pilbara botanists	Packsaddle Range along the northern extent of the Current Approved Development Envelope	None	<i>*Bidens bipinnata</i> , <i>*Cenchrus ciliaris</i>
Mining Area C Rail Corridor Rare Flora Survey (Phase 2) (Biota 2003)	Targeted Good	7,768 ha	21 st -31 st March 2002	No quadrats, targeted searches	Experienced Pilbara botanist	North-eastern sector of the Current Approved Development Envelope	None	None
Mining Area C Rail Corridor Rare Flora Survey (Biota 2002)	Targeted Poor	7,768 ha	12 th -18 th November 2001	No quadrats, targeted searches	Experienced Pilbara botanist with field assistant	North-eastern sector of the Current Approved Development Envelope	None	None
Mining Area C Packsaddle Village and Access Road Rare and Priority Flora (Ecologia Environment 2002)	Targeted Good	11 ha	17 th March 2002	No quadrats, targeted searches	Experienced Pilbara botanist and biologist	North-west sector of the Current Approved Development Envelope, dissecting Packsaddle Range	None	<i>*Sigesbeckia orientalis</i>

Report	Survey Type / Seasonal Conditions	Survey Area	Survey Date	Survey Effort	Experience of Personnel	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Area C to Yandi Rail Line Baseline Weed Survey (Ecologia Environment 2001)	Targeted Poor	7,768 ha	16-17 October 2001	No quadrats, targeted searches	Field team not reported	North-eastern sector of the Current Approved Development Envelope	Not recorded	<i>*Rumex vesicaria</i> , <i>*Argemone ochroleuca</i>
Marillana Creek Western Access Corridor - Biological Assessment (HGM 1999)	Level 2 Good	37,715 ha	23-30 April 1999	22 quadrats (100x100m) 0 quadrats within MAC Development Envelope	Field team not reported	Southern extent of rail alignment within; north-west sector	None	<i>*Bidens bipinnata</i> , <i>*Malvastrum americanum</i>
Mining Area C Biological Survey (Ecologia Environment 1998a)	Level 2 Good	Area not recorded	16 April - 8 May 1997	132 quadrats (100x100m) 90 quadrats within MAC Development Envelope	Experienced botanists	Northern extent of the Current Approved Development Envelope	<i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4)	<i>*Argemone ochroleuca</i> , <i>*Bidens bipinnata</i> , <i>*Datura leichhardtii</i> , <i>*Lysimachia arvensis</i> , <i>*Malvastrum americanum</i> , <i>*Sonchus oleraceus</i>

Table 5 Summary of results from previous flora and vegetation surveys completed in close proximity to the Proposed MAC Development Envelope.

Report	Survey Type	Survey Area	Survey Date	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Baby Hope Downs Flora and Vegetation Survey (Biota Environmental 2014)	Level 2	1,652 ha	27 October - 1 November 2014	5 km south-east	<i>Eremophila</i> sp. Hamersley Range (K. Walker KW 136) (P1), <i>Hibiscus</i> sp. Gurinbidy Range (M.E. Trudgen MET 15708) (P2), <i>Eremophila magnifica</i> subsp. <i>velutina</i> (P3), <i>Goodenia lyrata</i> (P3), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4)	* <i>Rumex vesicaria</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Chloris virgata</i> , * <i>Datura leichhardtii</i> , * <i>Flaveria trinervia</i> , * <i>Malvastrum americanum</i> , * <i>Sigesbeckia orientalis</i> , * <i>Vachellia farnesiana</i>
Area C West to Yandi Level 2 Flora and Vegetation Survey (Onshore Environmental 2014b)	Level 2	23,520 ha	21 May - 3 June 2011 19 July - 1 August 2012 20-29 August 2013	Extending northeast from just outside the northwest corner of the Proposed MAC Development Envelope	<i>Acacia bromilowiana</i> (P4), <i>Acacia effusa</i> (P3), <i>Acacia subtiliformis</i> (P3), <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Gymnanthera cunninghamii</i> (P3), <i>Goodenia nuda</i> (P4), <i>Goodenia</i> sp. all surveys have complied (or exceeded?) requirements within these. ⁵ , <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P3), <i>Vittadinia</i> sp. Coondewanna Flats (s. Van Leeuwen 4684) (P1)	* <i>Rumex vesicaria</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Cenchrus setiger</i> , * <i>Citrullus colocynthis</i> , * <i>Flaveria trinervia</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Sigesbeckia orientalis</i> , * <i>Sonchus oleraceus</i> , * <i>Tribulus terrestris</i> , * <i>Vachellia farnesiana</i>

⁵ Revised name is *Synostemon hamersleyensis* (Priority 1)

Report	Survey Type	Survey Area	Survey Date	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Tandanya Study Area Review of Flora and Vegetation (Onshore Environmental 2013a)	Level 2	45,731 ha	2 nd -15 th August 2011, 7 th -11 th October 2011, 15 th -20 th May 2012, 7 th -19 th June 2012	Adjoins the western boundary of the study area, west of the Great Northern Highway	<i>Acacia bromilowiana</i> (P4), <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Aristida lazaridis</i> (P2), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Eremophila magnifica</i> subsp. <i>velutina</i> (P3), <i>Goodenia lyrata</i> (P3), <i>Goodenia nuda</i> (P4), <i>Indigofera</i> sp. <i>Gilesii</i> (M.E. Trudgen 15869) (P3) ⁶ , <i>Oxalis</i> sp. <i>Pilbara</i> (M.E. Trudgen 12725) (P2), <i>Rhagodia</i> sp. <i>Hamersley</i> (M. Trudgen 17794) (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3), <i>Sida</i> sp. <i>Barlee Range</i> (S. van Leeuwen 1642) (P3), <i>Swainsona thompsoniana</i> (P3), <i>Themeda</i> sp. <i>Hamersley Station</i> (M.E Trudgen 11431) (P3), <i>Triodia</i> sp. <i>Mt Ella</i> (M.E. Trudgen 12739) (P3)	* <i>Aerva javanica</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Chloris virgata</i> , * <i>Citrullus colocynthis</i> , * <i>Cucumis myriocarpus</i> , * <i>Cynodon dactylon</i> , * <i>Datura leichhardtii</i> , * <i>Flaveria trinervia</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Sigesbeckia orientalis</i> , * <i>Sonchus oleraceus</i> , * <i>Vachellia farnesiana</i>
Vegetation Mapping Review Coolibah-lignum Flats Priority Ecological Community (Onshore Environmental 2013b)	Vegetation mapping	2,986 ha	18 th -20 th June 2012	Adjacent to the south-west corner of the study area, west of the Great Northern Highway	<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Vittadinia</i> sp. <i>Coondewanna Flats</i> (S. van Leeuwen 4684) (P1), <i>Aristida lazaridis</i> (P2), <i>Rhagodia</i> sp. <i>Hamersley</i> (M. Trudgen 17794) (P3), <i>Themeda</i> sp. <i>Hamersley Station</i> (M.E. Trudgen 11431) (P3), <i>Swainsona thompsoniana</i> (P3), <i>Goodenia lyrata</i> (P3), <i>Goodenia nuda</i> (P4)	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Chloris virgata</i> , * <i>Malvastrum americanum</i>

⁶ Revised name is *Indigofera gilesii* (Priority 3)

Report	Survey Type	Survey Area	Survey Date	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Southern Flank to Jinidi Level 2 Flora and Vegetation Survey (Biota 2012)	Level 2 Excellent	8,588 ha	22 March - 2 April 2011; 22 - 31 August 2011	Western sector adjoins the southeast corner of the Additional Development Envelope; extends northeast to Jinidi tenements	<i>Acacia subtiliformis</i> (P3), <i>Goodenia lyrata</i> (P3), <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (P3), <i>Grevillea saxicola</i> (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Goodenia nuda</i> (P4), <i>Ptilotus mollis</i> (P4)	* <i>Rumex vesicaria</i> , * <i>Aerva javanica</i> , * <i>Cenchrus ciliaris</i> , * <i>Cenchrus setiger</i> , * <i>Chloris virgata</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Vachellia farnesiana</i>
Coondewanna Flats Flora and Vegetation Assessment (Astron Environmental 2011a)	Level 2	6,758 ha	5 th -11 th September 2010, 9 th -19 th May 2011	Adjacent to the southwest corner of the study area, west of the Great Northern Highway	<i>Aristida lazaridis</i> (P2), <i>Goodenia nuda</i> (P4), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) (P3)	* <i>Bidens bipinnata</i> , * <i>Chloris virgata</i> , * <i>Cucumis myriocarpus</i> , * <i>Malvastrum americanum</i> , * <i>Sonchus oleraceus</i>
Camp Hill Study Area Level 2 Flora and Vegetation Survey and Level 1 Fauna Survey (Onshore Environmental 2011b)	Level 2	15,092 ha	2-15 August 2010	Adjacent to the north-west sector of the study area, west of the Great Northern Highway	<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3), <i>Acacia bromilowiana</i> (P4), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4)	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Cucumis melo</i> subsp. <i>agrestis</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Vachellia farnesiana</i>
Jinidi Study Area- Review of Flora and Vegetation (Onshore Environmental 2011c)	Level 2	20,458 ha	September 2005- May 2011	Approx. 10 km east (east of Weeli Wolli Creek)	<i>Acacia subtiliformis</i> (P3), <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (P3), <i>Goodenia nuda</i> (P4), <i>Indigofera</i> sp. Gilesii (M.E. Trudgen 15869) (P3) ⁷ , <i>Isotropis parviflora</i> (P2), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3), <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3)	* <i>Cenchrus ciliaris</i> , * <i>Bidens bipinnata</i> , * <i>Vachellia farnesiana</i> , * <i>Cucumis melo</i> subsp. <i>agrestis</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Flaveria trinervia</i>

⁷ Revised name is *Indigofera gilesii* (Priority 3)

Report	Survey Type	Survey Area	Survey Date	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Yandi Study Area- Review of Flora and Vegetation (Onshore Environmental 2011d)	Level 2	13,200 ha	9 th -16 th December 2010	Approx. 20 km north	<i>Acacia subtiliformis</i> (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3), <i>Goodenia nuda</i> (P4), <i>Lepidium catapycnon</i> (V, P4)	* <i>Rumex vesicaria</i> , * <i>Aerva javanica</i> , * <i>Argemone ochroleuca</i> subsp. <i>ochroleuca</i> , * <i>Bidens bipinnata</i> , * <i>Brassica rapa</i> , * <i>Cenchrus ciliaris</i> , * <i>Centaurea melitensis</i> , * <i>Chloris virgata</i> , * <i>Citrullus lanatus</i> , * <i>Conyza bonariensis</i> , * <i>Cucumis melo</i> subsp. <i>agrestis</i> , * <i>Cynodon dactylon</i> , * <i>Lactuca serriola</i> forma <i>serriola</i> , * <i>Malvastrum americanum</i> , * <i>Polypogon monspeliensis</i> , * <i>Rostraria cristata</i> , * <i>Setaria verticillata</i> , * <i>Sigesbeckia orientalis</i> , * <i>Solanum nigrum</i> , * <i>Sonchus asper</i> , * <i>Sonchus oleraceus</i> , * <i>Vachellia farnesiana</i>
Area C to Yandi Flora and Vegetation Survey (Astron Environmental 2010a)	Level 2	2,181 ha	6-11 September 2010	10 km north-east	<i>Acacia bromilowiana</i> (P4)	None recorded
Packsaddle West Vegetation and Flora Survey and Fauna Assessment (Astron Environmental 2010b)	Level 2	19,380 ha	9-20 April 2010, 3-16 May 2010	Adjoins the western boundary of the study area, west of the Great Northern Highway	<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3)	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i> , * <i>Vachellia farnesiana</i>

Report	Survey Type	Survey Area	Survey Date	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Jinayri to Area C Access Corridor Flora and Vegetation Survey (ENV Australia 2010b)	Level 2 Good	4,705 ha	25 th -29 th May 2009	Extends east towards Weeli Wolli Creek from the northeast sector of the Current Approved Development Envelope	<i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (P3), <i>Acacia subtiliformis</i> (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3)	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i> , * <i>Sigesbeckia orientalis</i> , * <i>Vachellia farnesiana</i>
Area C West NVCP Flora, Vegetation and Fauna Assessment (ENV Australia 2010d)	Level 2	11,330 ha	16 th -26 th March 2010, 20 th - 30 th August 2007, 25 th -27 th February 2008, 13 th -23 rd July	Adjoins the western boundary of the study area, west of the Great Northern Highway	<i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Eremophila magnifica</i> subsp. <i>velutina</i> (P3), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P3), <i>Triodia</i> sp. Mt Ella (ME Trudgen 12739) (P3)	* <i>Aerva javanica</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Chloris virgata</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Sigesbeckia orientalis</i> , * <i>Sonchus oleraceus</i>
Jinayri Access Road Flora and Vegetation Survey (ENV 2010)	Level 2	2,786 ha	20-25 May 2009	Approx. 10 km east (east of Weeli Wolli Creek)	<i>Acacia subtiliformis</i> (P3), <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (P3), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Lepidium catapycnon</i> (V, P4)	* <i>Argemone ochroleuca</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Chloris virgata</i> , * <i>Citrullus colocynthis</i> , * <i>Cynodon dactylon</i> , <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Sigesbeckia orientalis</i>
Packsaddle East Survey Area Level 2 Flora and Vegetation Survey (Onshore Environmental 2010)	Level 2	2,500 ha	26 th November- 6 th December 2009, 9 th -18 th February 2010, 14 th -21 st June 2010	Outside the north-east corner; eastern extent of Packsaddle Range towards Weeli Wolli Creek	<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Stylidium weeliwolli</i> (P2), <i>Acacia subtiliformis</i> (P3), <i>Fimbristylis sieberiana</i> (P3), <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (P3), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3), <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P3), <i>Goodenia nuda</i> (P4), <i>Lepidium catapycnon</i> (V, P4)	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i> , * <i>Sigesbeckia orientalis</i> , * <i>Vachellia farnesiana</i>

Report	Survey Type	Survey Area	Survey Date	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Jinayri Infrastructure Corridors Flora and Vegetation Survey (Woodman Environmental Consulting 2010)	Level 2 Good	19,020 ha	19 th -28 th May, 15 th -24 th June, 21 st -25 th September 2009	Adjoins the northeast corner of the Current Approved Development Envelope	<i>Lepidium catapycnon</i> (V, P4), <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (P3), <i>Stylidium weeliwolli</i> (P2), <i>Acacia subtiliformis</i> (P3), <i>Fimbristylis sieberiana</i> (P3), <i>Goodenia nuda</i> (P4), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3)	* <i>Aerva javanica</i> , * <i>Argemone ochroleuca</i> subsp. <i>ochroleuca</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Cenchrus setiger</i> , * <i>Cynodon dactylon</i> , * <i>Flaveria trinervia</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i>
Ministers North Exploration Leases Flora and Vegetation Assessment (ENV 2009)	Level 2	1,510 ha	13-19 September 2007	Outside the north-east corner; north of Packsaddle Range towards Yandi	<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P3)	* <i>Cenchrus setiger</i> , * <i>Chloris virgata</i> , <i>Sonchus oleraceus</i>
Flora and Vegetation of the Hope Downs 1 Area (Mattiske 2009)	Level 2	2,250 ha	June 2009	Outside the study area, adjacent to the eastern edge of the study area	<i>Acacia subtiliformis</i> (P3), <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (P3) <i>Acacia bromilowiana</i> (P4), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4)	* <i>Argemone mexicana</i> , * <i>Argemone ochroleuca</i> , * <i>Bidens bipinnata</i> , * <i>Malvastrum americanum</i> , * <i>Sonchus oleraceus</i> , * <i>Sigesbeckia orientalis</i>
Priority and Rare Flora Survey Mudlark Well Area (Pilbara Flora 2009)	Targeted	500 ha	12 th -19 th October 2008	Extending towards West Angelas from outside the south-west corner	<i>Rhagodia</i> sp Hamersley (M. Trudgen 17794) (P3), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Eremophila magnifica</i> subsp. <i>velutina</i> (P3)	* <i>Bidens bipinnata</i> , * <i>Datura leichhardtii</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i>
Flora and Vegetation Survey Coondewanna Flats Coolibah Lignum Priority Ecological Community (Pilbara Flora 2008b)	Level 2	3,060 ha	21 st -22 nd May 2008	Outside the south-west corner (west of Great Northern Highway)	<i>Swainsona thompsoniana</i> (P3)	* <i>Chloris virgata</i>

Report	Survey Type	Survey Area	Survey Date	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Fork South and Parallel Ridge Exploration Lease Flora and Vegetation Assessment (ENV 2008)	Level 2	3,689 ha	20-30 August 2007	Approx. 5 km west of the south-west corner	<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P3), <i>Triodia</i> sp. Mt. Ella (ME Trudgen 12739) (P3), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4)	* <i>Aerva javanica</i> , * <i>Bidens bipinnata</i> , * <i>Chloris virgata</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Sigesbeckia orientalis</i>
Boundary Ridge Exploration Lease Flora and Vegetation Assessment (ENV 2008b)	Level 2	1,700 ha	13 - 23 July 2007	Approx. 5 km south-west of the south-west corner	<i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Eremophila magnifica</i> subsp. <i>velutina</i> (P3)	* <i>Bidens bipinnata</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Sonchus oleraceus</i>
Alligator Jaws Exploration Lease Flora and Vegetation Assessment (ENV 2008c)	Level 2	2,036 ha	15 - 21 July 2007	Approx. 5 km west of the south-west corner	<i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4)	* <i>Bidens bipinnata</i> , * <i>Datura leichhardtii</i> , * <i>Malvastrum americanum</i> , * <i>Sigesbeckia orientalis</i> , * <i>Setaria verticillata</i>
Ministers North Biological Survey (Ecologia Environment 2006)	Level 1	3,029 ha	10 th -14 th May 2006	Outside the north-east corner; north of Packsaddle Range towards Yandi	None	* <i>Rumex vesicaria</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i>
Mudlark Well Exploration Project Biological Survey (Ecologia Environment 2005b)	Level 1	2,083 ha	18 - 23 August 2005	Approx. 10 km southwest	None	* <i>Salsola australis</i>

Report	Survey Type	Survey Area	Survey Date	Location of Survey	Conservation Significant Flora Recorded	Introduced (Weed) Taxa Recorded
Weeli Wollli Creek Biological Assessment Survey (Ecologia 1998)	Level 2	1,351 ha	8-15 December 1994 3 April - 13 April 1995	Extending towards West Angelas from outside the south-west corner	<i>Stylidium weeliwollli</i> (P2)	* <i>Aerva javanica</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Datura leichhardtii</i> , * <i>Malvastrum americanum</i> , * <i>Oxalis corniculata</i> , * <i>Phoenix dactylifera</i> , * <i>Sonchus oleraceus</i>

3.3.2 Threatened Flora listed under the EPBC Act and the WA Wildlife Conservation (Rare Flora) Notice

A search of the EPBC Act Protected Matters Database (DoE 2016) identified two Threatened flora occurring within a 50 km radius of the Proposed MAC Development Envelope; *Lepidium catapycnon* and *Thryptomene wittweri*. Both taxa are currently listed as Vulnerable (Appendix 1); however, it is noted that the State Conservation Code for *Lepidium catapycnon* has recently been downgraded from Threatened Flora to Priority 4 flora (Appendix 2). There were no records for either species within the Proposed Mining Area C Development Envelope.

The DPaW database search (DPaW 2016a) identified one Threatened flora taxon occurring within a 25 km radius of the Proposed MAC Development Envelope; *Thryptomene wittweri* (Table 6).

Thryptomene wittweri (Mountain Thryptomene) is only known from high-altitude mountaintops in the Pilbara, with its distribution extending south into the Gascoyne and Great Victoria Desert Bioregions. It is found on steep rocky scree slopes and breakaways near the summits of large ranges. This species has been recorded at Mt Meharry approximately 20 km west of the Proposed MAC Development Envelope on the eastern boundary of Karijini National Park. There are no records from within the Proposed Mining Area C Development Envelope, and suitable habitat for this species is not considered to occur.

Lepidium catapycnon is known from at least 32 populations covering approximately 21,736 km² in an area stretching roughly between the towns of Newman, Nullagine and Tom Price in the Pilbara Region of Western Australia. There are eight populations of *Lepidium catapycnon* confirmed to occur across the entire extent of Karijini National Park (Onshore Environmental 2013d). *Lepidium catapycnon* exhibits a strong habitat preference for steep upper breakaway slopes of mesa hills where it grows in skeletal light brown loam or sandy loam soils with a large proportion of loose rocks at the surface (50-100 percent) comprising a mixture of banded iron formation (BIF), banded chert and siltstone. The vegetation type most commonly associated with populations of *Lepidium catapycnon* is *Triodia* Hummock Grassland (or Open Hummock Grasslands) of *Triodia wiseana* and/or *Triodia brizoides*, with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* and Low Open Shrubland (to Low Scattered Shrubs) of *Acacia bivenosa* and *Senna glutinosa* subsp. *glutinosa* (Onshore Environmental 2013d).

3.3.3 Threatened Flora listed under the IUCN Red List database

There were no Threatened flora records identified from the IUCN database search (IUCN 2016).

3.3.4 Priority Flora recognised by the DPaW

The DPaW database search (DPaW 2016a) identified 50 Priority flora taxa as potentially occurring within a 25 km search radius of the Proposed MAC Development Envelope (Table 6). Priority flora identified during the database search that have been recorded within the Proposed MAC Development Envelope are identified in Table 6, as well as the presence of habitat and likelihood of occurrence for each of the 50 Priority flora taxa.

Table 6 Significant flora previously recorded from a 25 km search radius around the Proposed MAC Development Envelope (DPaW 2016a).

SCC - State Conservation Code - WC Act and DPaW (2016a); FCC - Federal Conservation Code (EPBC Act)

Species	Habitat	Previously Recorded	Habitat Present	SCC, FCC	Likelihood
<i>Acacia bromilowiana</i>	Red skeletal stony loam, orange-brown pebbly, gravel loam, laterite, banded ironstone, basalt. Rocky hills, breakaways, scree slopes, gorges, creek beds.	Y	Y	4	Recorded
<i>Acacia daweana</i>	Stony red loamy soils. Low rocky rises, along drainage lines.	N	Y	3	Low
<i>Acacia effusa</i>	Scree slopes of low ranges.	N	Y	3	Moderate
<i>Acacia subtiliformis</i>	Rocky calcrete plateau.	N	Y	3	Moderate
<i>Adiantum capillus-veneris</i>	Moist, sheltered sites in gorges and on cliff walls.	N	Y	2	Moderate
<i>Amaranthus centralis</i>	Alluvial plains and valleys, sandplains, rocky or gravelly hills and rises, and ephemeral watercourses and run-on areas.	N	Y	3	Low
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i>	Hardpan plains.	Y	Y	3	Recorded
<i>Barbula ehrenbergii</i>	Iron rich weathered conglomerate on gorge walls.	N	Y	1	Low
<i>Bothriochloa decipiens</i> var. <i>cloncurrans</i>	Woodlands on a range of soil types.	N	Y	1	Moderate
<i>Calotis latiuscula</i>	Rocky hillsides, floodplains, rocky creeks or river beds.	N	Y	3	Moderate
<i>Calotis squamigera</i>	Pebbly loam.	N	Y	1	Moderate
<i>Dampiera anonyma</i>	Skeletal red-brown to brown gravelly soil over banded ironstone, basalt, shale and jaspilite. Hill summits, upper slopes (above 1000m).	N	N	3	Low
<i>Dampiera metallorum</i>	Skeletal red-brown gravelly soil over banded ironstone. Steep slopes, summits of hills.	N	N	3	Low
<i>Eragrostis</i> sp. Mt Robinson (S. van Leeuwen 4109)	Red-brown skeletal soils, ironstone. Steep slopes, summits.	N	N	1	Low
<i>Eremophila forrestii</i> subsp. <i>Pingandy</i> (M.E. Trudgen 2662)	Flat plain with thin soil underlain by partly consolidated colluvium.	N	Y	2	Moderate
<i>Eremophila forrestii</i> subsp. <i>viridis</i>	Moderately to steeply sloping lower tip of hill spur. Soil: Red-brown very gravelly loam with gravel, pebble surface.	N	Y	3	Moderate
<i>Eremophila magnifica</i> subsp. <i>magnifica</i>	Skeletal soils over ironstone.	Y	Y	4	Recorded
<i>Eremophila magnifica</i> subsp. <i>velutina</i>	Skeletal soils over ironstone. Summits. Rocky breakaways.	N	Y	3	High
<i>Eremophila</i> sp. Hamersley Range (K. Walker KW 136)	Rocky gullies and gorges. Steep rocky hill slopes and summits, high in the landscape.	N	Y	1	Moderate

Species	Habitat	Previously Recorded	Habitat Present	SCC, FCC	Likelihood
<i>Eremophila</i> sp. West Angelas (S. van Leeuwen 4086)	High in landscape, summit of hill, gently undulating to steep terrain, skeletal red gritty soil over massive banded iron of the Brockman Iron Formation.	N	Y	1	Moderate
<i>Eremophila</i> sp. Snowy Mountain (S. van Leeuwen 3737)	Gently undulating to steep terrain, skeletal soil over banded iron of the Brockman Iron Formation.	N	N	1	Low
<i>Eucalyptus lucens</i>	Ironstone. Rocky slopes and mountain tops, high in the landscape.	N	N	1	Low
<i>Fimbristylis sieberiana</i>	Mud, skeletal soil pockets. Pool edges, sandstone cliffs.	N	N	3	Low
<i>Geijera salicifolia</i>	Skeletal soils, stony soils. Massive rock scree, gorges.	N	Y	3	Low
<i>Pleurocarpaea gracilis</i>	Skeletal, brown gritty soil over ironstone. Hill summit.	N	N	3	Low
<i>Goodenia lyrata</i>	Red sandy loam. Near claypan.	N	N	3	Moderate
<i>Goodenia</i> sp. East Pilbara (AA Mitchell PRP 727)	Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains.	N	Y	3	Moderate
<i>Grevillea saxicola</i>	Orange / brown loam soils on steep steep breakaway and scree slopes (often with southerly aspect)	Y	Y	3	Recorded
<i>Hibiscus</i> sp. Gurinbidy Range (M.E. Trudgen MET 15708)	Gullies and steep, rocky hill slopes.	N	Y	2	Moderate
<i>Indigofera gilesii</i>	Pebbly loam amongst boulders & outcrops. Hills.	N	Y	3	Moderate
<i>Iotasperma sessilifolium</i>	Cracking clay, black loam. Edges of waterholes, plains.	N	N	3	Low
<i>Lepidium catapycnon</i>	Skeletal soils. Hillsides.	N	Y	4	Recorded
<i>Myriocephalus nudus</i>	Moist areas, along rivers & creeks, granite outcrops.	N	Y	1	Low
<i>Nicotiana umbratica</i>	Shallow soils. Rocky outcrops.	Y	Y	3	Recorded
<i>Oldenlandia</i> sp. Hamersley Station (A.A. Mitchell PRP 1479)	Cracking clay, basalt. Gently undulating plain with large surface rocks, flat crabholed plain.	N	N	3	Low
<i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725)	Shaded gully on the lower slopes of a large hill, in the flowline in the gully. Soil: pebbly/gravelly red-brown loam amongst boulders.	N	Y	2	Moderate
<i>Pilbara trudgenii</i>	Skeletal, red stony soil over ironstone. Hill summits, steep slopes, screes, cliff faces.	N	N	3	Low
<i>Ptilotus mollis</i>	Stony hills, scree slopes.	N	Y	4	Moderate
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	Floodplains, hardpan plains.	Y	Y	3	Recorded

Species	Habitat	Previously Recorded	Habitat Present	SCC, FCC	Likelihood
<i>Rhynchosia bungarensis</i>	Pebbly, shingly coarse sand amongst boulders. Banks of flow line in the mouth of a gully in a valley wall.	N	Y	4	Low
<i>Rostellularia adscendens</i> var. <i>latifolia</i>	Ironstone soils. Near creeks, rocky hills.	Y	Y	3	Recorded
<i>Scaevola</i> sp. Hamersley Range basalts (S. van Leeuwen 3675)	Skeletal, brown gritty soil over basalt. Summits of hills, steep hills.	N	N	2	Low
<i>Sida</i> sp. Barlee Range (S van Leeuwen 1642)	Skeletal red soils pockets. Steep slope.	N	Y	3	Recorded
<i>Sida</i> sp. Hamersley Range (K. Newbey 10692)	-	N	Y	1	Moderate
<i>Stylidium weeliwollii</i>	Gritty sand soil, sandy clay. Edge of watercourses.	N	N	2	Low
<i>Tetralochea fordiana</i>	Shale pocket amongst ironstone.	N	N	1	Low
<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	Red clay. Clay pan, grass plain.	N	Y	3	Moderate
<i>Thryptomene wittweri</i>	Skeletal red stony soils. Breakaways, stony creek beds.	N	Y	T, V	Low
<i>Triodia</i> sp. Karijini (S. van Leeuwen 4684)	Summit and steep hill slopes, high in the landscape.	N	N	1	Moderate
<i>Triodia</i> sp. Mt. Ella (ME Trudgen 12739)	Light orange-brown, pebbly loam. Amongst rocks & outcrops, gully slopes.	Y	Y	3	Recorded
<i>Vittadinia</i> sp. Coondewanna Flats (S van Leeuwen 4684)	Floodplains, hardpan plains.	N	Y	1	Moderate

3.3.5 TECs listed under State and Federal Legislation

A search of the EPBC Act Protected Matters database (DoE 2016) confirmed there were no Federal listed TECs previously recorded within, or adjacent to, the Proposed MAC Development Envelope. Similarly, a search of the DPaWs communities database (DPaW 2016b) confirmed there were no State listed TEC records within the Proposed MAC Development Envelope.

3.3.6 PECs recognised by DPaW

A search of DPaWs communities database (DPaW 2016b) indicated that the buffer for sub-type 2 of the Coolibah-lignum Flats PEC overlaps the south-western corner of the Proposed MAC Development Envelope, with four additional PECs occurring within a 50 km radius (Figure 7).

Onshore Environmental (2013b) recently completed a review of vegetation mapping within Coodewanna Flats and Lake Robinson and confirmed fine-scale mapping for two sub-types of the Coolibah-lignum Flats PEC (Figure 8). The Priority 1 sub-type 2 lies at the lowest point of the Coodewanna Flats associated with Lake Robinson, and at its closest point is approximately 250 m west of the Proposed Mining Area C Development Envelope. The Priority 3(i) sub-type 1 occurs on alluvial flats (Coodewanna Flats) around Lake Robinson and extending to the south. The Great Northern Highway divides the PEC to the west from the Proposed Mining Area C Development Envelope.

Other PECs represented in the vicinity of the Proposed MAC Development Envelope include the Weeli Wolli Spring community (10 km to the east and south-east), the Fortescue Marsh (Marsh Land System, 30 km to the north-east), the West Angelas Cracking Clays community (15 km to the south), and the Brockman Iron Cracking Clay communities of the Hamersley Range (25 km to the south-west) (Figure 7). These communities are summarised in Table 7.

Table 7 PECs occurring within a 50 km radius of the Proposed MAC Development Envelope.

Community Name	Priority
<p>Coolibah-lignum flats: <i>Eucalyptus victrix</i> over <i>Muehlenbeckia</i> (<i>Duma</i>) community Woodland or forest of <i>Eucalyptus victrix</i> (Coolibah) over thicket of <i>Duma florulenta</i> (lignum) on red clays in run-on zones. Associated species include <i>Eriachne benthamii</i>, <i>Themeda triandra</i>, <i>Aristida latifolia</i>, <i>Eulalia aurea</i> and <i>Acacia aptaneura</i>. A series of sub-types have been identified:</p> <ul style="list-style-type: none"> • Coolibah woodlands over lignum (<i>Duma florulenta</i>) over swamp wandiree (Lake Robinson is the only known occurrence); • Coolibah and mulga (<i>Acacia aptaneura</i>) woodland over lignum and tussock grasses on clay plains (Coodewanna Flats and Wanna Munna Flats); and • Coolibah woodland over lignum and silky browntop (<i>Eulalia aurea</i>) (two occurrences known on Mt Bruce Flats). <p>Threats: dewatering and grazing, clearing associated with infrastructure corridors.</p>	<p>Priority 1</p> <p>Priority 3</p> <p>Priority 1</p>

Community Name	Priority
<p>Weeli Wollie Spring Community Fringing forest or tall woodland of Silver Cadjeput (<i>Melaleuca argentea</i>) and River Red Gum (<i>Eucalyptus camaldulensis</i>) over trees of Coolibah (<i>Eucalyptus victrix</i>) and a dense shrub layer dominated by wattles, in particular Pilbara Jam (<i>Acacia citrinoviridis</i>). Threats: dewatering and re-watering altering patterns of inundation, weed invasion.</p>	Priority 1
<p>Fortescue Marsh (Marsh Land System) Fortescue Marsh is an extensive, episodically inundated samphire marsh at the upper terminus of the Fortescue River and the western end of Goodiadarrie Hills. It is regarded as the largest ephemeral wetland in the Pilbara. It is a highly diverse ecosystem with fringing mulga woodlands (on the northern side), samphire shrublands and groundwater dependent riparian ecosystems. Endemic <i>Eremophila</i> species, populations of priority flora and several near endemic and new to science samphires. Threats: mining, altered hydrology (watering with fresh water), grazing and weed invasion.</p>	Priority 1
<p>West Angelas Cracking-Clays Open tussock grasslands of <i>Astrebla pectinata</i>, <i>Astrebla elymoides</i>, <i>Aristida latifolia</i>, in combination with <i>Astrebla squarrosa</i> and low scattered shrubs of <i>Sida fibulifera</i>, on cracking-clay loam depressions and flowlines. Threats: Disturbance footprints increasing from mine, future infrastructure development, possible weed invasion and changes in fire regime.</p>	Priority 1
<p>Brockman Iron cracking clay communities of the Hamersley Range Rare tussock grassland dominated by <i>Astrebla lappacea</i> in the Hamersley Range, on the Newman land system. Tussock grassland on cracking clays-derived in valley floors, depositional floors. This is a rare community and the landform is rare. Known from near West Angelas, Newman, Tom Price and boundary of Hamersley and Brockman Stations. Threats: Heavily grazed, mining and infrastructure developments.</p>	Priority 1

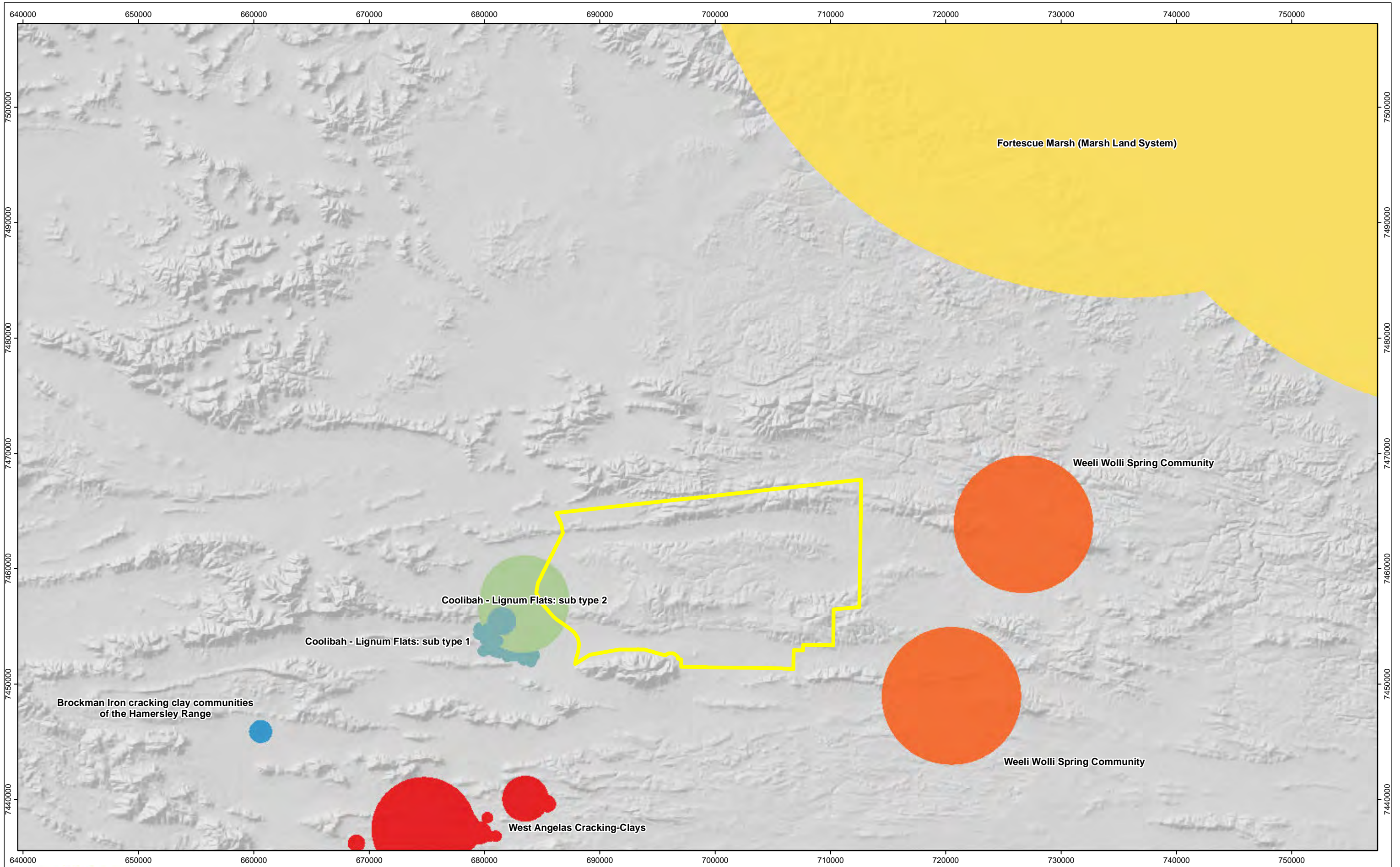
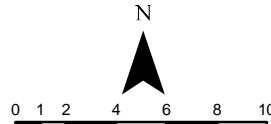



Figure:	7	Date:	24/06/2016
Sheet Size:	A3	Status:	DRAFT
Drawn by:	GSM	Requested by:	DB
		GSM Reference:	Fig 6_PEC

N



Kilometers
1:300,000








Datum: GDA94
Projection: MGA Zone 50

**BHPBIO
MINING AREA C**

Location of the PECs in relation to the Proposed
MAC Development Envelope

Figure 7

Legend

 Proposed Mining Area C Development Envelope	 Coolibah - Lignum Flats: sub type 2
PEC Locations	 Fortescue Marsh (Marsh Land System)
 Brockman Iron cracking clay communities of the Hamersley Range	 Weeli Wolli Spring Community
 Coolibah - Lignum Flats: sub type 1	 West Angelas Cracking-Clays



PO Box 7215
EATON WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213



ONSHORE ENVIRONMENTAL

ONSHORE ENVIRONMENTAL CONSULTANTS	Date:	25/08/2016
Sheet Size:	A3	Status: DRAFT
Drawn by: GSM	Requested by: DB	GSM Reference: Coodewana Flats Perim Mapping

N

0 250 500 1,000 1,500

Meters
1:40,000

Datum: GDA94
Projection: MGA Zone 50

COONDEWANNA FLATS PEC

Perimeter mapping of the Coolibah-lignum flats PEC
– Sub-type 1 and Sub-type 3(i),
at Coodewana Flats.

Figure 8

Legend

- +— Rio Tinto Rail Line
- Major Roads
- ▭ Proposed Mining Area C Development Envelope
- ▭ PEC extent

Subtypes

- ▭ Subtype 1
- ▭ Subtype 3(i)

GRIFFIN
SPATIAL & MAPPING

PO Box 7215
EATON WA 62332
admin@griffinspatial.com.au
+61 8 9725 3213

3.4 Flora Species

A total number of 479 plant taxa (including varieties and subspecies) from 53 families and 166 genera were recorded from the Proposed Mining Area C Development Envelope. Species representation was greatest among the Fabaceae, Poaceae, Malvaceae, Asteraceae, Amaranthaceae, Myrtaceae, Chenopodiaceae, Goodeniaceae, Scrophulariaceae and Solanaceae families, which is typical for the Pilbara Bioregion. The most speciose genus was *Acacia* (51 taxa), followed by *Senna* (19 taxa), *Sida* (17 taxa), *Eremophila* (15 taxa), *Ptilotus* (14 taxa) and *Triodia* (11 taxa).

3.5 Conservation Significant Flora Species

3.5.1 Threatened Flora listed under the WC Act and EPBC Act

No plant taxon gazetted as Threatened Flora (T) pursuant to subsection (2) of Section 23F of the WC Act or listed under the EPBC Act has been recorded within the Proposed MAC Development Envelope. It is highly unlikely that Threatened Flora occur within the Proposed MAC Development Envelope given the high sampling intensity and absence of suitable landforms to support these taxa.

3.5.2 Priority Flora

Ten taxa currently listed as Priority flora taxa have been recorded within the Proposed MAC Development Envelope to date, with eight situated within the Indicative Additional Impact Assessment Area and seven within the Additional Development Envelope (Table 8). These taxa are described further in Table 9 and locations are shown in Figure 9.


The representation of significant flora within the Proposed MAC Development Envelope is discussed in terms of populations. In biological terms, a population is a discrete group of interbreeding individuals of a species. However, it is often difficult to say which groups of individuals were once interconnected as a population and which were not. For the purposes of this report, populations are defined as management units of closely associated plants. The following guidelines taken from Stack (2010) have been applied to determine populations of significant flora represented within the Proposed MAC Development Envelope:


- plants more than 500 m from a known population are considered to be a new population;
- plants within 500 m of a known population are considered to be part of that population; and
- within a recognised population, plants that occur on different land tenure parcels, or those that have considerable, recognisable separation between them (e.g. plants occur on either side of a river, or on close but distinct peaks or outcroppings) are considered to be separate subpopulations.


Table 8 Presence of significant flora within the Proposed MAC Development Envelope, Indicative Additional Impact Assessment Area, and Additional Development Envelope.


Significant Taxon	Proposed MAC Development Envelope	Indicative Additional Impact Assessment Area	Additional Development Envelope
<i>Acacia bromilowiana</i> (P4)	X	X	
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3)	X	X	X
<i>Aristida lazaridis</i> (P2)	X	X	
<i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4)	X	X	X
<i>Grevillea saxicola</i> (P3)	X		X
<i>Nicotiana umbratica</i> (P3)	X		
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3)	X	X	X
<i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3)	X	X	X
<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P3)	X	X	X
<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3)	X	X	X


Table 9 Priority flora recorded from the Indicative Additional Impact Assessment Area.


Taxon	Photograph	Description and Regional Distribution	Occurrence within the Indicative Additional Impact Assessment Area
<p><i>Acacia bromilowiana</i> (Priority 4)</p>		<p>A tree or shrub with characteristic dark grey fibrous bark and reaching 12 m in height. The phyllodes are distinctively glaucous and slightly pruinose and flowering occurs from July to August. <i>Acacia bromilowiana</i> has previously been recorded on a variety of landforms in the Pilbara including rocky hills, breakaways, scree slopes, gorges and creek beds, occurring in red skeletal stony loam, orange-brown pebbly gravel loam, laterite, banded ironstone and basalt.</p> <p><i>Acacia bromilowiana</i> has previously been recorded over a 300 km range between Newman and 100 km northwest of Tom Price, with outlying records from west of Rudall River National Park (Appendix 3). The DPaW rare flora database search (DPaW 2016a) showed 28 confirmed records within Western Australia, including two records within Karijini National Park (Appendix 3).</p> <p>Locally it has been recorded from seven point locations on the northern slopes of Mount Robinson (>100 plants and up to 10 percent cover) (Onshore Environmental 2012a). It also occurs at surrounding BHP Billiton Iron Ore tenements and project areas including Tandanya (167 plants, Onshore Environmental 2013a), Mudlark (30 plants, Onshore Environmental 2013c) and Area C West to Yandi (30 plants, Onshore Environmental 2014b) tenements.</p>	<p><i>Acacia bromilowiana</i> was recorded at one population within the Proposed MAC Development Envelope, occurring just outside (north) of the Additional Development Envelope, but within the Indicative Additional Impact Assessment Area (OSA 41) (Appendix 4).</p> <p>It was recorded from the upper reaches of a gorge. Plants were between 4 m and 5 m in height and provided one percent foliage cover.</p> <p>Vegetation was described as 'Low Open Forest of <i>Callitris columellaris</i>, <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>, and <i>Corymbia ferriticola</i> over Open Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia wiseana</i> over Very Open Tussock Grassland of <i>Themeda triandra</i> (with Very Open Mallee of <i>Eucalyptus kingsmillii</i> subsp. <i>kingsmillii</i> and <i>Eucalyptus ewartiana</i>) on skeletal orange brown loam'.</p>


Taxon	Photograph	Description and Regional Distribution	Occurrence within the Indicative Additional Impact Assessment Area
<p><i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (Priority 3)</p>		<p><i>Aristida jerichoensis</i> var. <i>subspinulifera</i> is a compact tufted perennial grass ranging in height from 0.3 to 0.8 m, occurring on hardpan plains in the Pilbara. It is distinguishable by its muricate lemma groove.</p> <p><i>Aristida jerichoensis</i> var. <i>subspinulifera</i> has previously been recorded over a 350 km range extending from southeast of Newman to northwest of Tom Price (Appendix 3). The DPaW rare flora database search (DPaW 2016a) showed 29 confirmed records within Western Australia (Appendix 3).</p> <p>Locally, <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> has been recorded approximately 20 km east of the Proposed MAC Development Envelope, from the Coondewanna Flats PEC providing up to 10 percent cover (Onshore Environmental 2013), and from other BHP Billiton Iron Ore project areas including Area C West to Yandi (scattered plants providing <1 percent cover, Onshore Environmental 2014b), the Mudlark tenements (up to 100 percent cover, Onshore Environmental 2013) and the Tandanya tenements (up to 100 percent cover, Onshore Environmental 2013).</p>	<p>There were five populations represented within the Proposed MAC Development Envelope, with two of these populations occurring within the Indicative Additional Impact Assessment Area (Appendix 4).</p> <p><i>Aristida jerichoensis</i> var. <i>subspinulifera</i> occurred as scattered individuals or more commonly in groups of up to 300 plants, and was consistently recorded across the landform.</p>


Taxon	Photograph	Description and Regional Distribution	Occurrence within the Indicative Additional Impact Assessment Area
<p><i>Aristida lazaridis</i> (Priority 2)</p>		<p>A tufted perennial grass ranging from 0.4 m to 1.5 m in height. This species prefers sand or loam soils and occurs in the Pilbara and Kimberly Regions of Western Australia and in the Northern Territory, and Queensland.</p> <p><i>Aristida lazaridis</i> has previously been recorded over a 150 km range extending from northwest of Newman to the northeast corner of Karijini National Park (Appendix 3). The DPaW rare flora database search (DPaW 2016a) showed 18 confirmed records within Western Australia, including one record from within Karijini National Park (Appendix 3).</p> <p>Locally it has been found at Lake Robinson on the eastern fringe of the Coondewanna Flats (up to 20 percent cover, Onshore Environmental 2013b), and BHP Billiton Iron Ore's Mudlark (up to 15 percent cover, Onshore Environmental 2013c), Tandanya (up to 20 percent cover, Onshore Environmental 2013a) and Myopic (2 percent cover, Onshore Environmental 2009) tenements.</p>	<p>There were three populations represented within the Proposed MAC Development Envelope (Appendix 4). Population 3 occurred within the Indicative Additional Impact Assessment Area, population 2 was partially within, and population 1 was outside the Indicative Additional Impact Assessment Area (Appendix 4).</p> <p><i>Aristida lazaridis</i> has been recorded as a dominant ground cover in deep loam soils along a medium drainage line (unincised) situated north and west of the Packsaddle Village. A total of 2,405 plants from 94 point locations were recorded across the population (Onshore Environmental 2011a).</p> <p><i>Aristida lazaridis</i> has not been recorded from the Additional Development Envelope. However there are 60 records (2,190 plants) within the Indicative Additional Impact Assessment Area associated with OSA14 to the north-west of the current MAC operations.</p>


Taxon	Photograph	Description and Regional Distribution	Occurrence within the Indicative Additional Impact Assessment Area
<p><i>Eremophila magnifica</i> subsp. <i>magnifica</i> (Priority 4)</p>		<p>This shrub grows to a height of 1.5 m, producing blue or magenta flowers between August and November. It typically occurs on skeletal soils over ironstone and on rocky screes.</p> <p><i>Eremophila magnifica</i> subsp. <i>magnifica</i> has previously been recorded over a 320 km range extending from midway between Pannawonica and Tom Price southeast to Newman (Appendix 3). The DPaW rare flora database search (DPaW 2016a) showed 39 confirmed records within Western Australia, including seven records from within Karijini National Park (Appendix 3).</p> <p>Locally it is widespread across ranges in BHP Billiton Iron Ore's Mudlark (Onshore Environmental 2013a), Tandanya (Onshore Environmental 2013c) and Jinidi (Onshore Environmental 2011c) tenements, situated to the west, south-west and east of the Proposed MAC Development Envelope. Plant density ranges from scattered individuals to populations of greater than 1,000 plants. It typically occurs on steep to moderately sloping rocky hill slopes, hill crests, gullies and rocky drainages. <i>Eremophila magnifica</i> subsp. <i>magnifica</i> is widely collected from similar habitat at BHP Billiton Iron Ore's Eastern Ridge (Onshore Environmental 2012c) and Whaleback (Onshore Environmental 2014c) operations near Newman.</p>	<p>There were nine populations of <i>Eremophila magnifica</i> subsp. <i>magnifica</i> represented within the Proposed MAC Development Envelope (Appendix 4). Four of these populations occurred within the Indicative Additional Impact Assessment Area (Appendix 4).</p> <p>The vegetation association at these locations was typically described generally as 'Low Woodland of <i>Corymbia ferriticola</i>, <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Open Tussock Grassland of <i>Themeda triandra</i>, <i>Cymbopogon ambiguus</i> and <i>Eriachne mucronata</i> and Open Hummock Grassland of <i>Triodia pungens</i>'.</p>


Taxon	Photograph	Description and Regional Distribution	Occurrence within the Indicative Additional Impact Assessment Area
<p><i>Grevillea saxicola</i> (Priority 3)</p>		<p><i>Grevillea saxicola</i> is a single stemmed tree or tall shrub up to 7 m in height with cream flowers. It occurs on orange/ brown loam soils on steep breakaway and scree slopes (often with southerly aspect).</p> <p>The first record was from the eastern end of Packsaddle Range (Onshore Environmental 2011a) and it was later recorded from the southern sector of BHP Billiton Iron Ore's Jinidi project area (Onshore Environmental 2011e). It is now known from 97 locations extending across the Hamersley Range.</p>	<p><i>Grevillea saxicola</i> was recorded from one population in the southeast sector of the Proposed MAC Development Envelope and within the Additional Development Envelope, but outside of the Indicative Additional Impact Assessment Area (Appendix 4).</p> <p>It was associated with light brown loam soils on steep cliffs and breakaway scree slopes. Vegetation was described as 'Low Open Forest of <i>Acacia catenulata</i> subsp. <i>occidentalis</i>, <i>Acacia aptaneura</i> and <i>Grevillea saxicola</i> over Open Shrubland of <i>Scaevola acacioides</i> and <i>Acacia tetragonophylla</i> over Very Open Tussock Grassland of <i>Eriachne mucronata</i>.</p> <p><i>Grevillea saxicola</i> occurred as a tall shrub to 7 m in height (more commonly 3-4 m tall) and provided 5 percent ground cover. There were 55 plants recorded at the spot location, but the population number would be significantly higher.</p>

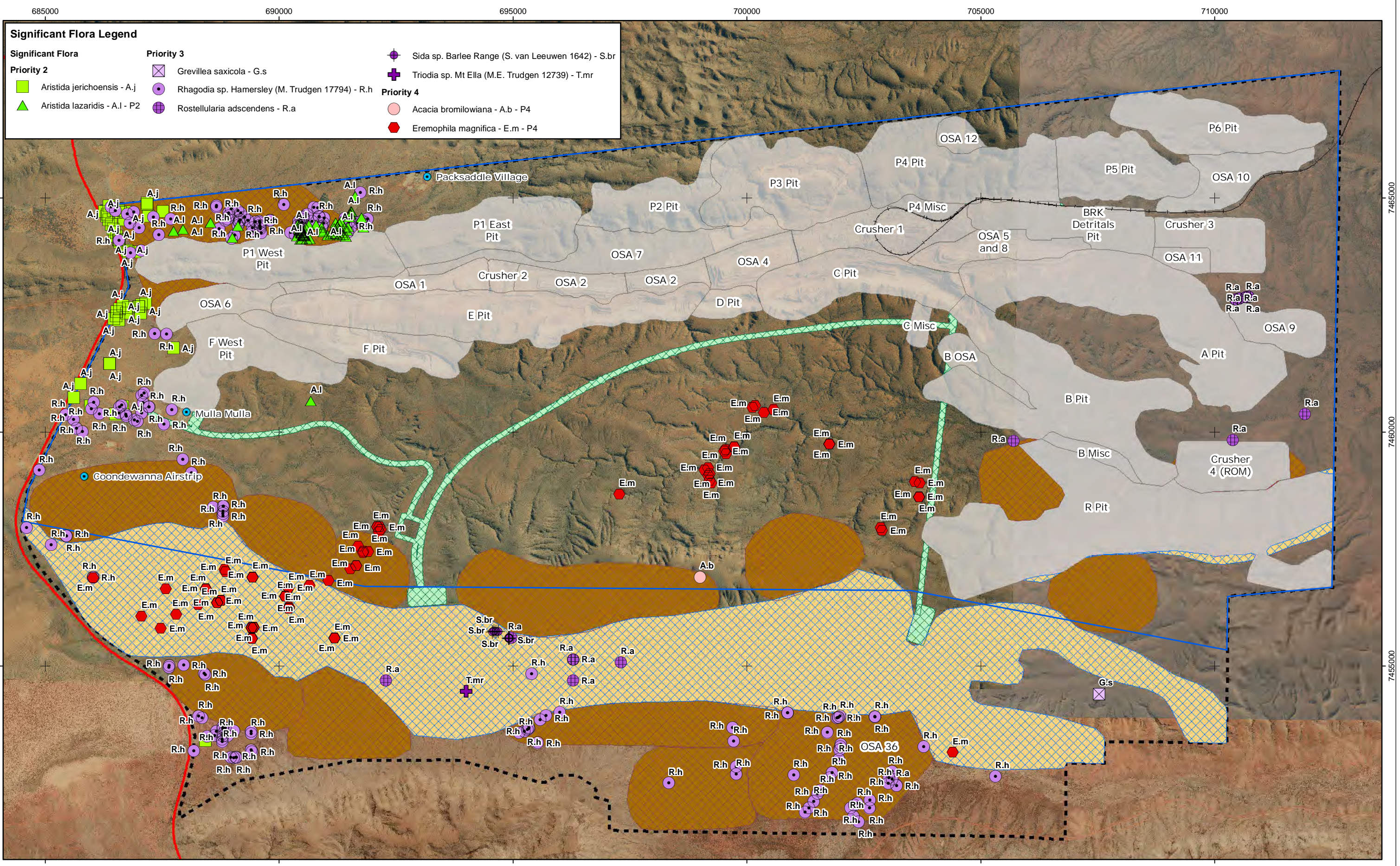
Taxon	Photograph	Description and Regional Distribution	Occurrence within the Indicative Additional Impact Assessment Area
<p><i>Nicotiana umbratica</i> (Priority 3)</p>		<p><i>Nicotiana umbratica</i> is an erect short-lived annual or perennial herb that reaches 0.7 m in height. It produces white flowers between April and June and grows in shallow soils on rocky outcrops.</p> <p><i>Nicotiana umbratica</i> is short-lived and hence likely to be under-surveyed within the Pilbara. However, previous records confirm its known distribution extending from the northern to the southern boundary of the Pilbara bioregion (WAH 2016). There are currently 19 records within the Pilbara.</p>	<p><i>Nicotiana umbratica</i> was recorded as a single plant growing under an overhang in a narrow gorge at one location in the central sector of the Proposed MAC Development Envelope (Onshore Environmental 2011a). The vegetation at this location was described as 'Low Woodland of <i>Corymbia ferriticola</i>, <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Open Tussock Grassland of <i>Themeda triandra</i>, <i>Cymbopogon ambiguus</i> and <i>Eriachne mucronata</i> and Open Hummock Grassland of <i>Triodia pungens</i>'.</p> <p>The single record occurs on the western fringe of the previously approved R-Pit which is outside of both the Additional Development Envelope and Indicative Additional Impact Assessment Area (Appendix 4).</p>

Taxon	Photograph	Description and Regional Distribution	Occurrence within the Indicative Additional Impact Assessment Area
<p><i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (Priority 3)</p>		<p><i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) is a perennial chenopod species growing to a height of 2 m in orange to red loam soils on flood plains. The current known distribution is restricted to the Pilbara bioregion with increasing numbers of populations recorded in recent years between Tom Price and Newman. <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) has previously been recorded over a 310 km range extending roughly between Tom Price and Newman, with outlying populations at Roy Hill and midway along the Munjina Roy Hill Road (Appendix 3). The DPaW rare flora database search (DPaW 2016a) showed 49 confirmed records within Western Australia, including one record from within Karijini National Park (Appendix 3).</p> <p>Locally it is widespread on mulga plains on BHP Billiton Iron Ore's Mudlark (192 plants, Onshore Environmental 2013c) and Tandanya (496 plants and up to 20 percent cover, Onshore Environmental 2013a) tenements to the west and south-west of the Development Envelope, and Jinidi tenement to the east (scattered plants providing <2 percent cover, Onshore Environmental 2011c). It has more recently been recorded from BHP Billiton Iron Ore's south-eastern tenements at Orebody 31 (scattered plants providing <2 percent cover, Onshore Environmental 2014d).</p>	<p>There were 13 populations of <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) represented within the Proposed MAC Development Envelope (Appendix 4). Eleven of these populations occurred within, or partially within, the Indicative Additional Impact Assessment Area (Appendix 4).</p> <p><i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) was recorded from four vegetation associations:</p> <ul style="list-style-type: none"> • Low Open Forest of <i>Acacia aptaneura</i> over Tussock Grassland of <i>Themeda triandra</i>, <i>Chrysopogon fallax</i> and <i>Aristida inaequiglumis</i>; • Low Open Woodland of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> over Open Shrubland of <i>Acacia pachyacra</i> over Open Tussock Grassland of <i>Themeda triandra</i>, <i>Aristida inaequiglumis</i> and <i>Aristida contorta</i>; • Tussock Grassland of <i>Themeda triandra</i>, <i>Digitaria ammophila</i> and <i>Aristida contorta</i> with Low Woodland of <i>Acacia aptaneura</i> over Open Shrubland of <i>Acacia aptaneura</i>, <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Sida ectogama</i>; and • Hummock Grassland of <i>Triodia melvillei</i> with Open Shrubland of <i>Acacia pachyacra</i> and Scattered Low Trees of <i>Eucalyptus xerothermica</i> and <i>Acacia aptaneura</i>.

Taxon	Photograph	Description and Regional Distribution	Occurrence within the Indicative Additional Impact Assessment Area
<p><i>Rostellularia adscendens</i> var. <i>latifolia</i> (Priority 3)</p>		<p>A low shrub to 0.3 m in height, flowering in April and May. It grows in ironstone soils with habitat ranging from creeks to rocky hills.</p> <p><i>Rostellularia adscendens</i> var. <i>latifolia</i> has a known distribution extending approximately 250 km northwest from the Proposed MAC Development Envelope to midway between Pannawonica and Tom Price, with additional records extending up to 300 km northeast to midway between Telfer and Marble Bar (Appendix 3). The DPaW rare flora database search (DPaW 2016a) showed 34 confirmed records within Western Australia, including six records from within Karijini National Park (Appendix 3).</p> <p>Locally, it has been recorded from a number of BHP Billiton Iron Ore's project areas including Area C West to Yandi (67 plants, Onshore Environmental 2014b), Mudlark (Onshore Environmental 2013), Tandanya (60 plants, Onshore Environmental 2013), Jinidi to Mainline (<2 percent cover within Weeli Wolli Creek, Onshore Environmental 2012b) and Yandi (<1 percent cover, Onshore Environmental 2011d).</p>	<p>There were 13 populations of <i>Rostellularia adscendens</i> var. <i>latifolia</i> represented within the Proposed MAC Development Envelope (Appendix 4). Ten of these populations occurred within, or partially within, the Indicative Additional Impact Assessment Area (Appendix 4).</p> <p>Plants occurred as scattered individuals or populations of up to a maximum of 82 plants. Associated vegetation was described as:</p> <ul style="list-style-type: none"> • Low Woodland of <i>Eucalyptus xerothermica</i> and <i>Corymbia hamersleyana</i> over Shrubland of <i>Acacia pyrifolia</i>, <i>Petalostylis labicheoides</i> and <i>Gossypium robinsonii</i> over Open Hummock Grassland of <i>Triodia pungens</i>; • Scattered Trees of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over High Shrubland of <i>Acacia monticola</i>, <i>Acacia pyrifolia</i> and <i>Santalum lanceolatum</i>; and • Low Open Woodland of <i>Eucalyptus xerothermica</i> over High Shrubland of <i>Petalostylis labicheoides</i>, <i>Gossypium robinsonii</i> and <i>Acacia maitlandii</i> over Shrubland of <i>Indigofera georgei</i> and <i>Rulingia luteiflora</i> (with Open Hummock Grassland of <i>Triodia pungens</i> and Open Tussock Grassland of <i>Themeda triandra</i> and <i>Cymbopogon procerus</i>).

Taxon	Photograph	Description and Regional Distribution	Occurrence within the Indicative Additional Impact Assessment Area
<p><i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (Priority 3)</p>		<p><i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) is a spreading shrub to 0.5 m in height found in skeletal red soil pockets on steep hill slopes and at the base of cliffs.</p> <p><i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) has a known distribution extending east to west over 420 km from Newman to Barlee Range Nature Reserve, and extending up to 50 km north of Tom Price (Appendix 3). The DPaW rare flora database search (DPaW 2016a) showed 42 confirmed records within Western Australia, including two records from within Karijini National Park and three records from within Barlee Range Nature Reserve (Appendix 3).</p> <p>Locally, it has been reported in low numbers from BHP Billiton Iron Ore's neighbouring Tandanya (ENV Australia 2010) and Jinidi (Onshore Environmental 2011e) tenements.</p>	<p>One population of <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) was recorded in the southern central sector of the Proposed MAC Development Envelope, occurring within the Additional Development Envelope and the Indicative Additional Impact Assessment Area (Appendix 4).</p> <p>Plants occurred at the base of cliffs and on steep hill slopes. Associated vegetation was described as:</p> <ul style="list-style-type: none"> • Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Very Open Tussock Grassland of <i>Cymbopogon ambiguus</i> over Open Hummock Grassland of <i>Triodia pungens</i>; and • Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Shrubland of <i>Dodonaea viscosa</i>, <i>Grevillea wickhamii</i> and <i>Senna glutinosa</i> subsp. <i>glutinosa</i> over Open Tussock Grassland of <i>Cymbopogon ambiguus</i> (with Open Hummock Grassland of <i>Triodia pungens</i>).

Taxon	Photograph	Description and Regional Distribution	Occurrence within the Indicative Additional Impact Assessment Area
<p><i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (Priority 3)</p>		<p><i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) was first discovered on Mt Ella (west of the Proposed MAC Development Envelope) in 1995, where it occurred on an upper slope below mulga and in an east to south-east facing gully (Trudgen and Casson 1998). <i>Triodia</i> sp. Mt. Ella (ME Trudgen 12739) is a perennial hummock grass to 0.4 m in height which could be easily confused with <i>Triodia pungens</i>.</p> <p><i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) has a known distribution extending over 200 km from Karijini National Park to 30 km east of Newman, with an outlying record from Rudall River National Park (Appendix 3). The DPaW rare flora database search (DPaW 2016a) showed 27 confirmed records within Western Australia, including one record from within Rudall River National Park (Appendix 3).</p> <p>Locally, it has previously been recorded from BHP Billiton Iron Ore's Mudlark (Onshore Environmental 2013) and Tandanya (Onshore Environmental 2013) tenements, and from Rio Tinto's West Angelas tenement (Trudgen and Casson 1998). It occurred on a range of landforms including gorges, hillslopes and drainage lines. <i>Triodia</i> sp. Mt. Ella (ME Trudgen 12739) is considered to be geographically restricted and uncommon, but unlikely to be rare (Trudgen and Casson 1998).</p>	<p>One population of <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) was recorded in the southern central sector of the Proposed MAC Development Envelope, occurring within the Additional Development Envelope and the Indicative Additional Impact Assessment Area (Appendix 4).</p> <p><i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) was recorded on red brown loam on stony slopes and upper plains associated with 'Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill and <i>Triodia pungens</i> with Low Open Woodland of <i>Corymbia deserticola</i> subsp. <i>deserticola</i>, <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Hakea chordophylla</i> over Low Open Shrubland of <i>Corchorus lasiocarpus</i>, <i>Halgania gustafsenii</i> and <i>Ptilotus rotundifolius</i>'.</p> <p>It was prominent on the northern slopes of Mt Robinson (outside the southern boundary of the Proposed MAC Development Envelope), and was also recorded on the western side of the Great Northern Highway.</p>



ONSHORE ENVIRONMENTAL

Figure:	9	Date:	21/11/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
		GSM Reference:	MAC_SigF

N

0 0.5 1 2 3 4

Kilometers
1:75,000

Datum: GDA94
Projection: MGA Zone 50

**BHPBIO
MINING AREA C**

Location of significant flora within the
Proposed MAC Development Envelope
Figure 9

Legend

Mine Accommodation	Indicative Additional Infrastructure Area	Ministerial Statement 491 (Northern Flank)
Previously Approved Areas	Indicative Additional OSA	Proposed Mining Area C Development Envelope
	Indicative Additional Pit Area	

GRIFFIN
SPATIAL & MAPPING

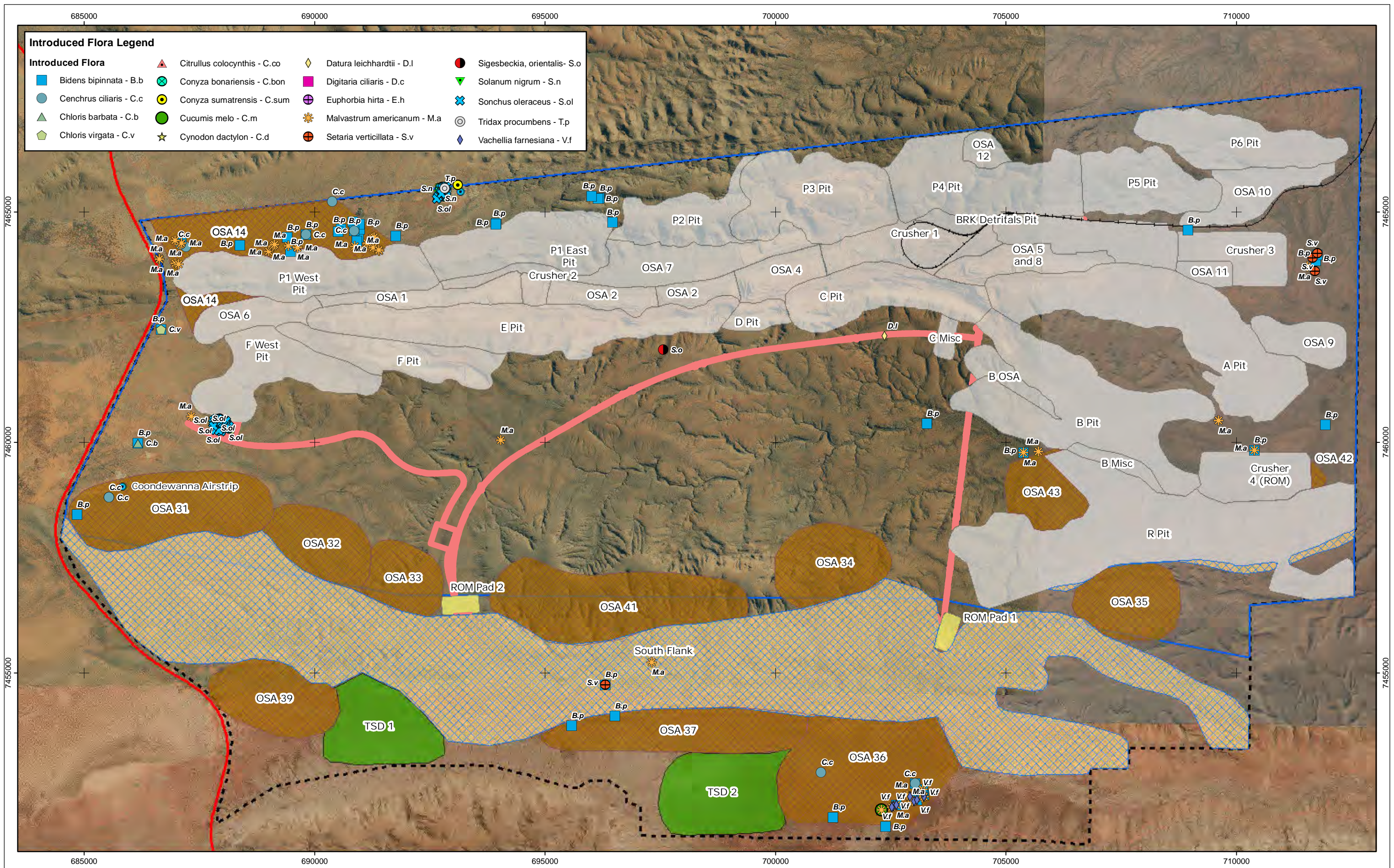
PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

3.6 Introduced Flora

A total of 19 introduced (weed) species have been recorded from the Proposed MAC Development Envelope to date (excluding previously approved areas), with seven situated within the Indicative Additional Impact Assessment Area and six within the Additional Development Envelope (Table 10). These taxa are described further in Table 11 and locations are shown in Figure 10. None of these taxa are listed as Declared Pests under the BAM Act.

Table 10 Presence of introduced flora within the Proposed MAC Development Envelope, Indicative Additional Impact Assessment Area, and Additional Development Envelope.

Significant Taxon	Proposed MAC Development Envelope	Indicative Additional Impact Assessment Area	Additional Development Envelope
* <i>Bidens bipinnata</i> (Bipinnate Beggartick)	X	X	X
* <i>Cenchrus ciliaris</i> (Buffel Grass)	X	X	X
* <i>Chloris barbata</i> (Purpletop Chloris)	X		
* <i>Chloris virgata</i> (Feathertop Rhodes Grass)	X		
* <i>Citrullus colocynthis</i> (Colocynth)	X		
* <i>Conyza bonariensis</i> (Flaxleaf Fleabane)	X		
* <i>Conyza sumatrensis</i> (Tall Fleabane)	X		
* <i>Cucumis melo</i> subsp. <i>agrestis</i> (Ulicardo Melon)	X	X	X
* <i>Cynodon dactylon</i> (Couch Grass)	X	X	
* <i>Datura leichhardtii</i> (Native Thornapple)	X		
* <i>Digitaria ciliaris</i> (Summer Grass)	X		
* <i>Euphorbia hirta</i> (Asthma Plant)	X		
* <i>Malvastrum americanum</i> (Spiked Malvastrum)	X	X	X
* <i>Setaria verticillata</i> (Whorled Pigeon Grass)	X	X	X
* <i>Sigesbeckia orientalis</i> (Indian Weed)	X		
* <i>Solanum nigrum</i> (Black Berry Nightshade)	X		
* <i>Sonchus oleraceus</i> (Common Sowthistle)	X		
* <i>Tridax procumbens</i> (Tridax)	X		
* <i>Vachellia farnesiana</i> (Mimosa Bush)	X	X	X



Introduced Flora Legend

Introduced Flora							
	Bidens bipinnata - B.b		Citrullus colocynthis - C.co		Datura leichhardtii - D.l		Sigesbeckia, orientalis- S.o
	Cenchrus ciliaris - C.c		Conyza bonariensis - C.bon		Digitaria ciliaris - D.c		Solanum nigrum - S.n
	Chloris barbata - C.b		Conyza sumatrensis - C.sum		Euphorbia hirta - E.h		Sonchus oleraceus - S.ol
	Chloris virgata - C.v		Cucumis melo - C.m		Malvastrum americanum - M.a		Tridax procumbens - T.p
			Cynodon dactylon - C.d		Setaria verticillata - S.v		Vachellia farnesiana - V.f

Figure: 10 Date: 02/08/2016
 Sheet Size: A3 Status: FINAL
 Drawn by: GSM Requested by: DB GSM Reference: MAC_INF

N

Kilometers
1:75,000
Datum: GDA94
Projection: MGA Zone 50



BHPBIO MINING AREA C
 Location of introduced (weed) species within the Proposed MAC Development Envelope
 Figure 10



Legend



- Mine Accommodation
- Indicative Additional Infrastructure Areas
- Indicative Additional OSA
- Indicative Additional Pits
- Indicative OSA Area
- Indicative Pit Area
- ROM
- Topsoil
- Previously Approved Areas
- Indicative Additional Infrastructure
- Ministerial Statement 491 (Northern Flank)
- Proposed Mining Area C Development Envelope



PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213


Table 11 Introduced weed species recorded from the Proposed MAC Development Envelope.



Taxon (Common Name)	Photograph	Description	Occurrence within Proposed MAC Development Envelope
<p><i>*Bidens bipinnata</i> (Bipinnate Beggars Tick)</p>		<p>Erect annual herb that grows up to 1 m in height. This species is widespread in the northern parts of Western Australia from Shark Bay up to the Northern Territory border. It has three pronged barbs on its seeds and is easily spread by livestock and other animals. In the Pilbara it is common in moist habitats such as drainage lines, flood plains and gorges, and responds vigorously following rainfall.</p>	<p>There were 113 records predominantly across northern and eastern sectors of the Proposed MAC Development Envelope, with a few scattered occurrences along the southern boundary. There were 12 records from within the Additional Development Envelope and 26 records within the Indicative Additional Impact Assessment Area.</p> <p>Numbers ranged from single plants to >1,000 individuals.</p> <p>The presence of <i>*Bidens bipinnata</i> was heavily influenced by seasonal conditions, with the distribution of records showing a preference for establishment on flood plains and stony plains.</p>
<p><i>*Cenchrus ciliaris</i> (Buffel Grass)</p>		<p>Tufted perennial grass originating from the Middle East as a fodder species by pastoralists. It grows in dense tussocks up to 1 m tall and typically occurs in monospecific stands on loamy plains and creekline levee banks. It is an aggressive colonising species that has become well established throughout the Pilbara, Gascoyne and Murchison regions of Western Australia, and is continuing to spread in the south west of the state (Hussey <i>et al.</i> 1997).</p>	<p>There were 54 records from disturbed surfaces and water gaining sites around developed areas within the northern sector of the Proposed MAC Development Envelope, and plains in western and southern parts. There were two records from within the Additional Development Envelope and 10 records within the Indicative Additional Impact Assessment Area.</p> <p>Ground cover was less than 10 percent.</p>



Taxon (Common Name)	Photograph	Description	Occurrence within Proposed MAC Development Envelope
<p>*<i>Chloris barbata</i> (Purpletop Chloris)</p>		<p>An annual grass reaching 1.1 m in height. It produces purple flowers during February or from April to October. It grows on white or red sand, loam or black clay on sand dunes and river levees.</p>	<p>There were three records (17 plants) from the central western fringe of the Proposed MAC Development Envelope, with ground cover ranging from <2 percent to 2-10 percent. *<i>Chloris barbata</i> was not recorded from either the Additional Development Envelope or the Indicative Additional Impact Assessment Area.</p>
<p>*<i>Chloris virgata</i> (Feathertop Rhodes Grass)</p>		<p>Annual grass or herb growing up to 1 m in height and flowers (green or purple) between April and September. It occurs on clay and sand soils and is found throughout Western Australia.</p>	<p>There were 15 records (427 plants) from the north-west sector of the Proposed MAC Development Envelope, with ground cover ranging from <2 percent to 75 percent. *<i>Chloris virgata</i> was not recorded from the Additional Development Envelope, but there was one record from the Indicative Additional Impact Assessment Area.</p>



Taxon (Common Name)	Photograph	Description	Occurrence within Proposed MAC Development Envelope
<p>*<i>Citrullus colocynthis</i> (Colocynth)</p>		<p>A yellow flowering, trailing perennial herb or climber flowering from January to October (Hussey <i>et al.</i> 1997). It occurs on rocky, stony loam or clay soils typically in wet disturbed sites such as floodplains. This taxon is widely distributed throughout Western Australia occurring in the Eremaean, Northern and South-Western Provinces.</p>	<p>There were three records (4 plants) from the north-west sector of the Proposed MAC Development Envelope, with ground cover <2 percent. *<i>Citrullus colocynthis</i> was not recorded from either the Additional Development Envelope or the Indicative Additional Impact Assessment Area.</p> <p>This species was not recorded during the baseline survey and is restricted to disturbed areas within the Proposed MAC Development Envelope. It was recorded and sprayed by Astron Environmental (2014a, 2014b) adjacent to both of the accommodation camps in 2014.</p>
<p>*<i>Conyza bonariensis</i> (Flaxleaf Fleabane)</p>		<p>An erect annual herb that grows up to 1.5 m in height and occurs in a variety of soils, typically in cultivated areas, waste areas and roadsides. It requires disturbance to establish and is usually unsuccessful in areas of high plant density. It flowers (white) from January to December and is found across Western Australia extending from Broome and further north down to Perth, Esperance and Albany.</p>	<p>There were 36 records (67 plants) from the north-west sector of the Proposed MAC Development Envelope, with ground cover <2 percent. *<i>Conyza bonariensis</i> was not recorded from the Additional Development Envelope, but there was one record from the Indicative Additional Impact Assessment Area.</p> <p>This species was not recorded during the baseline survey and is restricted to disturbed areas within the Proposed MAC Development Envelope. It was recorded and sprayed by Astron Environmental (2014a, 2014b) adjacent to both of the accommodation camps.</p>



Taxon (Common Name)	Photograph	Description	Occurrence within Proposed MAC Development Envelope
<p><i>*Conyza sumatrensis</i> (Tall Fleabane)</p>		<p>An annual herb reaching 2 m in height and produces white/cream/yellow flowers all year round. It grows in gritty loam, sandy clay or grey sands on sand dunes, ditches, swamps, seasonally wet areas and road verges.</p>	<p>One record (4 plants) from the Packsaddle Village in the north-west sector of the Proposed MAC Development Envelope. <i>*Conyza sumatrensis</i> was not recorded from either the Additional Development Envelope or the Indicative Additional Impact Assessment Area.</p> <p>This species was not recorded during the baseline survey and is restricted to disturbed areas within the Proposed MAC Development Envelope. It was recorded and sprayed by Astron Environmental (2014b) near the accommodation camp.</p>
<p><i>*Cucumis melo</i> subsp. <i>agrestis</i> (Ulicardo Melon)</p>		<p>A yellow flowering, trailing annual herb or climber). It has two flowering periods from February to June and September to October (Hussey <i>et al.</i> 1997). It produces fleshy fruit and is usually found in woodland or grassland on clay soils. This species is widely distributed throughout Western Australia especially the Pilbara and Kimberley regions.</p>	<p>Recorded as a single plant from one location on red brown clay loam soils on narrow drainage floors and channels in the far south-east corner of the Proposed MAC Development Envelope. This record was from within the Additional Development Envelope and within the Indicative Additional Impact Assessment Area.</p>


Taxon (Common Name)	Photograph	Description	Occurrence within Proposed MAC Development Envelope
<p>*<i>Cynodon dactylon</i> (Couch)</p>		<p>A prostrate rhizomatous perennial grass that grows up to 0.3 m in height and flowers (green and purple) from June to November/February. Couch grows on sand, loam or clay soils and occurs across Western Australia (Hussey <i>et al.</i> 1997). It is usually found in open areas that are prone to disturbances such as grazing, flooding and fire. Couch originates from Africa and southern Europe and was introduced into Western Australia for use as turf and pasture.</p>	<p>There were three records adjacent to the Packsaddle Village within the north-west sector of the Proposed MAC Development Envelope, including approximately 300 m² within the landfill facility. Ground cover ranged from <2 percent to >75 percent. *<i>Cynodon dactylon</i> was not recorded from either the Additional Development Envelope or the Indicative Additional Impact Assessment Area.</p>
<p>*<i>Datura leichhardtii</i> (Native Thornapple)</p>		<p>Annual herb growing up to 1 m in height, flowering white between June and October. Grows on alluvial soils along watercourses.</p>	<p>There were four records (4 plants) from the northern sector of the Proposed MAC Development Envelope. *<i>Datura leichhardtii</i> was not recorded from either the Additional Development Envelope, but there was one record from the Indicative Additional Impact Assessment Area.</p>

Taxon (Common Name)	Photograph	Description	Occurrence within Proposed MAC Development Envelope
<p><i>*Digitaria ciliaris</i> (Summer Grass)</p>		<p>A decumbent, tufted annual grass reaching 1 m in height and flowering green between November and December or January to July. Found growing on sand, clay, alluvium and sandstone.</p>	<p>There were three records (54 plants) recorded in close proximity to the Packsaddle Village in the north-west sector of the Proposed MAC Development Envelope. <i>*Digitaria ciliaris</i> was not recorded from either the Additional Development Envelope or the Indicative Additional Impact Assessment Area.</p> <p><i>*Digitaria ciliaris</i> was not recorded during the baseline survey, and has likely been brought to site in recent years. It was recorded and sprayed by Astron Environmental (2014b) near the Packsaddle Village and nearby along the access road.</p>
<p><i>*Euphorbia hirta</i> (Asthma Plant)</p>		<p>An erect or decumbent, many branched, annual herb between 0.1 m and 0.8 m in height. Flowers are yellow green or white and occur between January and October. This species grows on alluvial soils often along watercourses.</p>	<p>There were eight records (117 plants) in the north-west sector of the Proposed MAC Development Envelope. <i>*Euphorbia hirta</i> was not recorded from either the Additional Development Envelope or the Indicative Additional Impact Assessment Area.</p> <p>This species was not recorded during the baseline survey and is restricted to the camp areas within the Development Envelope. It was recorded and sprayed by Astron Environmental (2014a, 2014b) at the two accommodation villages and along an adjacent access road.</p>

Taxon (Common Name)	Photograph	Description	Occurrence within Proposed MAC Development Envelope
<p>*<i>Malvastrum americanum</i> (Spiked Malvastrum)</p>		<p>Erect perennial herb or shrub, ranging from 0.5 m to 1.3 m in height. It grows in a variety of soil types on stony ridges and hill sides, flood plains and along drainage lines.</p>	<p>There were 59 records (>500 plants) distributed throughout the Proposed MAC Development Envelope, with the majority of records from the northern sector and scattered records from plains in the south. Ground cover ranged from <2 percent to 2-10 percent. There were 12 records from within the Additional Development Envelope and 31 records within the Indicative Additional Impact Assessment Area.</p>
<p>*<i>Setaria verticillata</i> (Whorled Pigeon Grass)</p>		<p>A loosely tufted annual grass-like herb, growing between 0.1 m and 1.3 m in height. It grows in a variety of soils including sand, clay and loam.</p>	<p>There were 8 records supporting scattered plants across northern and southern sectors of the Proposed MAC Development Envelope. There was one record from within the Additional Development Envelope and within the Indicative Additional Impact Assessment Area.</p>

Taxon (Common Name)	Photograph	Description	Occurrence within Proposed MAC Development Envelope
<p><i>*Sigesbeckia orientalis</i> (Indian Weed)</p>		<p>An erect and slender annual herb that reaches 1 m in height. Flowers are yellow and occur between January and December. It grows in loamy soils over granite or limestone in rocky gullies, on limestone ranges and along creek beds.</p>	<p>There were four records (16 plants) in the northern sector of the Proposed MAC Development Envelope. <i>*Sigesbeckia orientalis</i> was not recorded from either the Additional Development Envelope or the Indicative Additional Impact Assessment Area.</p>
<p><i>*Solanum nigrum</i> (Black Berry Nightshade)</p>		<p>An erect, perennial herb or shrub growing to a height of between 0.3 m and 0.8 m. It produces white flowers from January to December (Western Australian Herbarium 2016). <i>*Solanum nigrum</i> has dull black or purplish berries and small anthers and seeds. The young fruits may be toxic and the plant is a common weed of gardens, horticultural crops, wastelands, disturbed woodlands, pastures, creeklines and wetlands. It is distributed throughout Western Australia from Broome to Albany and originates from of Europe (Hussey <i>et al.</i> 1997).</p>	<p>There were 22 records (219 plants) in the northern sector of the Proposed MAC Development Envelope, providing <2 percent ground cover with the exception of one location where ground cover was 30-70 percent. <i>*Solanum nigrum</i> was not recorded from either the Additional Development Envelope or the Indicative Additional Impact Assessment Area.</p> <p>This species was not recorded during the baseline survey and is restricted to disturbed areas within the Proposed Development Envelope. It was recorded and sprayed by Astron Environmental (2014a, 2014b) around the Packsaddle Village and access road, and in a highly disturbed area in close proximity to mine infrastructure.</p>

Taxon (Common Name)	Photograph	Description	Occurrence within Proposed MAC Development Envelope
<p><i>*Sonchus oleraceus</i> (Common Sowthistle)</p>		<p>An erect, annual herb that grows to approximately 1.5 m in height and produces yellow flowers between January and December. It occurs on a variety of soils and is a weed of disturbed ground. The leaves of <i>*Sonchus oleraceus</i> are generally flaccid and are weakly prickly or have no prickles. The weed is widespread on roadsides, gardens, market gardens and wasteland from Wittenoom to the Nullarbor and it is native to Eurasia and North Africa (Hussey <i>et al.</i> 1997).</p>	<p>There were 122 records (8,607 plants) in the northern sector of the Proposed MAC Development Envelope, typically providing <2 percent ground cover with a few records with up to 70 percent cover. <i>*Sonchus oleraceus</i> was not recorded from either the Additional Development Envelope, but there were two records from the Indicative Additional Impact Assessment Area. This species was not recorded during the baseline survey and is restricted to disturbed areas within the Development Envelope. It was recorded and sprayed by Astron Environmental (2014a, 2014b) at both accommodation camps, along an access road and in a two highly disturbed areas in close proximity to mine infrastructure.</p>
<p><i>*Tridax procumbens</i> (Tridax)</p>		<p>A prostrate to erect perennial herb reaching 0.4 m in height. Yellow flowers occur all year round. Found on wet and often disturbed ground.</p>	<p>One record (1 plant) from the the northern sector of the Proposed MAC Development Envelope. <i>*Tridax procumbens</i> was not recorded from either the Additional Development Envelope or the Indicative Additional Impact Assessment Area. This species was not recorded during the baseline survey and is restricted to disturbed areas around the Packsaddle accommodation camp (Astron Environmental 2014a).</p>

Taxon (Common Name)	Photograph	Description	Occurrence within Proposed MAC Development Envelope
<p><i>*Vachellia farnesiana</i> (Mimosa Bush)</p>		<p>An erect spreading thicket forming thorny tree or shrub. It grows up to 4 m in height and produces yellow flowers from June to August. Mimosa Bush grows on stony, sandy, clay or loam soils and is common in low lying areas such as creeks and river banks as well as in disturbed areas. It is widespread from the Kimberly and extends south to near Perth (Hussey <i>et al.</i> 1997).</p>	<p>There were eight records (24 plants) from the south-east sector of the Proposed MAC Development Envelope. All eight records were from within the Additional Development Envelope, and also from within the Indicative Additional Impact Assessment Area (OSA 36).</p>

3.7 Vegetation

Vegetation association mapping of the Proposed MAC Development Envelope has most recently been reviewed and updated by Onshore Environmental as part of the baseline surveys completed at Area C and Surrounds (Onshore Environmental 2011a) and Southern Flank (Onshore Environmental 2012a). During 2014 vegetation mapping of these two study areas was consolidated into a larger dataset as part of BHP Billiton Iron Ore's Pilbara tenement mapping (Onshore Environmental 2014a). Vegetation mapping provided as part of the current report is congruent with the larger Pilbara database.

A total of 34 vegetation associations have been described and mapped within the Proposed MAC Development Envelope (Figure 11, Appendix 5). The vegetation associations have been classified into 13 Broad Floristic Formations on the basis of the dominant vegetation stratum (Table 12).

Twenty-nine of the 34 vegetation associations are represented within the Indicative Additional Impact Assessment Area, and 24 vegetation associations are represented within the Additional Development Envelope (Table 12).

Table 12 Vegetation associations mapped within the Proposed MAC Development Envelope, Indicative Additional Impact Assessment Area and Additional Development Envelope.

Map Code	Broad Floristic Formation	Vegetation Association	Area (ha) within Proposed MAC Development Envelope	Area (ha) within Indicative Additional Impact Assessment Area	Area (ha) within Additional Development Envelope
CALCRETE PLAINS					
CP TwTa Ese AbPIApy	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> and <i>Triodia angusta</i> with Open Mallee of <i>Eucalyptus socialis</i> subsp. <i>eucentrica</i> and Open Shrubland of <i>Acacia bivenosa</i> , <i>Petalostylis labicheoides</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> on light brown clay loam on calcrete plains and rises	28.80	16.93	0.00
FLOOD PLAINS					
FP Ev Aa EuaErbTt	<i>Eucalyptus</i> Woodland	Woodland of <i>Eucalyptus victrix</i> over Low Woodland of <i>Acacia aptaneura</i> over Open Tussock Grassland of <i>Eulalia aurea</i> , <i>Eriachne benthamii</i> and <i>Themeda triandra</i> on orange clay loam on floodplains	1.30	0.50	1.30
FP AaApApt TtChfErb	<i>Acacia</i> Low Open Forest	Low Open Forest of <i>Acacia aptaneura</i> , <i>Acacia paraneura</i> and <i>Acacia pteraneura</i> over Open Tussock Grassland of <i>Themeda triandra</i> , <i>Chrysopogon fallax</i> and <i>Eriachne benthamii</i> on red brown clay loam on floodplains	5.26	2.88	5.26
FP AaAcaoAp ErInSolPto ArcErdiArj	<i>Acacia</i> Low Open Woodland	Low Open Woodland of <i>Acacia aptaneura</i> , <i>Acacia catenulata</i> subsp. <i>occidentalis</i> and <i>Acacia paraneura</i> over Low Open Shrubland of <i>Eremophila lanceolata</i> , <i>Solanum lasiophyllum</i> and <i>Ptilotus obovatus</i> over Very Open Tussock Grassland of <i>Aristida contorta</i> , <i>Eragrostis dielsii</i> and <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> on red brown clay loam on hardpan intergrove plains	1.41	1.32	0.00
FP TtEua ExAa AprAtpErlo	<i>Themeda</i> Tussock Grassland	Tussock Grassland of <i>Themeda triandra</i> and <i>Eulalia aurea</i> with Low Woodland of <i>Eucalyptus xerothermica</i> and <i>Acacia aptaneura</i> over Open Shrubland of <i>Acacia pruinocarpa</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Eremophila longifolia</i> on red brown clay loam on unincised drainage lines and floodplains	134.69	56.18	0.00

Map Code	Broad Floristic Formation	Vegetation Association	Area (ha) within Proposed MAC Development Envelope	Area (ha) within Indicative Additional Impact Assessment Area	Area (ha) within Additional Development Envelope
FOOTSLOPES					
FS Ts CdHc AancAiGrwh	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of <i>Corymbia deserticola</i> subsp. <i>deserticola</i> and <i>Hakea chordophylla</i> over Open Shrubland of <i>Acacia ancistrocarpa</i> , <i>Acacia inaequilatera</i> and <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> on red brown sandy loam on footslopes and stony plains	6,170.72	1,276.30	1,459.52
FS TsTpTw EII AbApaAanc	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835), <i>Triodia pungens</i> and <i>Triodia wiseana</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and Open Shrubland of <i>Acacia bivenosa</i> , <i>Acacia pachyachra</i> and <i>Acacia ancistrocarpa</i> on red brown loam on footslopes and low undulating hills	58.73	0.00	0.00
GORGES AND GULLYS					
GG CcolCfEII ErmuThmbCya	<i>Callitris</i> Low Open Forest	Low Open Forest of <i>Callitris columellaris</i> , <i>Corymbia ferritcola</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Tussock Grassland of <i>Eriachne mucronata</i> , <i>Themeda</i> sp. Mt Barricade (M.E. Trudgen 2471) and <i>Cymbopogon ambiguus</i> and Very Open Hummock Grassland of <i>Triodia pungens</i> on orange brown loam on upper gorges	15.39	15.39	11.55
GG CfEIIFib AhDovmAsha CyaErmuThmb	<i>Corymbia</i> Low Woodland	Low Woodland of <i>Corymbia ferritcola</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Ficus brachypoda</i> over Open Shrubland of <i>Acacia hamersleyensis</i> , <i>Dodonaea viscosa</i> subsp. <i>mucronata</i> and <i>Astrotricha hamptonii</i> over Open Tussock Grassland of <i>Cymbopogon ambiguus</i> , <i>Eriachne mucronata</i> and <i>Themeda</i> sp. Mt Barricade on red brown loam along clifflines and gorges	1,603.49	736.78	620.60

Map Code	Broad Floristic Formation	Vegetation Association	Area (ha) within Proposed MAC Development Envelope	Area (ha) within Indicative Additional Impact Assessment Area	Area (ha) within Additional Development Envelope
GG TtErmuThmb EIIChCf AtpGoroPI	<i>Themeda</i> Tussock Grassland	Tussock Grassland of <i>Themeda triandra</i> , <i>Eriachne mucronata</i> and <i>Themeda</i> sp. Mt Barricade with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , <i>Corymbia hamersleyana</i> and <i>Corymbia ferriticola</i> over High Shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Gossypium robinsonii</i> and <i>Petalostylis labicheoides</i> on red brown sandy loam in narrowly incised rocky drainage lines	633.80	132.67	130.19
HILL CRESTS AND UPPER HILL SLOPES					
HC TpTwTs EIICh AarGooKeve	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> , <i>Triodia wiseana</i> and <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Low Shrubland of <i>Acacia arida</i> , <i>Gompholobium oreophilum</i> and <i>Keraudrinia velutina</i> subsp. <i>elliptica</i> on red brown loam on hills	157.49	0.00	0.00
HC Tw Ah EkkEgCh	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> with Shrubland of <i>Acacia hamersleyensis</i> and Open Mallee of <i>Eucalyptus kingsmillii</i> subsp. <i>kingsmillii</i> , <i>Eucalyptus gamophylla</i> and <i>Corymbia hamersleyana</i> (mallee form) on red brown loam and silty loam on hill crests	1,113.81	239.35	282.19
HC TwTsTp EIICh Ah	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> , <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) and <i>Triodia pungens</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Open Shrubland of <i>Acacia hamersleyensis</i> on red brown clay loam on hill crests and upper hill slopes	87.79	58.03	24.43
HILL SLOPES AND UNDULATING LOW HILLS					
HS AaApr ErjpAmarCocf TwTp	<i>Acacia</i> Low Woodland	Low Woodland of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> over Shrubland of <i>Eremophila jucunda</i> subsp. <i>pulcherrima</i> , <i>Acacia marramamba</i> and <i>Codonocarpus cotinifolius</i> over Open Hummock Grassland of <i>Triodia wiseana</i> and <i>Triodia pungens</i> on red brown loam on hill slopes	578.98	521.84	197.90

Map Code	Broad Floristic Formation	Vegetation Association	Area (ha) within Proposed MAC Development Envelope	Area (ha) within Indicative Additional Impact Assessment Area	Area (ha) within Additional Development Envelope
HS TbrTw EII	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia brizoides</i> and/or <i>Triodia wiseana</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> on brown sandy loam on steep hill slopes	2,297.42	455.43	230.54
HS Tp EII SeggGrwhErII	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> with Scattered Low Trees of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and Scattered Shrubs of <i>Senna glutinosa</i> subsp. <i>glutinosa</i> , <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> and <i>Eremophila latrobei</i> subsp. <i>latrobei</i> on skeletal orange brown loam on stony hill slopes	95.46	69.19	84.36
HS TsTw Eg GrwhSeggAb	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) and <i>Triodia wiseana</i> with Very Open Mallee of <i>Eucalyptus gamophylla</i> over Open Shrubland of <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> , <i>Senna glutinosa</i> subsp. <i>glutinosa</i> and <i>Acacia bivenosa</i> on red brown sandy clay loam on hill slopes	0.33	0.26	0.33
HS TsTwTp EIICh AhiAaa	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835), <i>Triodia wiseana</i> and <i>Triodia pungens</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Low Open Shrubland of <i>Acacia hilliana</i> and <i>Acacia adoxa</i> var. <i>adoxo</i> on red brown sandy loam on hill slopes	10,913.43	3,710.48	3,179.13
HS TwTpTbr EII Ep	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> , <i>Triodia pungens</i> and <i>Triodia brizoides</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Mallee of <i>Eucalyptus pilbarensis</i> on red brown loam on steep hill slopes	14.32	10.06	10.06
HS TwTpTs EII AprAaAanc	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> , <i>Triodia pungens</i> and <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Shrubland of <i>Acacia pruinocarpa</i> , <i>Acacia aptaneura</i> and <i>Acacia ancistrocarpa</i> on red brown loam on plains and low hills	346.91	103.99	0.00

Map Code	Broad Floristic Formation	Vegetation Association	Area (ha) within Proposed MAC Development Envelope	Area (ha) within Indicative Additional Impact Assessment Area	Area (ha) within Additional Development Envelope
HS Tp AaApr ErfrAmarSegl	<i>Triodia</i> Open Hummock Grassland	Open Hummock Grassland of <i>Triodia pungens</i> with Low Open Woodland of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> over Open Shrubland of <i>Eremophila fraseri</i> , <i>Acacia marramamba</i> and <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> on red brown loam on undulating hills	48.91	48.91	48.91
MAJOR DRAINAGE LINES					
MA EcrEvEx AypAtpGoro TtEuaCyp	<i>Eucalyptus</i> Low Open Forest	Low Open Forest of <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> , <i>Eucalyptus victrix</i> and <i>Eucalyptus xerothermica</i> over High Shrubland of <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Gossypium robinsonii</i> over Open Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Cymbopogon procerus</i> on red brown clay loam on major drainage lines	48.98	30.06	48.98
MA AtpAypAse Ecr ThmbTtCyp	<i>Acacia</i> High Shrubland	High Shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> and <i>Acacia sericophylla</i> with Scattered Trees of <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> over Open Tussock Grassland of <i>Themeda</i> sp. Mt Barricade (M.E. Trudgen 2471), <i>Themeda triandra</i> and <i>Cymbopogon procerus</i> on brown loam and gravels on major drainage channels	41.23	0.00	0.00
MEDIUM DRAINAGE LINES					
ME TpTlo ExAciCh PIAypGoro	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia longiceps</i> with Low Woodland of <i>Eucalyptus xerothermica</i> , <i>Acacia citrinoviridis</i> and <i>Corymbia hamersleyana</i> over High Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> and <i>Gossypium robinsonii</i> on red brown clay loam on medium drainage lines and surrounding floodplains	1,924.75	676.89	529.93
ME TtAriCya ChEII AmPIAnI	<i>Themeda</i> Open Tussock Grassland	Open Tussock Grassland of <i>Themeda triandra</i> , <i>Aristida inaequiglumis</i> and <i>Cymbopogon ambiguus</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Shrubland of <i>Acacia monticola</i> , <i>Petalostylis labicheoides</i> and <i>Androcalva luteiflora</i> on red brown alluvium on minor and medium drainage lines	213.75	75.14	73.77

Map Code	Broad Floristic Formation	Vegetation Association	Area (ha) within Proposed MAC Development Envelope	Area (ha) within Indicative Additional Impact Assessment Area	Area (ha) within Additional Development Envelope
ME TtChfEua ExEvCh PIApaApy	<i>Themeda</i> Tussock Grassland	Tussock Grassland of <i>Themeda triandra</i> , <i>Chrysopogon fallax</i> and <i>Eulalia aurea</i> with Low Open Woodland of <i>Eucalyptus xerothermica</i> , <i>Eucalyptus victrix</i> and <i>Corymbia hamersleyana</i> and Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia pachyacra</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> on red sandy loam on medium drainage lines	28.91	0.00	0.00
ME TtEuaEte ApyAtpPI EvCh	<i>Themeda</i> Tussock Grassland	Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Eriachne tenuiculmis</i> with High Shrubland of <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Petalostylis labicheoides</i> and Open Woodland of <i>Eucalyptus victrix</i> and <i>Corymbia hamersleyana</i> on red brown silty loam on medium drainage lines and flood plains	35.85	0.00	0.00
MINOR DRAINAGE LINES					
MI AtpPIAm TpTs ChEII	<i>Acacia</i> Open Scrub	Open Scrub of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Petalostylis labicheoides</i> and <i>Acacia monticola</i> over Open Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia</i> sp. Shovelanna Hill (S.van Leeuwen 3835) with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> on red brown sandy loam on minor drainage lines	1,896.65	825.19	599.05
MI PIAtpAm ChEII TwTp	<i>Petalostylis</i> Shrubland	Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Acacia monticola</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Hummock Grassland of <i>Triodia wiseana</i> and <i>Triodia pungens</i> on red brown loam on minor drainage lines	161.62	105.28	120.17
STONY PLAINS					
SP AaApr TmTwTp TtChfAri	<i>Acacia</i> Low Open Forest	Low Open Forest of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> over Open Hummock Grassland of <i>Triodia melvillei</i> , <i>Triodia wiseana</i> and <i>Triodia pungens</i> over Tussock Grassland of <i>Themeda triandra</i> , <i>Chrysopogon fallax</i> and <i>Aristida inaequiglumis</i> on red brown loam on plains	491.47	220.56	209.93

Map Code	Broad Floristic Formation	Vegetation Association	Area (ha) within Proposed MAC Development Envelope	Area (ha) within Indicative Additional Impact Assessment Area	Area (ha) within Additional Development Envelope
SP AcaoAa ArobDiaChf	<i>Acacia</i> Low Open Forest	Low Open Forest of <i>Acacia catenulata</i> subsp. <i>occidentalis</i> and <i>Acacia aptaneura</i> over Very Open Tussock Grassland of <i>Aristida obscura</i> , <i>Digitaria ammophila</i> and <i>Chrysopogon fallax</i> on red brown clay loam on lower stony plains	68.80	44.29	68.80
SP TpTb Eg PIAbAanc	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia basedowii</i> with Open Mallee of <i>Eucalyptus gamophylla</i> and Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia bivenosa</i> and <i>Acacia ancistrocarpa</i> on red brown loamy sand on stony plains and footslopes	260.17	42.91	0.00
SP TpTm AaExAcao ApaErffAads	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia melvillei</i> with Low Open Woodland of <i>Acacia aptaneura</i> , <i>Eucalyptus xerothermica</i> and <i>Acacia catenulata</i> subsp. <i>occidentalis</i> and Open Shrubland of <i>Acacia pachyacra</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Acacia adsurgens</i> on red brown clay loam or silty loam on stony plains and floodplains	3,346.43	1,927.01	1,766.66
SP TsTwTp EgEt AbApaApr	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835), <i>Triodia wiseana</i> and <i>Triodia pungens</i> with Very Open Mallee of <i>Eucalyptus gamophylla</i> and <i>Eucalyptus trivalva</i> over Open Shrubland of <i>Acacia bivenosa</i> , <i>Acacia pachyacra</i> and <i>Acacia pruinocarpa</i> on red brown sandy loam and clay loam on stony plains	1,188.37	814.58	484.77

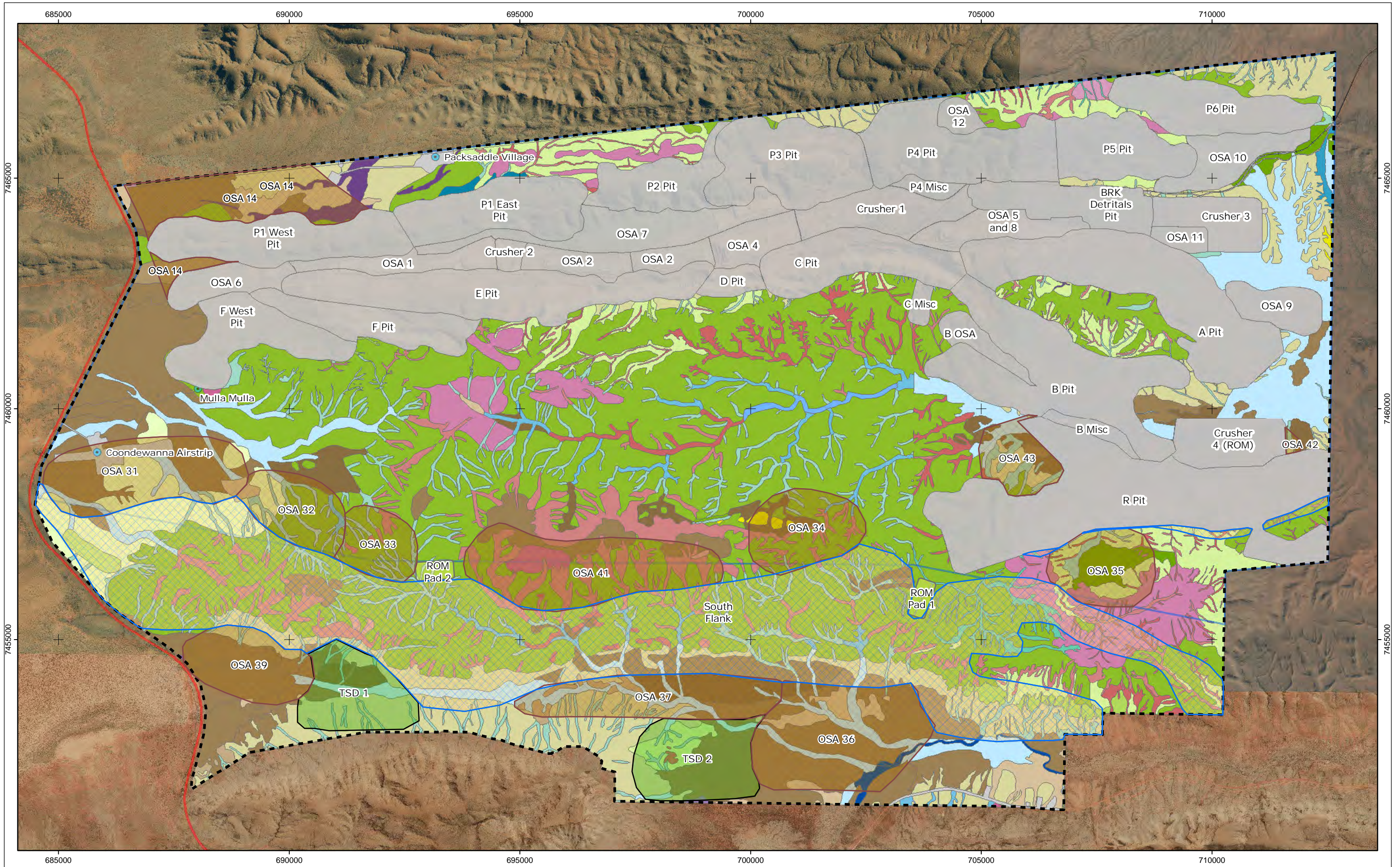
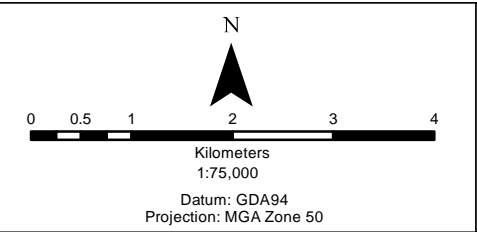


Figure:	11	Date:	02/08/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
		GSM Reference:	MAC_Veg_type






**BHPBIO
MINING AREA C**
 Vegetation association map for the Proposed
 MAC Development Envelope
 Figure 11


GRIFFIN
 SPATIAL & MAPPING
 PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213









Legend

Vegetation Types



Hill Crest

	HC TpTwTs EIICh AarGooKeve	Hummock Grassland of <i>Triodia pungens</i> , <i>Triodia wiseana</i> and <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwin 3835) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Low Shrubland of <i>Acacia arida</i> , <i>Gompholobium oreophilum</i> and <i>Keraudrinia velutina</i> subsp. <i>elliptica</i> on red brown loam on hill crests and upper hill slopes
	HC Tw Ah EkkEgCh	Hummock Grassland of <i>Triodia wiseana</i> with Shrubland of <i>Acacia hamersleyensis</i> and Open Mallee of <i>Eucalyptus kingsmillii</i> subsp. <i>kingsmillii</i> , <i>Eucalyptus gamophylla</i> and <i>Corymbia hamersleyana</i> (mallee form) on red brown loam and silty loam on hill crests
	HC TwTsTp EIICh Ah	Hummock Grassland of <i>Triodia wiseana</i> , <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) and <i>Triodia pungens</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Open Shrubland of <i>Acacia hamersleyensis</i> on red brown clay loam on hill crests and upper hill slopes




Hillslope

	HS AaApr ErjpAmarCocf TwTp	Low Woodland of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> over Shrubland of <i>Eremophila jucunda</i> subsp. <i>pulcherrima</i> , <i>Acacia marramamba</i> and <i>Codonocarpus cotinifolius</i> over Open Hummock Grassland of <i>Triodia wiseana</i> and <i>Triodia pungens</i> on red brown loam on steep hill slopes
	HS TbrTw EII	Hummock Grassland of <i>Triodia brizoides</i> and/or <i>Triodia wiseana</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> on brown sandy loam on steep hill slopes
	HS Tp AaApr ErfrAmarSegl	Open Hummock Grassland of <i>Triodia pungens</i> with Low Open Woodland of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> over Open Shrubland of <i>Eremophila fraseri</i> , <i>Acacia marramamba</i> and <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> on red brown loam on undulating hills
	HS Tp EII SeggGrwhErlI	Hummock Grassland of <i>Triodia pungens</i> with Scattered Low Trees of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and Scattered Shrubs of <i>Senna glutinosa</i> subsp. <i>glutinosa</i> , <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> and <i>Eremophila latrobei</i> subsp. <i>latrobei</i> on skeletal orange brown loam on stony hill slopes
	HS TsTw Eg GrwhSeggAb	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) and <i>Triodia wiseana</i> with Very Open Mallee of <i>Eucalyptus gamophylla</i> over Open Shrubland of <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> , <i>Senna glutinosa</i> subsp. <i>glutinosa</i> and <i>Acacia bivenosa</i> on red brown sandy clay loam on hill slopes
	HS TsTwTp EIICh AhiAaa	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835), <i>Triodia wiseana</i> and <i>Triodia pungens</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Low Open Shrubland of <i>Acacia hilliana</i> and <i>Acacia adoxa</i> var. <i>adoxo</i> on red brown sandy loam on hill slopes
	HS TwTpTbr EII Ep	Hummock Grassland of <i>Triodia wiseana</i> , <i>Triodia pungens</i> and <i>Triodia brizoides</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Mallee of <i>Eucalyptus pilbarensis</i> on red brown loam on steep hill slopes
	HS TwTpTs EII AprAaAanc	Hummock Grassland of <i>Triodia wiseana</i> , <i>Triodia pungens</i> and <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Shrubland of <i>Acacia pruinocarpa</i> , <i>Acacia aptaneura</i> and <i>Acacia ancistrocarpa</i> on red brown loam on plains and low hills


Foot Slopes

	FS Ts CdHc AancAiGrwh	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of <i>Corymbia deserticola</i> subsp. <i>deserticola</i> and <i>Hakea chordophylla</i> over Open Shrubland of <i>Acacia ancistrocarpa</i> , <i>Acacia inaequilatera</i> and <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> on red brown sandy loam on footslopes and stony plains
	FS TsTpTw EII AbAaAanc	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835), <i>Triodia pungens</i> and <i>Triodia wiseana</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and Open Shrubland of <i>Acacia bivenosa</i> , <i>Acacia pachyachra</i> and <i>Acacia ancistrocarpa</i> on red brown loam on footslopes, low undulating hills and stony plains






Gorge / Gully

	GG CcolCfEII ErmuThmbCya	Low Open Forest of <i>Callitris columellaris</i> , <i>Corymbia ferritcola</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Tussock Grassland of <i>Eriachne mucronata</i> , <i>Themeda</i> sp. Mt Barricade (M.E. Trudgen 2471) and <i>Cymbopogon ambiguus</i> and Very Open Hummock Grassland of <i>Triodia</i> subsp. <i>pungens</i> on orange brown loam on upper gorges
	GG CfEII Fib AhDovmasha CyaErmuThmb	Low Woodland of <i>Corymbia ferritcola</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Ficus brachypoda</i> over Open Shrubland of <i>Acacia hamersleyensis</i> , <i>Dodonaea viscosa</i> subsp. <i>mucronata</i> and <i>Astrotricha hamptonii</i> over Open Tussock Grassland of <i>Cymbopogon ambiguus</i> , <i>Eriachne mucronata</i> and <i>Themeda</i> sp. Mt Barricade on red brown loam along cliff lines and gorge walls
	GG TtErmuThmb EIIChCf AtpGoroPI	Tussock Grassland of <i>Themeda triandra</i> , <i>Eriachne mucronata</i> and <i>Themeda</i> sp. Mt Barricade with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , <i>Corymbia hamersleyana</i> and <i>Corymbia ferritcola</i> over High Shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Gossypium robinsonii</i> and <i>Petalostylis labicheoides</i> on red brown sandy loam on narrowly incised rocky drainage lines

Calcrete Plain

	CP TwTa Ese AbPIApy	Hummock Grassland of <i>Triodia wiseana</i> and <i>Triodia angusta</i> with Open Mallee of <i>Eucalyptus socialis</i> subsp. <i>eucentrica</i> and Open Shrubland of <i>Acacia bivenosa</i> , <i>Petalostylis labicheoides</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> on light brown clay loam on calcrete plains and
---	---------------------	--

Stony Plain

	SP AaApr TmTwTp TtChfAri	Low Open Forest of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> over Open Hummock Grassland of <i>Triodia melvillei</i> , <i>Triodia wiseana</i> and <i>Triodia pungens</i> over Tussock Grassland of <i>Themeda triandra</i> , <i>Chrysopogon fallax</i> and <i>Aristida inaequiglumis</i> on red brown loam on stony plains
	SP AcaoAa ArobDiaChf	Low Open Forest of <i>Acacia catenulata</i> subsp. <i>occidentalis</i> and <i>Acacia aptaneura</i> over Very Open Tussock Grassland of <i>Aristida obscura</i> , <i>Digitaria ammophila</i> and <i>Chrysopogon fallax</i> on red brown clay loam on lower stony plains
	SP TpTb Eg PIAbAanc	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia basedowii</i> with Open Mallee of <i>Eucalyptus gamophylla</i> and Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia bivenosa</i> and <i>Acacia ancistrocarpa</i> on red brown loamy sand on stony plains and
	SP TpTm AaExAcao ApaErffAads	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia melvillei</i> with Low Open Woodland of <i>Acacia aptaneura</i> , <i>Eucalyptus xerothermica</i> and <i>Acacia catenulata</i> subsp. <i>occidentalis</i> and Open Shrubland of <i>Acacia pachyachra</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Acacia adsurgens</i> on red brown clay loam or silty loam on stony plains and floodplains
	SP TsTwTp EgEt AbApaApr	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835), <i>Triodia wiseana</i> and <i>Triodia pungens</i> with Very Open Mallee of <i>Eucalyptus gamophylla</i> and <i>Eucalyptus trivalva</i> over Open Shrubland of <i>Acacia bivenosa</i> , <i>Acacia pachyachra</i> and <i>Acacia pruinocarpa</i> on red brown sandy loam and clay loam on stony plains

Flood Plain





	FP AaAcaoAp ErlnSolPto ArcErdiArj	Low Open Woodland of <i>Acacia aptaneura</i> , <i>Acacia catenulata</i> subsp. <i>occidentalis</i> and <i>Acacia paraneura</i> over Low Open Shrubland of <i>Eremophila lanceolata</i> , <i>Solanum lasiophyllum</i> and <i>Ptilotus obovatus</i> over Very Open Tussock Grassland of <i>Aristida contorta</i> , <i>Eragrostis dielsii</i> and <i>Aristida jericohenis</i> var. <i>subspinulifera</i> on red brown clay loam on hardpan intergrove plains
	FP AaApApt TtChfErb	Low Open Forest of <i>Acacia aptaneura</i> , <i>Acacia paraneura</i> and <i>Acacia pteraneura</i> over Open Tussock Grassland of <i>Themeda triandra</i> , <i>Chrysopogon fallax</i> and <i>Eriachne benthamii</i> on red brown clay loam on floodplains
	FP Ev Aa EuaErbTt	Woodland of <i>Eucalyptus victrix</i> over Low Woodland of <i>Acacia aptaneura</i> over Open Tussock Grassland of <i>Eulalia aurea</i> , <i>Eriachne benthamii</i> and <i>Themeda triandra</i> on orange clay loam on
	FP TtEua ExAa AprAtpErla	Tussock Grassland of <i>Themeda triandra</i> and <i>Eulalia aurea</i> with Low Woodland of <i>Eucalyptus xerothermica</i> and <i>Acacia aptaneura</i> over Open Shrubland of <i>Acacia pruinocarpa</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Eremophila longifolia</i> on red brown clay loam on uncised drainage lines and floodplains



Figure: 11	Date: 30/06/2015
Sheet Size: A3	Status: FINAL
Drawn by: GSM	Requested by: DB
GSM Reference: MAC_Veg_cond	

BHPBIO
MINING AREA C
Vegetation association map legend - Page 1

Figure 11



Major Drainage


 MA AtpApyAse Ecr ThmbTtCyp

High Shrubland of *Acacia tumida* var. *pilbarensis*, *Acacia pyrifolia* var. *pyrifolia* and *Acacia sericophylla* with Scattered Trees of *Eucalyptus camaldulensis* subsp. *refulgens* over Open Tussock Grassland of *Themeda* sp. Mt Barricade (M.E. Trudgen 2471), *Themeda triandra* and *Cymbopogon procerus* on brown loam and gravels on major drainage channels

 MA EcrEvEx ApyAtpGoro TtEuaCyp

Low Open Forest of *Eucalyptus camaldulensis* subsp. *refulgens*, *Eucalyptus victrix* and *Eucalyptus xerothermica* over High Shrubland of *Acacia pyrifolia* var. *pyrifolia*, *Acacia tumida* var. *pilbarensis* and *Gossypium robinsonii* over Open Tussock Grassland of *Themeda triandra*, *Eulalia aurea* and *Cymbopogon procerus* on red brown clay loam on major drainage lines

Medium Drainage

 ME TpTlo ExAciCh PIAPypGoro

Hummock Grassland of *Triodia pungens* and *Triodia longiceps* with Low Woodland of *Eucalyptus xerothermica*, *Acacia citrinoviridis* and *Corymbia hamersleyana* over High Shrubland of *Petalostylis labicheoides*, *Acacia pyrifolia* var. *pyrifolia* and *Gossypium robinsonii* on red brown clay loam on medium drainage lines and surrounding floodplains

 ME TtAriCya ChEII AmPIAnI

Open Tussock Grassland of *Themeda triandra*, *Aristida inaequiglumis* and *Cymbopogon ambiguus* with Low Open Woodland of *Corymbia hamersleyana* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Shrubland of *Acacia monticola*, *Petalostylis labicheoides* and *Androcalva luteiflora* on red brown alluvium on minor and medium drainage lines

 ME TtChfEua ExEvCh PIAPaApy

Tussock Grassland of *Themeda triandra*, *Chrysopogon fallax* and *Eulalia aurea* with Low Open Woodland of *Eucalyptus xerothermica*, *Eucalyptus victrix* and *Corymbia hamersleyana* and Shrubland of *Petalostylis labicheoides*, *Acacia pachyacra* and *Acacia pyrifolia* var. *pyrifolia* on red sandy loam on medium drainage lines

 ME TtEuaEte ApyAtpPI EvCh

Tussock Grassland of *Themeda triandra*, *Eulalia aurea* and *Eriachne tenuiculmis* with High Shrubland of *Acacia pyrifolia* var. *pyrifolia*, *Acacia tumida* var. *pilbarensis* and *Petalostylis labicheoides* and Open Woodland of *Eucalyptus victrix* and *Corymbia hamersleyana* on red brown silty loam on medium drainage lines and flood plains

Minor Drainage

 MI AtpPIAm TpTs ChEII

Open Scrub of *Acacia tumida* var. *pilbarensis*, *Petalostylis labicheoides* and *Acacia monticola* over Open Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill (S.van Leeuwen 3835) with Low Open Woodland of *Corymbia hamersleyana* and *Eucalyptus leucophloia* subsp. *leucophloia* on red brown sandy loam on minor drainage lines

 MI PIATpAm ChEII TwTp


Shrubland of *Petalostylis labicheoides*, *Acacia tumida* var. *pilbarensis* and *Acacia monticola* with Low Open Woodland of *Corymbia hamersleyana* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Hummock Grassland of *Triodia wiseana* and *Triodia pungens* on red brown loam on minor drainage lines


Other

 Cleared

 Mine Accommodation

 Indicative Additional Infrastructure Areas

 Indicative Additional OSA


 Indicative Additional Pits

 Indicative OSA Area

 Indicative Pit Area

 ROM

 Topsoil

 Previously Approved Areas

 Indicative Additional Infrastructure

 Ministerial Statement 491 (Northern Flank)

 Proposed Mining Area C Development Envelope



Figure:	11	Date:	30/06/2015
Sheet Size:	A3	Status:	FINAL
Drawn by GSM	Requested by DB	GSM Reference MAC_Veg_cond	



3.8 Vegetation Condition

Vegetation condition within the Proposed MAC Development Envelope ranged from *completely degraded* to *pristine* (Figure 12, Appendix 6) with the largest proportion of Development Envelope rated as *excellent* (61 percent) or *very good* (25 percent) (Table 13). Smaller areas supported vegetation condition rated as *pristine* (3 percent), *good* (4 percent), *degraded* (<1 percent) or *completely degraded* (6 percent).

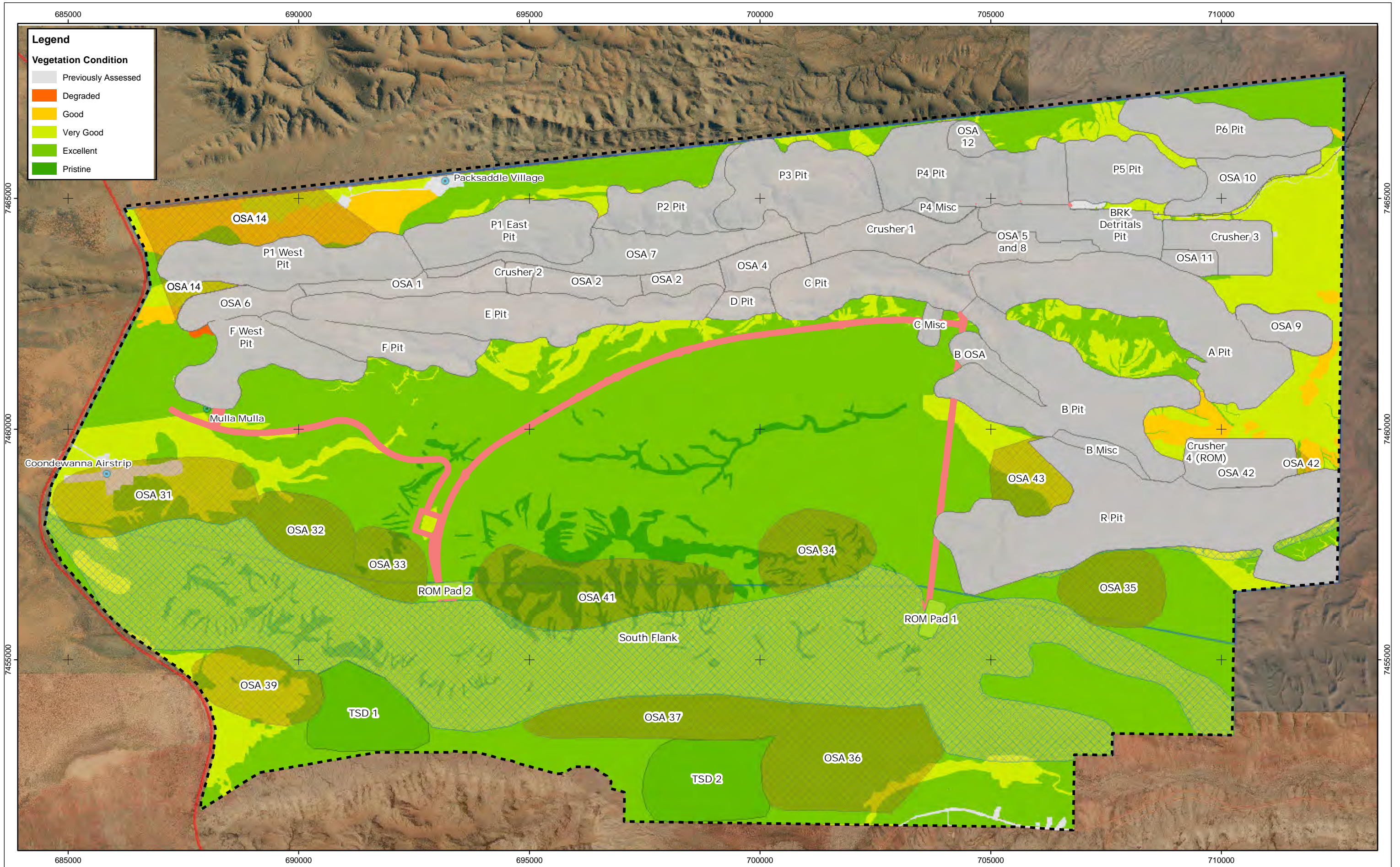
Vegetation in areas of higher relief, with restricted access and supporting less palatable plant species retained higher condition scores in the range of *excellent* to *pristine* (Figure 12). This included the northern fringe of the Development Envelope supporting remote sections of Packsaddle Range, and the majority of uplands occurring south of the existing MAC infrastructure and mining operations. The deep rocky gorge habitats through central sectors of the Development Envelope supported vegetation condition rated as *pristine* (Figure 12). Vegetation condition declined to *very good* or *good* on drainage lines and flood plains in western and eastern sectors of the Proposed MAC Development Envelope, as well as areas of Packsaddle Range supporting exploration (Figure 12). The major impact on lowland vegetation resulted from grazing by domestic stock which contributed to changes in native vegetation structure and composition, introduction of weed species, and surface instability. Areas supporting vegetation condition rated as *degraded* or *completely degraded* were restricted to areas within or adjacent to existing mining operations at MAC (Figure 12).

Vegetation condition within Indicative Additional Impact Assessment Area in the southern half of the Development Envelope were rated as *pristine*, *excellent* and *very good*, and were in contrast to ratings around existing MAC operations in the northern sector where vegetation condition was rated as *very good*, *good* or *completely degraded* (Figure 12). Vegetation condition for the majority of the Indicative Additional Impact Assessment Area was rated as *excellent* (77.2 percent), with deep and inaccessible gorges rated as *pristine* (6 percent) (Table 13). These gorges were situated predominantly within the proposed footprint of the Southern Flank Pit, and OSAs 33, 34, 39 and 41 (Figure 12). Vegetation condition declined to *good* on flood plains and stony plains due primarily to grazing by domestic stock.

Table 13 Vegetation condition within the Proposed MAC Development Envelope, Additional Development Envelope, and Indicative Additional Impact Assessment Area. Note: percentages provide proportional representation of the total area.

Vegetation Condition	Area within the Proposed MAC Development Envelope (ha)	Area within the Additional Development Envelope (ha)	Area within the Indicative Additional Impact Assessment Area (ha)
Completely Degraded	2,168.02 ⁸ (6.1%)	29.35 (0.3%)	74.11 (0.6%)
Degraded	304.29 (0.8%)	0.00	0.00
Good	1,425.72 (4.0%)	0.00	527.27 (4.3%)
Very Good	9,005.84 (25.0%)	605.99 (5.9%)	1,463.59 (11.9%)
Excellent	21,934.85 (60.9%)	9,062.64 (88.7%)	9,473.21 (77.2%)
Pristine	1,189.64 (3.2%)	520.20 (5.1%)	732.73 (6.0%)

⁸ Total includes cleared areas.



ONSHORE ENVIRONMENTAL

Figure:	12	Date:	03/08/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference		MAC_SigF	

N

0 0.5 1 2 3 4
Kilometers
1:75,000

Datum: GDA94
Projection: MGA Zone 50

BHPBIO MINING AREA C
Vegetation condition map for the Proposed MAC Development Envelope
Figure 12

Legend

Mine Accommodation	Indicative OSA Area	Indicative Additional Infrastructure
Indicative Additional Infrastructure Areas	Indicative Pit Area	Ministerial Statement 491 (Northern Flank)
Indicative Additional OSA	ROM	Proposed Mining Area C Development Envelope
Indicative Additional Pits	Topsoil	
	Previously Approved Areas	

GRIFFIN SPATIAL & MAPPING
PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

3.9 Significance of Vegetation Associations

3.9.1 National Significance

A search of the EPBC Act Protected Matters database (DotE 2016) confirmed there were no Federal listed TECs recorded within, or adjacent to, the Proposed MAC Development Envelope.

3.9.2 State Significance

A search of the DPaW communities database (DPaW 2015b) confirmed there were no State listed TECs or PECs recorded within the Proposed MAC Development Envelope. However, sub-type 2 of the Coolibah-lignum Flats PEC is associated with Lake Robinson and occurs approximately 250 m west of the Proposed MAC Development Envelope at its closest point. The Priority 3(i) sub-type 1 PEC occurs on adjacent alluvial flats (Coondewanna Flats) extending to the south of Lake Robinson and separated from the Additional Development Envelope by the Great Northern Highway. Field assessments confirmed that neither of the sub-types for the Coolibah-lignum Flats PEC occurred within the Proposed MAC Development Envelope.

3.9.3 Local Significance on Basis of Specialised Landform

Local significance can be determined where a vegetation association is confined to a specialised habitat that is not common in the local area. There were four vegetation associations within the Additional Development Envelope and Indicative Additional Impact Assessment Area determined to be of local significance. These vegetation associations are described in further detail below.

Major Drainage Lines

All major ephemeral water courses in the Hamersley subregion are listed as 'ecosystems at risk' by the DPaW due to threats from grazing and weed invasion as described by Kendrick (2001). There was one vegetation association recorded within the Additional Development Envelope that occurred on a major drainage line; Low Open Forest of *Eucalyptus camaldulensis* subsp. *refulgens*, *Eucalyptus victrix* and *Eucalyptus xerothermica* over High Shrubland of *Acacia pyrifolia* var. *pyrifolia*, *Acacia tumida* var. *pilbarensis* and *Gossypium robinsonii* over Open Tussock Grassland of *Themeda triandra*, *Eulalia aurea* and *Cymbopogon procerus* on red brown clay loam on major drainage lines (MA EcrEvEx ApypAtpGoro TtEuaCyp). It occurred over 49.0 ha along a major drainage in the south-east corner of the Additional Development Envelope and was represented within the Indicative Additional Impact Assessment Area (30.0 ha). There were two Priority flora taxa recorded from within this association; *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3) and *Rostellularia adscendens* var. *latifolia* (P3).

Mulga Vegetation on Floodplains

'Valley Floor Mulga' within the Hamersley subregion (Kendrick 2001) was considered to be an 'ecosystem at risk' by the the then Department of Conservation and Land Management (now DPaW). This ecosystem is represented by vegetation associations occurring on valley floors or broad plains, which have a reasonably dense Mulga overstorey (i.e. at least 10-30 percent cover). The understorey is variable, comprising mixed tussock grasslands, hummock grasslands and/or herblands.

Mulga is widespread across arid and semi-arid regions of Western Australia, covering approximately 37 percent of the surface area of Western Australia (Fox 1980). 'Valley floor mulga' extends over a range of approximately 350 km through the southern half

of the Pilbara. It is thought that Mulga sensitivity to disturbance is greatest at the northern limit of its distribution in the Pilbara (Fox 1988). The sensitivity of Mulga in the Pilbara may be related to the dominance of summer rainfall.

Three vegetation associations represented within both the Proposed MAC Development Envelope and the Indicative Additional Impact Assessment Area support Mulga vegetation on stony plains and floodplains (Figure 13), and are equivalent to 'Valley Floor Mulga'. These vegetation associations are described as:

- Low Open Forest of *Acacia aptaneura* and *Acacia pruinocarpa* over Open Hummock Grassland of *Triodia melvillei*, *Triodia wiseana* and *Triodia pungens* over Tussock Grassland of *Themeda triandra*, *Chrysopogon fallax* and *Aristida inaequiglumis* on red brown loam on plains (SP AaApr TmTwTp TtChfAri);
- Low Open Forest of *Acacia catenulata* subsp. *occidentalis* and *Acacia aptaneura* over Very Open Tussock Grassland of *Aristida obscura*, *Digitaria ammophila* and *Chrysopogon fallax* on red brown clay loam on lower stony plains (SP AcaoAa ArobDiaChf); and
- Tussock Grassland of *Themeda triandra* and *Eulalia aurea* with Low Woodland of *Eucalyptus xerothermica* and *Acacia aptaneura* over Open Shrubland of *Acacia pruinocarpa*, *Acacia tumida* var. *pilbarensis* and *Eremophila longifolia* on red brown clay loam on unincised drainage lines and floodplains (FP TtEua ExAa AprAtpErlo).

Mulga is drought tolerant but reliant on overland flow of surface water following summer rains. Interruption of surface water flows may impact on the integrity of Mulga stands and ultimately lead to tree decline. Additionally the three vegetation associations listed above support species of state conservation significance including *Aristida lazaridis* (P2), *Aristida jerichoensis* var. *subspinulifera* (P3) and *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3).

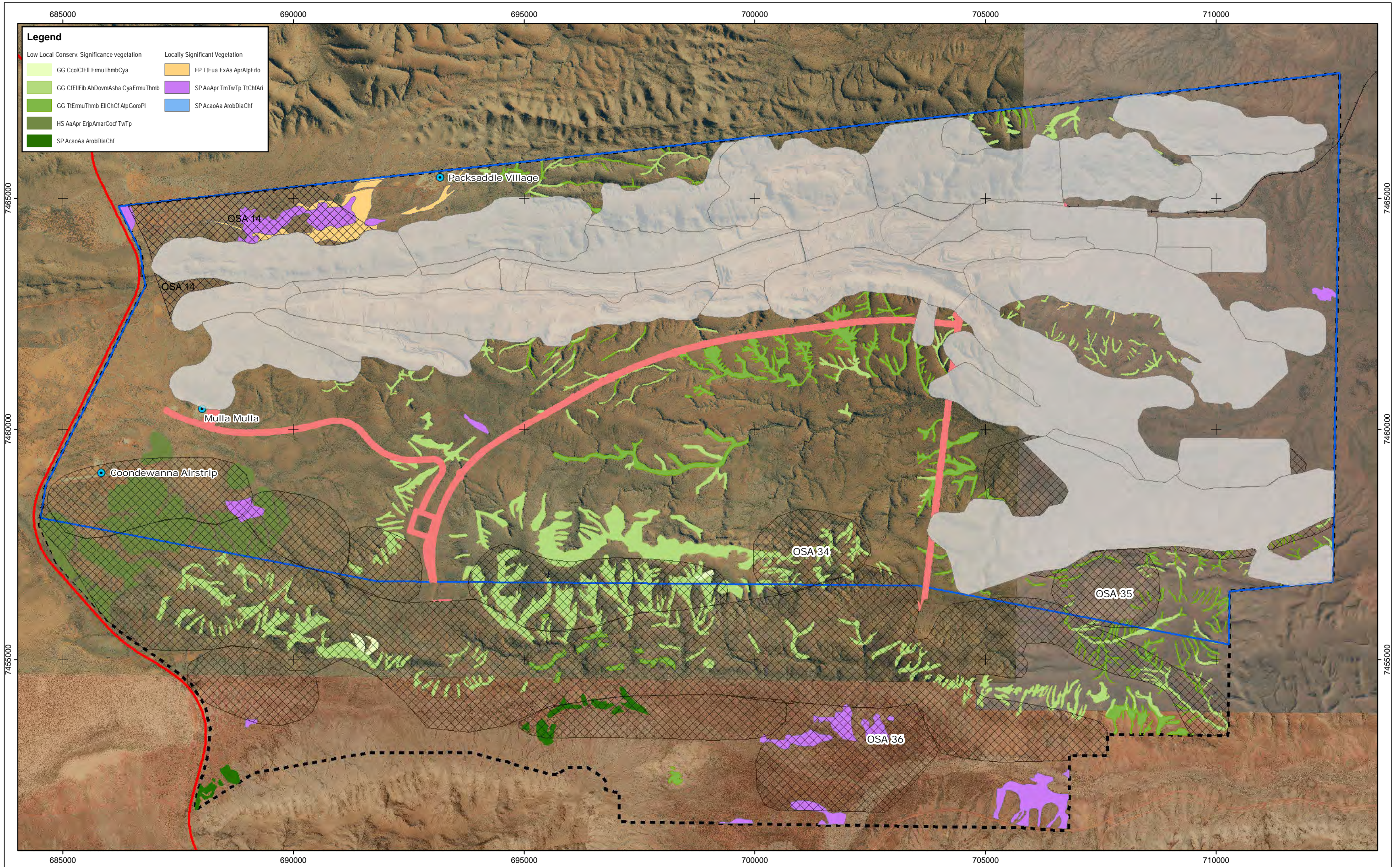


Figure 13
Distribution of Mulga vegetation on floodplains and stony plains, and vegetation associations classified as having 'low' local conservation significance within the Indicative Additional Impact Assessment Area.

3.9.4 Local Significance on Basis of Supporting Significant Flora

There are 15 vegetation associations within the Proposed MAC Development Envelope that support at least one conservation significant flora species, and therefore, may be considered locally significant (Table 14). Five of the ten Priority flora recorded from the Proposed MAC Development Envelope were restricted to three vegetation associations occurring on gorges (Table 14, Figure 13); *Acacia bromilowiana* (P4), *Grevillea saxicola* (P3), *Sida* sp. Barlee Range (S. van Leeuwen 1642) (P3), *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3) and *Nicotiana umbratica* (P3). It is noted that *Grevillea saxicola* (P3) and *Nicotiana umbratica* (P3) occur outside the Indicative Additional Impact Assessment Area. The three gorge associations also support *Eremophila magnifica* subsp. *magnifica* (P4), *Rostellularia adscendens* var. *latifolia* (P3) and *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3).

The remaining twelve vegetation associations supporting Priority flora taxa occurred on hill slopes, footslopes, stony plains, flood plains, and minor, medium and major drainage lines (Table 14). Together, these vegetation associations support the more cosmopolitan Priority flora taxa *Aristida jerichoensis* var. *subspinulifera* (occurring in four associations), *Aristida lazaridis* (occurring in six associations), *Eremophila magnifica* subsp. *magnifica* (occurring in five associations), *Rostellularia adscendens* var. *latifolia* (occurring in five associations) and *Rhagodia* sp. Hamersley (M. Trudgen 17794) (occurring in eight associations). These taxa are represented both within and outside of the Indicative Additional Impact Assessment Area (Table 14).

Table 14 Number of Priority flora records (locations) within each of the 15 vegetation associations supporting significant flora, with comparison between the Proposed MAC Development Envelope (left column) and the Indicative Additional Development Envelope (right column).

Vegetation Association	Acacia bromilowiana		Aristida jerichoensis var. subspinulifera		Aristida lazaridis		Eremophila magnifica subsp. magnifica		Grevillea saxicola		Rostellularia adscendens var. latifolia		Rhagodia sp. Hammersley		Sida sp. Barlee Range		Triodia sp. Mt Ella		Nicotiana umbratica	
GG CcoICfEII ErmuThmbCya	1	1																		
GG CfEIIIFib AhDovmAsha CyaErmuThmb							20	11	1	0	1	1			7	7	1	1		
GG TtErmuThmb EIICf AtpGoroPI							10	0					2	1					1	0
HS AaApr ErjpAmarCocf TwTp							1	1					2	2						
HS TsTwTp EIICf AhiAaa					1	0	27	16			1	1	1	0						
FS Ts CdHc AancAiGrwh			3	0	21	0					11	0	13	1						
SP AaApr TmTwTp TtChfAri			9	1	13	13							57	50						
SP AcaoAa ArobDiaChf													4	4						
SP TpTm AaExAcao ApaErffAads			34	9	3	3	2	2					59	33						
SP TsTwTp EgEt AbApaApr			3	1								2	2	4	2					
FP TtEua ExAa AprAtpErlo					55	44							8	6						
MI AtpPIAm TpTs ChEII					1	0	5	2			1	0								
ME TtAriCya ChEII AmPIAnI							3	0			2	2								
ME TpTlo ExAcicH PIAppyGoro			1	0							9	0	8	5						
MA EcrEvEx AppyAtpGoro TtEuaCyp											1	1	4	3						

4 EVALUATION OF IMPACTS

4.1 Direct Clearing

4.1.1 Vegetation Complex Mapping

The Proposed MAC Development Envelope is located within the Hamersley Botanical District within the Pilbara IBRA region, which is part of the Eremaean Province (Beard 1990). Broad scale vegetation mapping undertaken by Beard (1975) and refined by Shepherd *et al.* (2002) show two vegetation complexes occurring within the Development Envelope; Hamersley 82 and Hamersley 18 (Figure 3). The Pre-European extent remaining for each of these vegetation complexes is estimated at close to 100 percent, or 2,290,910 ha (100 percent) and 24,659,110 ha (99.9 percent) respectively. At a regional scale the area of each vegetation complex within the Proposed MAC Development Envelope is 22,864 ha (Hamersley 82) and 13,168 ha (Hamersley 18), representing less than 1 percent of the total extent of each. The regional impact from direct clearing within the Development Envelope (and smaller Indicative Additional Impact Assessment Area) will be insignificant at the vegetation complex level.

4.1.2 Vegetation Association Mapping

Broadscale mapping at the vegetation association level occurs over a limited extent within the Pilbara, so inference at this fine scale is not possible. However, BHP Billiton Iron Ore has recently merged and collated vegetation association maps from 162 historical baseline surveys within their Pilbara tenure into a single consolidated map. The vegetation map represents a unique database on which to undertake preliminary impact assessment at the vegetation association level. The fine scale vegetation map covers 4,296 km² (429,623 ha), which represents 2.36 percent of the total Pilbara region.

Based on BHP Billiton Iron Ore's consolidated vegetation association mapping database, 29 of the 34 vegetation associations mapped within the Proposed Mining Area C Development Envelope have less than 30 percent of their total mapped area within the Additional Development Envelope or the Indicative Additional Impact Assessment Area, and most (21) have less than 10 percent of their mapped occurrence within the Indicative Additional Impact Assessment Area (Table 15). Impacts to these vegetation associations from clearing are therefore considered to be minor.

For two vegetation associations, both containing a dominant Mulga canopy, 50 percent or more of their total mapped area (within the consolidated vegetation association mapping database) occurs within the Indicative Additional Impact Assessment Area (Table 15):

- Low Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over Shrubland of *Eremophila jucunda* subsp. *pulcherrima*, *Acacia marramamba* and *Codonocarpus cotinifolius* over Open Hummock Grassland of *Triodia wiseana* and *Triodia pungens* on red brown loam on hill slopes (HS AaApr ErjpAmarCocf TwTp); and
- Low Open Forest of *Acacia catenulata* subsp. *occidentalis* and *Acacia aptaneura* over Very Open Tussock Grassland of *Aristida obscura*, *Digitaria ammophila* and *Chrysopogon fallax* on red brown clay loam on lower stony plains (SP AcaoAa ArobdiaChf).

4.1.3 Significant Vegetation Associations

There are no TECs or PECs represented within the Additional Development Envelope or Proposed Mining Area C Development Envelope, and hence no direct impact on Federal or State listed communities of conservation significance.

Fifteen vegetation associations within the Indicative Additional Impact Assessment Area are considered to have local conservation significant (Table 16). Ten of these are determined to have *very low* local conservation significance (Table 16), as they are well represented outside the Indicative Additional Impact Assessment Area and support Priority flora that occur within multiple vegetation associations within the Proposed MAC Development Envelope and wider Pilbara bioregion.

The remaining five vegetation associations occurring within the Indicative Additional Impact Assessment Area are determined to have *low* local conservation significance (Table 16, Figure 13). Three of the five vegetation associations occur on gorges and support Priority flora that are restricted to each of the three associations, noting that all three vegetation associations are well represented regionally.

The remaining two vegetation associations, 'Low Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over Shrubland of *Eremophila jucunda* subsp. *pulcherrima*, *Acacia marramamba* and *Codonocarpus cotinifolius* over Open Hummock Grassland of *Triodia wiseana* and *Triodia pungens* on red brown loam on hill slopes (HS AaApr ErjpAmarCocf TwTp)' and 'Low Open Forest of *Acacia catenulata* subsp. *occidentalis* and *Acacia aptaneura* over Very Open Tussock Grassland of *Aristida obscura*, *Digitaria ammophila* and *Chrysopogon fallax* on red brown clay loam on lower stony plains (SP AcaoAa ArobDiaChf)', have 49 percent or greater of their extent within BHP Billiton Iron Ore's Pilbara tenure occurring within the Indicative Additional Impact Assessment Area. This triggered a review of the regional representation, which confirmed that both associations are well represented across the wider Pilbara bioregion.

The vegetation association 'HS AaApr ErjpAmarCocf TwTp' was mapped as occurring on rocky hill slopes (hence the 'HS' prefix to the vegetation code). The vegetation association is characterised by the mid stratum shrubs *Eremophila jucunda* subsp. *pulcherrima* and *Acacia marramamba* which occur predominantly on rocky soils in areas of higher relief. Mulga vegetation occurring on uplands in the Pilbara is not considered to be a 'lower-slope mulga' or 'valley floor mulga' association, both of which are considered to be an ecosystem at risk by Kendrick (2001). Given its position in the landscape, the impact to 'HS AaApr ErjpAmarCocf TwTp' is considered to be very low.

'Valley Floor Mulga' within the Hamersley subregion is considered to be an 'ecosystem at risk' by Kendrick (2001). Vegetation association 'SP AcaoAa ArobDiaChf' is equivalent to 'valley floor mulga' given its occurrence on stony plains in areas of lower relief. Two Principal Botanists from Onshore Environmental have undertaken baseline flora and vegetation survey work within the Proposed Mining Area C Development Envelope on a regular basis since 2004 (Dr Darren Brearley and Dr Jerome Bull). Both botanists have also undertaken surveys across the wider Hamersley Range, including targeted survey work by helicopter within Karijini National Park. The botanists can confirm that vegetation supporting *Acacia catenulata* subsp. *occidentalis* and *Acacia aptaneura* is common on plains between Newman and Roy Hill (approximate range 150 km). It is also noted that seven other vegetation associations within BHP Billiton Iron Ore's consolidated vegetation mapping database support *Acacia catenulata* subsp. *occidentalis* and *Acacia*

aptaneura as dominant upperstorey components, and considered to be closely affiliated with 'SP AcaoAa ArobDiaChf'. As such, this vegetation association is not considered to be locally endemic or unique. Similarly, neither the vegetation association nor related ecosystem has been nominated as a PEC by DPaW since identified as an ecosystem at risk by Kendrick (2001) 16 years ago, suggesting a low level of perceived conservation significance. Hence, the overall impact is considered to be low.

Table 15 Representation of 34 vegetation associations occurring within the Proposed MAC Development Envelope and Indicative Additional Impact Assessment Area, with reference to the extent recorded from consolidated vegetation mapping across BHP Billiton Iron Ore’s Pilbara tenements. Shaded cells represent vegetation associations where >30 percent of the current mapped extent within BHP Billiton Iron Ore’s Pilbara tenure is within the Indicative Additional Impact Assessment Area.

Vegetation Code	Total area (ha) in consolidated mapping of BHPBIO Pilbara tenure	Total area (ha) within the Proposed MAC Development Envelope	% of total consolidated mapping area within the Proposed MAC Development Envelope	Total area (ha) within the Indicative Additional Impact Assessment Area	% of total consolidated mapping area within the Indicative Additional Impact Assessment Area
CP TwTa Ese AbPIApy	9926.13	28.80	0.29	16.93	0.17
FP Ev Aa EuaErbTt	122.62	1.30	1.06	0.50	0.41
FP AaApApt TtChfErb	10214.10	5.26	0.05	2.88	0.03
FP AaAcaoAp ErInSolPto ArcErdiArj	5761.48	1.41	0.02	1.32	0.02
FP TtEua ExAa AprAtpErlo	1934.84	134.68	6.96	56.18	2.90
FS Ts CdHc AancAiGrwh	43900.73	6170.72	14.06	1276.30	2.91
FS TsTpTw EII AbApaAanc	6748.88	58.73	0.87	0.00	0.00
GG CcoICfEII ErmuThmbCya	582.91	15.39	2.64	15.39	2.64
GG CfEIIIFib AhDovmAsha CyaErmuThmb	3588.29	1603.49	44.69	736.78	20.53
GG TtErmuThmb EIIChCf AtpGoroPI	943.63	633.80	67.17	132.67	14.06
HC TpTwTs EIICh AarGooKeve	5284.7	157.49	2.98	0.00	0.00
HC Tw Ah EkkEgCh	4757.58	1113.81	23.41	239.35	5.03
HC TwTsTp EIICh Ah	7908.09	87.79	1.11	58.03	0.73
HS AaApr ErjpAmarCocf TwTp	714.57	578.98	81.02	521.84	73.03
HS TbrTw EII	13910.33	2297.42	16.52	455.43	3.27
HS Tp EII SeggGrwhErII	379.68	95.46	25.14	69.19	18.22

Vegetation Code	Total area (ha) in consolidated mapping of BHPBIO Pilbara tenure	Total area (ha) within the Proposed MAC Development Envelope	% of total consolidated mapping area within the Proposed MAC Development Envelope	Total area (ha) within the Indicative Additional Impact Assessment Area	% of total consolidated mapping area within the Indicative Additional Impact Assessment Area
HS TsTw Eg GrwhSeggAb	1029.87	0.33	0.03	0.26	0.03
HS TsTwTp EICh AhiAaa	42184.16	10913.43	25.87	3710.48	8.80
HS TwTpTbr EI Ep	1569.66	14.32	0.91	10.06	0.64
HS TwTpTs EI AprAaAanc	1321.63	346.91	26.25	103.99	7.87
HS Tp AaApr ErfrAmarSegl	304.60	48.91	16.06	48.91	16.06
MA EcrEvEx ApypAtpGoro TtEuaCyp	2120.24	48.98	2.31	30.06	1.42
MA AtpApypAse Ecr ThmbTtCyp	257.85	41.23	15.99	0.00	0.00
ME TpTlo ExAciCh PIApypGoro	12126.98	1924.75	15.87	676.89	5.58
ME TtAriCya ChEI AmPIAnI	1565.97	213.75	13.65	75.14	4.80
ME TtChfEua ExEvCh PIAPAyp	1230.16	28.91	2.35	0.00	0.00
ME TtEuaEte ApypAtpPI EvCh	1032.77	35.85	3.47	0.00	0.00
MI AtpPIAm TpTs ChEI	5187.88	1896.65	36.56	825.19	15.91
MI PIAtPAm ChEI TwTp	1069.6	161.62	15.11	105.28	9.84
SP AaApr TmTwTp TtChfAri	7638.46	491.47	6.43	220.56	2.89
SP AcaoAa ArobDiaChf	88.65	68.80	77.61	44.29	49.96
SP TpTb Eg PIAbAanc	2113.58	260.17	12.31	42.91	2.03
SP TpTm AaExAcao ApaErffAads	34872.97	3346.43	9.60	1927.01	5.53
SP TsTwTp EgEt AbApaApr	4301.32	1188.37	27.63	814.58	18.94

Table 16 Impact assessment for locally significant vegetation associations within the Indicative Additional Impact Assessment Area.

Vegetation Association	Characteristics Defining Local Significance	% of Consolidated Mapping Area within Indicative Additional Impact Assessment Area	Impact
GG CcolCfEII ErmuThmbCya	Supports one P4 flora which is restricted to this vegetation association.	2.64	Low
GG CfEIIFib AhDovmAsha CyaErmuThmb	Supports four P3 flora and one P4 flora taxon. Three of the P3 flora are restricted to this vegetation association.	20.53	Low
GG TtErmuThmb EIICfCf AtpGoroPI	Supports two P3 flora and one P4 flora taxon. One of the P3 flora is restricted to this vegetation association.	14.06	Low
HS AaApr ErjpAmarCocf TwTp	Supports one P3 flora and one P4 flora taxon	73.03	Low
HS TsTwTp EIICf AhiAaa	Supports one P2, two P3 flora and one P4 flora taxon	8.80	Very Low
FS Ts CdHc AancAiGrwh	Supports one P2 and three P3 flora taxa	2.91	Very Low
SP AaApr TmTwTp TtChfAri	Supports one P2 and two P3 flora taxa	2.89	Very Low
SP AcaoAa ArobDiaChf	Supports one P3 flora taxa	49.96	Low
SP TpTm AaExAcao ApaErffAads	Supports one P2, two P3 flora and one P4 flora taxon	5.53	Very Low
SP TsTwTp EgEt AbApaApr	Supports three P3 flora taxon	18.94	Very Low
FP TtEua ExAa AprAtpErlo	Supports one P2 and one P3 flora taxon	2.90	Very Low
MI AtpPIAm TpTs ChEII	Supports one P2, one P3 flora and one P4 flora taxon	15.91	Very Low
ME TtAriCya ChEII AmPIAnI	Supports one P3 flora and one P4 flora taxon	4.80	Very Low
ME TpTlo ExAciCh PIApypGoro	Supports three P3 flora taxa	5.58	Very Low
MA EcrEvEx ApypAtpGoro TtEuaCyp	Supports two P3 flora taxa	1.42	Very Low
MA AtpApypAse Ecr ThmbTtCyp	No significant flora recorded	0.00	None

4.1.4 Impacts to Significant Flora

Eight Priority flora taxa have been recorded within the Indicative Additional Impact Assessment Area (Table 17). *Grevillea saxicola* (P3) and *Nicotiana umbratica* (P3) have not been recorded from within the Additional Impact Assessment, and are not discussed further in this assessment.

Acacia bromilowiana (Priority 4)

Acacia bromilowiana was recorded from one population within the upper reaches of a gorge within the Indicative Additional Impact Assessment Area (Figure 9) where plants provided an estimated one percent foliage cover (Table 17, Appendix 4). The record is within the Indicative Additional Impact Assessment Area, and more specifically will be disturbed by OSA 41 (Table 18). *Acacia bromilowiana* has also been recorded from just outside the southern boundary of the Proposed MAC Development Envelope, occurring as >100 plants and providing up to 10 percent cover from seven point locations on the northern slopes of Mount Robinson (Onshore Environmental 2012a).

The DPaW rare flora database search (DPaW 2016a) showed 28 records within Western Australia, extending over a 300 km range between Newman and 100 km northwest of Tom Price, with outlying records from west of Rudall River National Park. There are two records from Karijini National Park (Appendix 7).

The impact of direct clearing the single population of *Acacia bromilowiana* (Priority 4) within the Indicative Additional Impact Assessment Area is therefore considered to be *very low*.

Aristida jerichoensis var. *subspinulifera* (Priority 3)

Five populations of *Aristida jerichoensis* var. *subspinulifera* containing a total of 2,398 individual plants have been recorded within the Proposed MAC Development Envelope⁹. Two of these populations, containing a total of approximately 790 plants occur on stony plains and flood plains within the Indicative Additional Impact Assessment Area (Table 17, Appendix 4).

The DPaW rare flora database search (DPaW 2016a) showed 29 records within Western Australia, extending over a 350 km range from southeast of Newman to northwest of Tom Price (Appendix 7). While none of these records occur within formal conservation reserves, the taxon has been extensively recorded on neighbouring tenements within a 25 km radius of the Proposed MAC Development Envelope.

The impact of direct clearing two of the five populations of *Aristida jerichoensis* var. *subspinulifera* represented within the Indicative Additional Impact Assessment Area is considered to be *low*.

Aristida lazaridis (Priority 2)

There were three populations of *Aristida lazaridis* containing 2,316 plants represented within the north-west sector of the Proposed MAC Development Envelope⁹. Population 3 occurred within the Indicative Additional Impact Assessment Area, population 2 was partially within the Indicative Additional Impact Assessment Area, and population 1 was outside the Indicative Additional Impact Assessment Area

⁹ Excludes plants within the Mining Area C Revision 6 Impact Assessment Area.

(Table 17, Appendix 4). It is estimated that 2,114 plants occur within the Indicative Additional Impact Assessment Area.

The DPaW rare flora database search (DPaW 2016a) showed 18 records within Western Australia, extending over a 150 km range from northwest of Newman to the northeast corner of Karijini National Park (Appendix 7). There is one record from within Karijini National Park.

The impact of disturbing two of the three populations of *Aristida lazaridis* associated with the Indicative Additional Impact Assessment Area is determined to be *low*.

Eremophila magnifica subsp. *magnifica* (Priority 4)

There were nine populations of *Eremophila magnifica* subsp. *magnifica* supporting in excess of 593 plants associated with rocky gorge sites, cliff faces and steep rocky slopes predominantly throughout the central and south-western sectors of the Proposed MAC Development Envelope¹⁰. Four of the nine populations supporting over 196 plants occur within the Indicative Additional Impact Assessment Area (Table 17, Appendix 4).

The DPaW rare flora database search (DPaW 2016a) showed 39 confirmed records within Western Australia, extending over a 320 km range from midway between Pannawonica and Tom Price southeast to Newman (Appendix 7). This included seven records from within Karijini National Park.

The impact of direct clearing three of the eight populations of *Eremophila magnifica* subsp. *magnifica* associated with the Indicative Additional Impact Assessment Area is determined to be *low*.

Rhagodia sp. Hamersley (M. Trudgen 17794) (Priority 3)

There were 13 populations supporting over 274 plants of *Rhagodia* sp. Hamersley (M. Trudgen 17794) represented predominantly on flood plains in north-western, western and southern sectors of the Proposed MAC Development Envelope¹⁰. Ten of the 13 populations supporting more than 225 plants occur within, or partially within, the Indicative Additional Impact Assessment Area (Table 17, Appendix 4).

The DPaW rare flora database search (DPaW 2016a) showed 49 confirmed records within Western Australia, extending over a 310 km range roughly between Tom Price and Newman, with outlying populations at Roy Hill and midway along the Munjina Roy Hill Road (Appendix 7). There was one record from within Karijini National Park.

The impact of partially disturbing eleven of the 13 populations of *Rhagodia* sp. Hamersley (M. Trudgen 17794) associated with the Indicative Additional Impact Assessment Area is determined to be *low*.

Rostellularia adscendens var. *latifolia* (Priority 3)

There were nine populations of *Rostellularia adscendens* var. *latifolia* supporting 97 plants associated with broad medium drainage lines in the north-east and south-east sectors of the Proposed MAC Development Envelope¹⁰, with five of these populations supporting 69 plants situated within the Indicative Additional Impact Assessment Area (Table 17, Appendix 4).

The DPaW rare flora database search (DPaW 2016a) showed 34 confirmed records within Western Australia, extending approximately 250 km northwest from the MAC Development Envelope to midway between Pannawonica and Tom Price, with additional records extending up to 300 km northeast to midway between Telfer and

¹⁰ Excludes plants within the Mining Area C Revision 6 Impact Assessment Area.

Marble Bar (Appendix 7). There was a total of six records from within Karijini National Park.

The impact of direct clearing five of the nine populations of *Rostellularia adscendens* var. *latifolia* associated with the Indicative Additional Impact Assessment Area is determined to be *low*.

Sida sp. Barlee Range (S. van Leeuwen 1642) (Priority 3)

There was one population with 47 plants of *Sida* sp. Barlee Range (S. van Leeuwen 1642) associated with the base of cliffs and on steep hill slopes in the southern central sector of the proposed MAC Development Envelope, and within the Indicative Additional Impact Assessment Area (Table 17, Appendix 4).

The DPaW rare flora database search (DPaW 2016a) showed 42 confirmed records within Western Australia, extending east to west over 420 km from Newman to Barlee Range Nature Reserve, and extending up to 50 km north of Tom Price (Appendix 7). There were two records from within Karijini National Park and three records from within Barlee Range Nature Reserve.

The impact of direct clearing the sole population of *Sida* sp. Barlee Range (S. van Leeuwen 1642) associated with the Indicative Additional Impact Assessment Area is determined to be *low*.

Triodia sp. Mt Ella (M.E. Trudgen 12739) (Priority 3)

There was one population of *Triodia* sp. Mt Ella (M.E. Trudgen 12739) recorded on stony slopes and upper plains in the southern central sector of the Proposed MAC Development Envelope, and within the Indicative Additional Impact Assessment Area (Table 17, Appendix 4). Plants provided up to 10 percent ground coverage. It was also prominent on the northern slopes of Mt Robinson (outside the southern boundary of the Development Envelope), and has also been recorded on the western side of the Great Northern Highway.

The DPaW rare flora database search (DPaW 2016a) showed 27 confirmed records within Western Australia, extending over 200 km from Karijini National Park to 30 km east of Newman, with an outlying record from Rudall River National Park (Appendix 7). There was one record from within Rudall River National Park.

The impact of direct clearing the sole population of *Triodia* sp. Mt Ella (M.E. Trudgen 12739) associated with the Indicative Additional Impact Assessment Area is determined to be *low*.

Table 17 Number of Priority flora populations occurring within the MAC Development Envelope¹¹ and Indicative Additional Impact Assessment Area.

Vegetation Association	No. Populations Within Proposed MAC Development Envelopment	No. Plants Within Proposed MAC Development Envelopment	No. Populations Within Indicative Additional Impact Assessment Area	No. Plants Within Indicative Additional Impact Assessment Area
<i>Acacia bromilowiana</i> (P4)	1	1% cover	1	1% cover
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3)	5	2,398	2	790
<i>Aristida lazaridis</i> (P2)	3	2,316	2 (incl 1 partially)	2,114
<i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4)	9	593	3	>196
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3)	13	274	10 (incl 4 partially)	>225
<i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3)	9	97	5	69
<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P3)	1	47	1	47
<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3)	1	2-10% cover	1	2-10% cover

¹¹ Excludes plants within the Mining Area C Revision 6 Impact Assessment Area, including the sole population of *Nicotiana umbratica* (P3). Also note that the sole population of *Grevillea saxicola* (P3) occurred outside the Indicative Additional Impact Area and was also excluded.

Table 18 Location of Priority flora within the Indicative Additional Impact Assessment Area. Number of records represented.

Vegetation Association	OSA 14	OSA 31	OSA 33	OSA 36	OSA 37	OSA 39	OSA 41	SF PIT	TSD 2
<i>Acacia bromilowiana</i> (P4)							1		
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3)	11								
<i>Aristida lazaridis</i> (P2)	60								
<i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4)			8					44	
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3)	64	9		33	11	3		5	3
<i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3)				1				6	
<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P3)								7	
<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3)								1	

4.2 Cumulative Impacts

The cumulative impact assessment addresses significant flora and vegetation represented within the Indicative Additional Impact Assessment Areas. Representation within the cumulative impact area¹², including BHP Billiton Iron Ore and third party project areas, was compared to representation across the remainder of the Pilbara. Due to the limited extent of fine scale vegetation association mapping, the representation of vegetation was quantified at the vegetation complex level (Beard 1975) and using land system mapping (van Vreeswyk *et al.* 2004).

4.2.1 Significant Flora

Mapping of confirmed locations for each of the eight significant flora represented within the Indicative Additional Impact Assessment Areas confirmed broadly similar distributional patterns extending between Newman and Tom Price (Appendix 3). An intersect of significant flora records from the DPaW rare flora database search covering the whole of Western Australia with cumulative disturbance areas proposed from BHP Billiton Iron Ore and Third Parties, confirmed that the majority of these records occurred outside of the proposed disturbance footprints (Table 19, Appendix 7).

¹² Shape files of cumulative impact area provided by BHP Billiton Iron Ore

Table 19 Number of DPaW records with Western Australia, number of records within cumulative BHPBIO disturbance footprint, and number of records within cumulative third party disturbance footprint for each of eight Priority flora occurring within the Indicative Additional Impact Assessment Area.

Vegetation Association	DPaW Records in WA	No. DPaW Records Occurring Within:	
		Cumulative BHPBIO Disturbance	Cumulative Third Party Disturbance
<i>Acacia bromilowiana</i> (P4)	28	0	0
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3)	29	2	0
<i>Aristida lazaridis</i> (P2)	18	2	0
<i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4)	39	1	3
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3)	49	3	6
<i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3)	34	6	0
<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P3)	42	3	4
<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3)	27	3	2

In summary, the eight significant flora occurring within the Indicative Additional Impact Assessment Areas are well represented across a large proportion of the Hamersley sub-region, and the cumulative impact from proposed disturbance by BHP Billiton Iron and Third Parties will not significantly reduce the representation of these taxa.

4.2.2 Vegetation

Based on the original mapping by Beard (1975) that was more recently refined by Shepherd *et al.* (2002), there were two vegetation associations represented within the Proposed MAC Development Envelope; Hamersley 18 and Hamersley 82 (Figure 3). Less than 2 percent of the total extent for each vegetation association was represented within the Proposed MAC Development Envelope, with less than 5 percent represented in cumulative BHP Billiton Iron Ore or Third Party disturbance areas (Table 20, Appendix 8). This represents a *low* cumulative impact on the basis of Beard's (1975) vegetation association mapping.

Table 20 Current Pre-European extent of vegetation associations occurring within the Proposed MAC Development Envelope (Shepherd *et al.* 2002), and area represented within the Proposed MAC Development Envelope, cumulative BHPBIO disturbance footprint, and cumulative Third Party disturbance footprint. Percentages a proportion of the current Pre-European extent for each vegetation association.

Vegetation Association	Current Pre-European Extent (ha)	Proposed MAC Development Envelope (ha)	Cumulative BHPBIO Disturbance (ha)	Cumulative Third Party Disturbance (ha)
Hamersley 18	770,898	13,167 (1.7 %)	35,994 (4.7%)	4,878 (0.6%)
Hamersley 82	5,602,479	22,864 (0.4%)	54,590 (1.0%)	15,594 (0.3%)

Of the 102 land systems mapped across the Pilbara at scale of 1:250,000 by van Vreeswyk *et al.* (2004), five occur within the Proposed MAC Development Envelope (Figure 4). Less than 4.2 percent of the total extent for each land system was represented within the Proposed MAC Development Envelope, with less than 10.7 percent represented in cumulative BHP Billiton Iron Ore or Third Party disturbance areas (Table 21, Appendix 9). This represents a *low* cumulative impact to land systems.

Table 21 Current extent of land systems occurring within the Proposed MAC Development Envelope (descriptions from van Vreeswyk *et al.* 2004), and area represented within the Proposed MAC Development Envelope, cumulative BHPBIO disturbance footprint, and cumulative Third Party disturbance footprint. Percentages a proportion of the total extent of each land system.

Land System	Total Extent of Land System (ha)	Proposed MAC Development Envelope (ha)	Cumulative BHPBIO Disturbance (ha)	Cumulative Third Party Disturbance (ha)
Boolgeeda	774,800	8,721 (1.1%)	25,670 (3.3%)	8,107 (1.0%)
Newman	1,458,000	23,092 (1.6%)	56,546 (3.9%)	20,848 (1.4%)
Pindering	35,100	1,487 (4.2%)	1,873 (5.3%)	286 (0.8%)
Platform	157,000	1,904 (1.2%)	4,716 (3.0%)	2,012 (1.3%)
Wannamunna	57,700	827 (1.4%)	6,205 (10.7%)	356 (0.6%)

The Proposal will be developed and operated as part of the existing Mining Area C Project which has previously been approved under Ministerial Statement 491. The Indicative Additional Impact Assessment Area intersects similar vegetation associations to those represented within the Current Approved Development Envelope. None of the vegetation associations represent TECs or PECs and all vegetation associations (and land systems) that may be disturbed by this Proposal are well represented in the Pilbara bioregion. Therefore no significant cumulative impacts are predicted for vegetation within the Indicative Additional Impact Assessment Area.

4.3 Surface Water Flows

The Proposed MAC Development Envelope spans the divide separating the Coondewanna Catchment to the west, and the Weeli Wolli Catchment to the east. The Weeli Wolli Catchment drains into Weeli Wolli Creek situated approximately 10 km east of the Proposed MAC Development Envelope, and then north into the upper Fortescue River. The total Weeli Wolli Creek Catchment (above its outfall into the marsh system) has an area of 4,150 km² and comprises approximately 13 percent of the total marsh catchment (RPS 2015). The Weeli Wolli Creek Catchment above the spring totals approximately 1,400 km² (RPS 2014).

The western fringe of the Proposed MAC Development Envelope sheds surface water to the west of a natural catchment divide in the North Flank Valley where it drains across the Great Northern Highway and into Coondewanna Flats. The Coondewanna Catchment is a closed drainage system (i.e. has no external streamflow discharge) with an area of around 860 km². Catchment runoff is discharged into the internal depression of Lake Robinson where it dissipates by seepage and evapotranspiration. Homestead Creek discharges into Lake Robinson from the north and is the main drainage entering the lake (RPS 2015).

Proposed pit, OSA and infrastructure development within the Indicative Additional Impact Assessment Area have the potential to impact surface water resources by:

- changing local surface water flow patterns;
- affecting surface water runoff volumes and quality;
- increasing the risk of erosion and sedimentation; or
- contamination from chemicals/hydrocarbons.

The pits and landforms that comprise the Indicative Additional Impact Assessment Area are primarily located near catchment divides without major watercourses. Most of the modelled pit inflow enters the pits through a series of overland flow paths (MWH 2016). The pit outlines intersect several concentrated flow paths with contributing catchment areas of up to 400 ha. These flow paths are currently modelled as pit inflow locations; however, interception and diversion of these flows would likely be considered as part of further mine planning efforts and would reduce the overall impacts (MWH 2016).

The total cumulative area of mine-affected areas and diverted catchments for South Flank, North Flank, Baby Hope, and Hope Downs 1 is approximately 6.9% of the Coondewanna catchment, 7.2% of the Weeli Wolli Creek catchment, and approximately 2% of the Fortescue Marsh catchment (MWH 2016).

In summary, the proposed project will alter local flow paths and runoff volumes for small, ephemeral creeks within the Indicative Additional Development Envelope. Impacts will be minimised through BHP Billiton Iron Ore's standard surface water management measures (MWH 2016).

The alteration of existing surface water regimes by project infrastructure may impact on susceptible downstream vegetation, most notably mulga dominated vegetation associations situated on floodplains. Mulga occurs as low open forest and low woodland where the predominant tree or tall shrub species is *Acacia aptaneura*. The lateral root system of Mulga is adapted to absorb water from a shallow soil layer. The density and height of pristine Mulga stands is strongly influenced by soil moisture regimes, which are controlled by local landforms, surface water flow, and soil moisture holding capacity (Fox 1988). Where stands are affected by reduced water availability, whether through altered surface drainage or extended drought, initial mortality generally occurs in the larger trees (Fox 1978a, 1980).

Three vegetation associations represented within both the Proposed MAC Development Envelope and the Indicative Additional Impact Assessment Area support Mulga vegetation on stony plains and floodplains (see Section 3.8.3). They predominantly occur in the north-west sector and along the southern fringe of the Proposed MAC Development Envelope (Figure 13). While all three vegetation associations are susceptible to altered surface water flows, the extent of the three vegetation associations is relatively small (321.1 ha within the Indicative Additional Impact Assessment Area). Alteration to natural surface water flows from within the Indicative Additional Impact Assessment Area may impact on the health of Mulga situated downstream of the Southern Flank Pit.

Surface water runoff from the proposed disturbance areas could potentially mobilise additional sediments to the drainage systems. The main potential sources for sediment are the OSAs, haul roads and stockpiles. With implementation of existing management practices at Mining Area C it is unlikely that increased sedimentation of surface water run-off will impact on downstream flora and vegetation. In addition,

the risk of hydrocarbon or chemical spillage can be mitigated through standard best practices for pollution control (MWH 2016).

Proposed changes to surface hydrology are not likely to result in any significant alteration to the composition or structure of existing vegetation associations. While vegetation situated downstream of the Southern Flank Pit is likely to be at highest risk from impacts associated with reduced surface water flows, increased sediment loading and contamination, the potential impacts are not determined to be significant because vegetation associations do not support high risk species and are well represented regionally. In addition, the proposal will not impact on vegetation within the adjacent Coolibah-lignum Flats PEC at Coondewanna Flats and lake Robinson, or vegetation within the Weeli Wolli Spring PEC.

4.4 Fire

Changes in natural fire regimes are a primary threatening process to vegetation in the Pilbara. Vegetation is particularly vulnerable when dense tussock grasslands establish following summer cyclonic rains. Combined with dry and hot summer conditions fire intensity can increase to extreme, resulting in significant alteration to vegetation structure and composition. The impact can be exacerbated in areas of increased fire frequency.

Large expanses of the Proposed MAC Development Envelope show evidence of being impacted by wildfire, an increasing trend in the Pilbara (D. Brearley *pers. obs.* 2016). Wildfire resulting from lightning strike is a natural phenomenon for which arid zone vegetation is well adapted, with many plant taxa reliant on heat and smoke to break seed dormancy and stimulate germination (Fox 1978b). However, increased access into previously remote areas can increase the frequency of fire through accidental occurrences and arson.

Vegetation associations that are more sensitive to fire include those associated with deep gorge habitats and dense mulga stands on floodplains. There is a mosaic of fire ages evident across the Proposed MAC Development Envelope, with vegetation condition assessment confirming the the majority of vegetation remains in good or better condition.

Fire is a natural occurrence in vegetation associations represented within the Development Envelope. The close proximity to Great Northern Highway and the 24 hour camping ground on the western flank of Mount Robinson pose an increased risk to mining infrastructure and adjacent vegetation within the Indicative Additional Impact Assessment Area.

Fire is a natural occurrence in vegetation associations within the Proposed Mining Area C Development Envelope, and the increased risk posed by implementation of the Proposal is manageable. Potential alteration of fire regimes from implementation of the Proposal is not considered a significant risk to vegetation or flora.

4.5 Introduced Species

Domestic stock such as cattle are significant vectors for weed species within lowland areas of the Pilbara including the Proposed MAC Development Envelope. Cattle are typically found on floodplains and along ephemeral drainage lines and levees in low

lying areas supporting palatable grasses. Additionally these areas are often where stock watering points are maintained by pastoralists. Vegetation condition typically declines across these lowlands due to alteration of native vegetation structure and composition, including a higher loading of introduced weed species. Although drainage lines are ephemeral in nature, higher moisture status across lowland habitats further enhances the establishment and spread of weeds.

Another important factor influencing weed establishment is access. Increasing vehicular access combined with disturbance such as clearing for roads and other infrastructure, has the potential to introduce and/or spread weed species. An example of this is seen along the verge of Great Northern Highway.

Existing operations at Mining Area C manage the introduction of weed species through various strategies associated with prevention (quarantine) and control (targeted spray programs and progressive rehabilitation). However, there is an increased prevalence of weed species within developed project areas at Mining Area C. An increase of weed species and distribution within disturbed sites in the Additional Development Envelope is considered likely given the proximity of the Proposal to existing weed infested areas. The impacts of increased weed spread to native vegetation and flora (including conservation significant species) is not considered significant provided that they are restricted to areas of disturbance.

4.6 Dust

A modelled assessment of the potential air quality impact from the proposed Southern Flank development has recently been completed by Pacific Environment (2016). The study found that mining of Marra Mamba ore primarily above the water table will result in high dust emission and potential issues with visibility due to the Project's close proximity to the Great Northern Highway. A very high risk of reduced visibility particularly during small averaging periods (1-hour) in high dust days is possible. Nevertheless, a low risk rating is predicted along the Great Northern Highway for the majority of the year (greater than 60%). The majority of the receptors on Great Northern Highway are predicted to have a potential high risk of visibility less than 10% of the time (Pacific Environment 2016).

Dust associated with iron ore mining in the Pilbara is generally chemically inert (Butler 2009, Turner 2013) so any potential impacts on plants are likely to be physical, including leaf abrasion, blocking of stomata of leaves and/or increasing absorption of incident radiation, which in turn can elevate leaf temperature, and negatively impact on photosynthetic processes and transpiration loss. These physical effects tend to be proportional to the amount of dust that vegetation is exposed to and the size of the dust particles i.e. the higher the dust loading and the smaller the particle size then the higher the risk (Grierson 2015).

Within the Pilbara dust generated by mining activities is likely to be both short-lived and transported for relatively short distances of 100 to 200 m, mainly at the time of service track construction (Grierson 2015). Long-term observations of vegetation in close proximity to other mine sites across the Hamersley Ranges have demonstrated repeatedly the overall resilience of vegetation to extremely high levels of dust exposure. Plants coloured orange with dust for several years survive quite well, in part because plants in arid environments mainly grow in response to high rainfall and have very low metabolic rates outside of these periods. Growth periods thus also

coincide with when (i) foliage is washed clean by rainfall and (ii) lower dust emissions due to damping down of the environment.

There is low risk of increased dusting to vegetation forming the two sub-types of the Coolibah-lignum Flats PEC, situated outside the south-west corner of the Proposed MAC Development Envelope. Studies suggest that this is unlikely to impact on the community.

5.0 CONCLUSION

Baseline surveys completed across the entire Indicative Additional Impact Assessment Area have confirmed that flora and vegetation is representative of the Current Approved Development Envelope. None of the vegetation associations are of Federal or State conservation significance, and all are well represented within the Pilbara bioregion. The eight Priority flora taxa occurring within the Indicative Additional Impact Assessment Area have also been recorded on surrounding tenements and have a relatively wide distribution within the Pilbara bioregion. There are no significant cumulative impacts predicted for flora or vegetation.

In conclusion, it has been determined that the Proposal is unlikely to have a significant impact on flora and vegetation values, and will therefore meet the EPA's objective "*To maintain representation, diversity, viability and ecological function at the species, population and community level*" (EPA 2013).

6.0 STUDY TEAM

The flora and vegetation impact assessment for the Mining Area C Southern Flank proposal was planned, co-ordinated and executed by the following personnel:

Onshore Environmental Consultants P/L

ABN 41 095 837 120

PO Box 227

YALLINGUP WA 6282

pf 08 9756 6206 m0427 339 842

Email onshoreenv@westnet.com.au

Project Staff

Dr Darren Brearley PhD Project Manager

Ms Jessica Waters BSc Botanist

Mr Todd Griffin GIS Specialist

7.0 REFERENCES

- Aplin T.E.H. (1979) The Flora. Chapter 3 in O'Brien, B.J. (ed.) (1979). Environment and Science. University of Western Australia Press.
- Astron Environmental Services (2010) *Packsaddle West Vegetation and Flora Survey and Fauna Assessment*. Consultants report prepared for BHP Billiton Iron Ore.
- Astron Environmental Services (2011a) *Coondewanna Flats Flora and Vegetation Assessment*. Consultants report prepared for BHP Billiton Iron Ore.
- Astron Environmental Services (2011b) *Nimingarra and Shay Gap Vegetation and Flora Survey*. Consultants report prepared for BHP Billiton Iron Ore.
- Astron Environmental Services (2014a) Mine, Port & Rail Operations Weed Control - Area C, March 2014. Letter Report Prepared for BHP Billiton Iron Ore
- Astron Environmental Services (2014b) Mine, Port & Rail Operations Weed Control - Area C, March 2014. Letter Report Prepared for BHP Billiton Iron Ore
- Astron Environmental Services (2014c) *Coondewanna Flats Ecohydrological Study Ecological Water Requirements of Vegetation Report*. Consultants report prepared for BHP Billiton Iron Ore.
- Australian Natural Resource Atlas (2008) *Biodiversity Assessment - Pilbara*. Australian Natural Resource Atlas, website. www.anra.gov.au. Available at <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>.
- Beard, J. S. (1975) Pilbara. Explanatory Notes and Map Sheet 5, 1:1 000 000 series Vegetation Survey of Western Australia. University of Western Australia Press: Nedlands.
- Bettanay, E., Churchward, H.M. and McArthur, W. M. (1967) *Atlas of Australian Soils*. Sheet 6. Meekatharra - Hamersey Range Area CSIRO, Melbourne.
- BHP Billiton Iron Ore Pty Ltd (2016) *Guidance for Vegetation and Flora Surveys*. Iron Ore Controlled Document, Rehabilitation and Biodiversity, Number 0124627, Version 1.
- Biota (2002) *Mining Area C Rail Corridor Rare Flora Survey*. Consultants report prepared for BHP Billiton Iron Ore.
- Biota (2003) *Mining Area C Rail Corridor Rare Flora Survey (Phase 2)*. Consultants report prepared for BHP Billiton Iron Ore.
- Biota (2012) Southern Flank to Jinidi Level 2 Flora and Vegetation Survey. Unpublished report prepared for BHP Billiton Iron Ore, Biota Environmental Sciences, Western Australia.
- Burbidge, N. T. (1959) Div. Plant Ind. Tech Paper 12. Notes on plants and plant habitats observed in the Abydos-Woodstock area, Pilbara District, CSIRO, Western Australia.
- Bureau of Meteorology (2016) Climate Statistics for Australian Locations: Newman.
- Butler, R. (2009) *Vulnerability of Plant Functional Types to Dust Deposition in the Pilbara, NW Australia*. Honours Thesis, School of Plant Biology, The University of Western Australia. Supervised by Pauline Grierson, Garth Humphries & Gerald Page.

- Dawe, C. and Dunlop, J.N. (1983) Introduction to Hamersley Range National Park. In Muir, B.G. (ed.) A Fauna Survey of the Hamersley Range National Park W.A. Bull No. 1 National Parks Authority WA.
- Department of Parks and Wildlife (DPaW) (2016a) Threatened and Priority Flora Database Search.
- Department of Parks and Wildlife (DPaW) (2016b) *List of Threatened Ecological Communities on the Department of Parks and Wildlife's Threatened Ecological Community (TEC) Database endorsed by the Minister for the Environment*. WA Threatened Species and Communities Unit, Department of Parks and Wildlife.
- Department of Environment (DoE) (2016) Interactive Environmental Database Reporting Tool Search. www.environment.gov.au
- Ecologia Environment (1997) *Hope Downs Biological Survey*. Consultants report prepared for Hancock Prospecting.
- Ecologia Environment (1998a) *Mining Area C Biological Survey*. Report prepared for BHP Billiton Iron Ore.
- Ecologia Environment (2001) Mining Area C to Yandi Rail Line Baseline Weed Survey. Report prepared for BHP Billiton.
- Ecologia Environment (2002) *Mining Area C Village and Access Road Rare and Priority Flora*. Report prepared for BHP Billiton Iron Ore.
- Ecologia Environment (2004a) *Packsaddle Range Biological Survey*. Report prepared for BHP Billiton Iron Ore.
- Ecologia Environment (2004b) *Area C, Deposits D, E and F Biological Survey*. Report prepared for BHP Billiton Iron Ore.
- Ecologia Environment (2005a) *Packsaddle Wastewater Treatment Plant*. Report prepared for BHP Billiton Iron Ore.
- Ecologia Environment (2005b) *Mudlark Well Exploration Project Biological Survey*. Report prepared for BHP Billiton Iron Ore.
- Ecologia Environment (2006) *Ministers North Biological Survey*. Prepared for BHP Billiton Iron Ore Pty Ltd.
- ENV Australia (2007) *Area C, R-Deposit Flora and Vegetation Assessment*. Prepared for BHP Billiton Iron Ore Pty Ltd.
- ENV Australia (2008a) *Southern Flank Exploration Lease Flora and Vegetation Assessment*. Prepared for BHP Billiton Iron Ore.
- ENV Australia (2008b) Boundary Ridge Exploration Lease. Flora and Vegetation Assessment. Prepared for BHP Billiton Iron Ore.
- ENV Australia (2008c) Alligator Jaws Exploration Lease. Flora and Vegetation Assessment. Prepared for BHP Billiton Iron Ore.
- ENV Australia (2010a) *Southern Flank NVCP Extension Flora, Vegetation and Fauna Survey*. Prepared for BHP Billiton Iron Ore.
- ENV Australia (2010b) *Area C to Jinayri Flora and Vegetation Survey*. Prepared for BHP Billiton Iron Ore.
- ENV Australia (2010c) *Southern Flank West Flora and Vegetation Survey*. Prepared for BHP Billiton Iron Ore.
- ENV Australia (2010d) *Area C West NVCP Flora, Vegetation and Fauna Assessment*. Prepared for BHP Billiton Iron Ore.

- Environmental Protection Authority (EPA) (2000) Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas, Position Statement No. 2, EPA, Perth.
- Environmental Protection Authority (EPA) (2002) Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3, EPA, Perth.
- Environmental Protection Authority (EPA) (2004) EPA Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51, EPA, Perth.
- Environmental Protection Authority (EPA) (2013) Environmental Assessment Guideline No. 8, Environmental factors and objectives (EAG 8). EPA, Perth.
- Grierson, P. (2015) Dust suppression and likelihood of adverse impact on *Acacia* sp. East Fortescue at Orebody 31. Confidential report to BHP Billiton Iron Ore. University of Western Australia.
- Halpern Glick Maunsell (HGM) (1999) *Marillana Creek Western Access Corridor - Biological Assessment*. Report prepared for BHP Billiton Iron Ore.
- Hussey, B. M. J., Keighery, G. J., Cousens, R. D., Dodd, J. and Lloyd, S. G. (1997) Western Weeds. The Plant Protection Society of Western Australia and Agriculture Western Australia. Kensington, W.A.
- IBRA Revision 6.1 Environment Australia 2011 Online at: <http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html#ibra>
- International Union for Conservation of Nature (IUCN) (2014) Interactive Environmental Database Reporting Tool Search, performed February 2014. www.iucn.org
- Keighery, B. J. (1994) Bushland Plant Survey: a Guide to Plant Community Survey for the Community. Wildflower Society of WA (Inc.), Nedlands, Western Australia.
- Kendrick (2001) Bioregion: Pilbara 3 Subregion (PIL3). Department of Conservation and Land Management, Perth.
- Kneeshaw, M. (2008) Guide to the geology of the Hamersley and North East Pilbara Iron Ore Provinces. Compiled and written for BHP Billiton Iron Ore.
- Mattiske (2009) Flora and Vegetation of the Hope Downs 1 Area. Unpublished report prepared for Rio Tinto Iron Ore Pty Ltd, Mattiske Consulting Pty Ltd, Western Australia.
- O'Brien, B.J. and Associates Pty. Ltd. (1992) *Marandoo Iron Ore Mine and Central Pilbara Railway*. Environmental Review and Management Programme. Report to Hamersley Iron.
- Onshore Environmental (2010) *Packsaddle East Survey Area Level 2 Flora and Vegetation Survey*. Consultants report prepared for BHP Billiton Iron Ore.
- Onshore Environmental (2011a) *Area C and Surrounds Level 2 Flora and Vegetation Survey*. Consultants report prepared for BHP Billiton Iron Ore.
- Onshore Environmental (2011b) *Camp Hill Study Area Level 2 Flora and Vegetation Survey*. Consultants report prepared for BHP Billiton Iron Ore.
- Onshore Environmental (2011c) *Jinidi Study Area Review of Flora and Vegetation*. Consultants report prepared for BHP Billiton Iron Ore.
- Onshore Environmental (2011d) *Yandi Study Area- Review of Flora and Vegetation*. Consultants report prepared for BHP Billiton Iron Ore.

- Onshore Environmental (2012a) *Southern Flank Study Area Level 2 Flora and Vegetation Survey*. Consultants report prepared for BHP Billiton Iron Ore.
- Onshore Environmental (2012b) *Weeli Wollli Spring PEC - Flora and Vegetation Survey*. Consultants report prepared for BHP Billiton Iron Ore.
- Onshore Environmental (2012c) *Orebody 25 Targeted Significant Flora Survey, Vegetation Mapping of Homestead Creek*. Consultants report prepared for BHP Billiton Iron Ore.
- Onshore Environmental (2013a) *Tandanya Study Area Review of Flora and Vegetation*. Consultants report prepared for BHP Billiton Iron Ore.
- Onshore Environmental (2013b) *Vegetation Mapping Review Coolibah-lignum Flats Priority Ecological Community*. Consultants report prepared for BHP Billiton Iron Ore.
- Onshore Environmental (2013c) *Level 2 Flora and Vegetation Survey Mudlark Leases*. Consultants report prepared for BHP Billiton Iron Ore.
- Onshore Environmental (2013d) *Targeted Survey for *Lepidium catapycnon* at Karijini National Park*. Consultants report prepared for BHP Billiton Iron Ore.
- Onshore Environmental (2014a) *Consolidation of Regional Vegetation Mapping - BHP Billiton Iron Ore Pilbara Tenure*. Confidential Report to BHP Billiton Iron Ore.
- Onshore Environmental (2014b) *Level 2 Flora and Vegetation Survey Area C West to Yandi*. Consultants report prepared for BHP Billiton Iron Ore.
- Onshore Environmental (2014c) *Targeted Flora Survey Assessment Mt Whaleback OB29/30/35*. Consultants report prepared for BHP Billiton Iron Ore.
- Onshore Environmental (2014d) *Level 2 Flora and Vegetation Survey Orebody 31*. Consultants report prepared for BHP Billiton Iron Ore.
- Pacific Environment (2016) Updated air quality modelling for South Flank proposal. Memorandum to BHP Billiton Iron Ore by Jon Harper. Perth, Western Australia.
- Pilbara Flora (2008a) *Field Survey for Priority and Rare Flora Area C Southern Flank*. Prepared for BHP Billiton Iron Ore.
- Pilbara Flora (2008b) *Flora and Vegetation Survey Coondewanna Flats Coolibah Lignum Priority Ecological Community*. Prepared for BHP Billiton Iron Ore.
- Pilbara Flora (2009) *Priority and Rare Flora Survey Mudlark Well Area*. Prepared for BHP Billiton Iron Ore.
- RPS (2014) Mining Area C Environmental Surface Water Initial Assessment. Prepared for BHP Billiton, 24th April 2014.
- Shepherd, D.P., Beeston, G.R., and Hopkins, A.J.M. (2002) Native Vegetation in Western Australia. Technical Report 249. Department of Agriculture, Western Australia, South Perth.
- Specht R.L. (1970) Vegetation. In *The Australian Environment*. 4th edn (Ed. G.W. Leeper). Melbourne.
- Stack, G. (2010) *Threatened and Priority Flora Report Form - Field Manual*. RCM Project. Department of Environment and Conservation.
- Thackway and Cresswell (1995) *An Interim Biogeographic Regionalisation for Australia: A framework for setting priorities in the National Reserves System Cooperative Program Version 4*. Australian Nature Conservation Agency, Canberra.

- Thiele, K.R. and Shepherd, K.A. (2014) *Spartothamnella canescens* (Lamiaceae: Chloantheae), a new species from Western and Central Australia, with notes on the status of *S. sp.* Helena & Aurora Range. In: *Nuytsia* 24: 177-185.
- Tille, P. (2006) Soil-landscapes of Western Australia's rangelands and arid interior. Resource management technical report 313. Department of Agriculture and Food.
- Turner GF (2013) *Vulnerability of Plant Functional Types to Mining Dust Deposition at the Jack Hills, Western Australia*. Masters Thesis, School of Plant Biology, The University of Western Australia. Supervised by Pauline Grierson & Gerald Page.
- Trudgen, M.E. (2009) BHP Billiton Iron Ore - Vegetation classification system for utilisation in the Pilbara Bioregion. Professional advice provided to BHP Billiton Iron Ore.
- van Leeuwen S. and Bromilow B (2002) *Botanical survey of Hamersley Range uplands: National Reserve System Project N709: final report, May 2002*. Department of Conservation and Land Management, 91 p.
- van Vreeswyk *et. al.* (2004) An inventory and condition survey of the Pilbara region, Western Australia. Western Australian Department of Agriculture Technical Bulletin No. 92.
- Western Australian Herbarium (WAH) (2014) *Florabase - Information on the Western Australian flora*. Department of Parks and Wildlife. Online: <http://florabase.dpaw.wa.gov.au> [February 2014].
- Woodman Environmental Consulting (2009a) *Flora and Vegetation Assessment Area C Mining Operation Environmental Management Plan A, D, P1 and P3 Deposits*. Report prepared for BHP Billiton Iron Ore.
- Woodman Environmental Consulting (2009b) *Coondewanna Catchment Flora and Vegetation Study*. Report prepared for BHP Billiton Iron Ore.
- Woodman Environmental Consulting (2010) *Jinayri Infrastructure Corridors Flora and Vegetation Survey*. Report prepared for BHP Billiton Iron Ore.

APPENDIX 1

Conservation categories for flora described
under the EPBC Act.

Category	Description
Extinct	A species is extinct if there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A species is categorised as extinct in the wild if it is only known to survive in cultivations, in captivity, or as a naturalised population well outside its past range; or if it has not been recorded in its known/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	The species is facing an extremely high risk of extinction in the wild and in the immediate future.
Endangered	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival, or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Conservation Dependent	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 within a period of 5 years.

APPENDIX 2

Conservation Codes for Western Australian Flora.

Specially protected fauna or flora are species* which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such. Categories of specially protected fauna and flora are:

T Threatened Species

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

Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act.

Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the Wildlife Conservation Act.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR Critically endangered species

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EN Endangered species

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

VU Vulnerable species

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EX Presumed extinct species

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.

IA Migratory birds protected under an international agreement

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.

CD Conservation dependent fauna

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

OS Other specially protected fauna

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists 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 species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1: Priority One - Poorly Known Taxa

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise 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. Such species are in urgent need of further survey.

2: Priority Two - Poorly Known Taxa

Species that are known from one or a few collections (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. 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. Such species are in urgent need of further survey.

3: Priority Three - Poorly Known Taxa

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. Such species are in need of further survey.

4: Priority Four - Rare, Near Threatened and other taxa in need of monitoring

(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 taxa are usually represented on conservation lands.

(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.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

APPENDIX 3

State wide distribution of significant flora represented within the
MAC Development Envelope

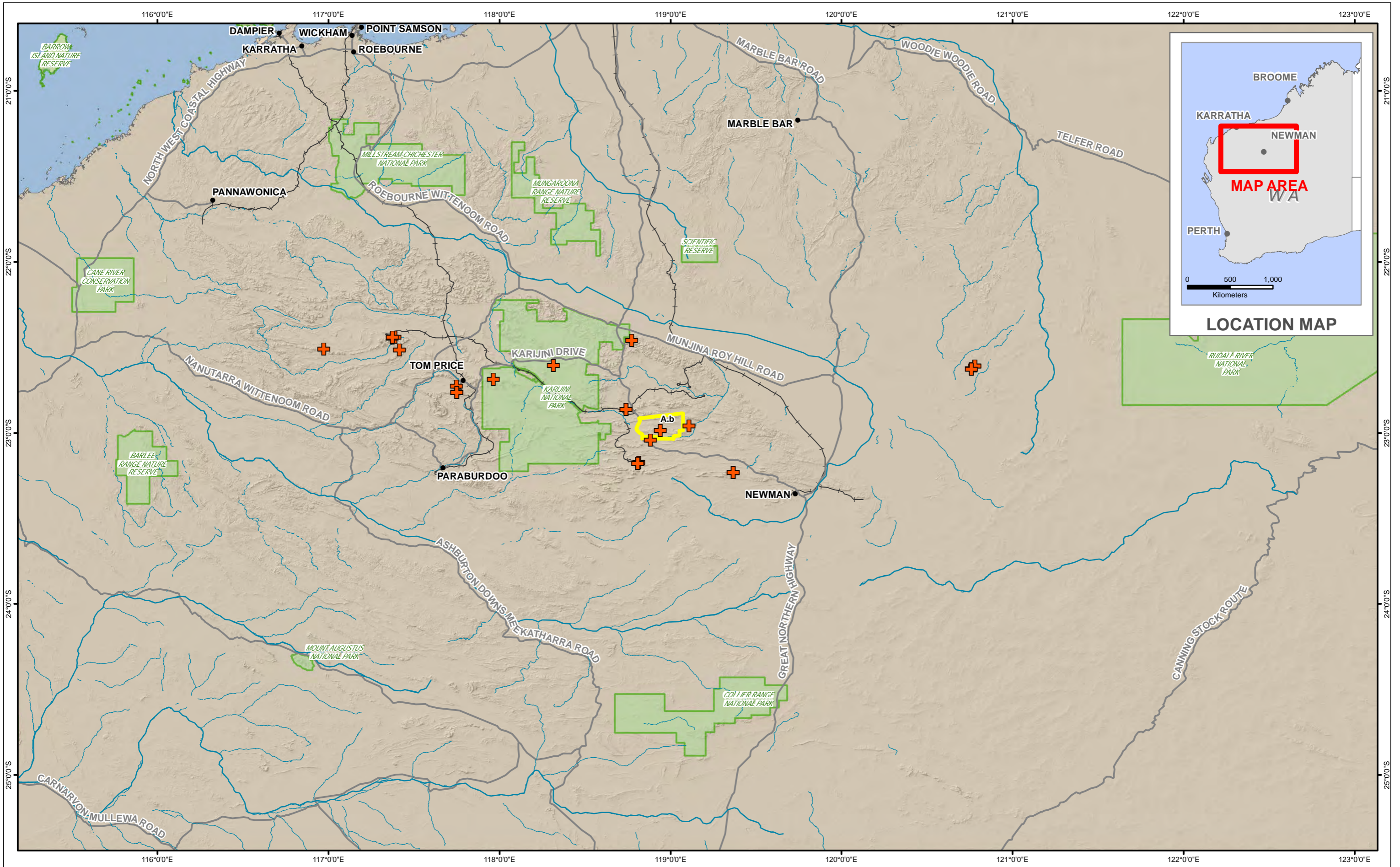
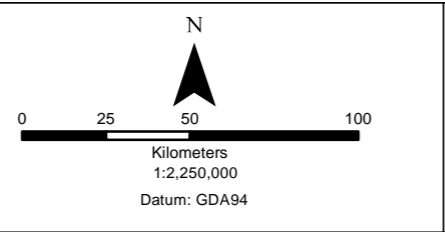


Figure:	3.1
Date:	15/08/2016
Sheet Size:	A3
Status:	FINAL
Drawn by:	GSM
Requested by:	DB
GSM Reference:	MAC_Location Acacia bromilowiana



BHPBIO
Acacia bromilowiana - distribution
 Appendix 3

- Legend**
- Acacia bromilowiana*
 - Proposed Mining Area C Development Envelope
 - Nature Conservation Reserve

- Watercourses
- Roads
- Railways

PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213

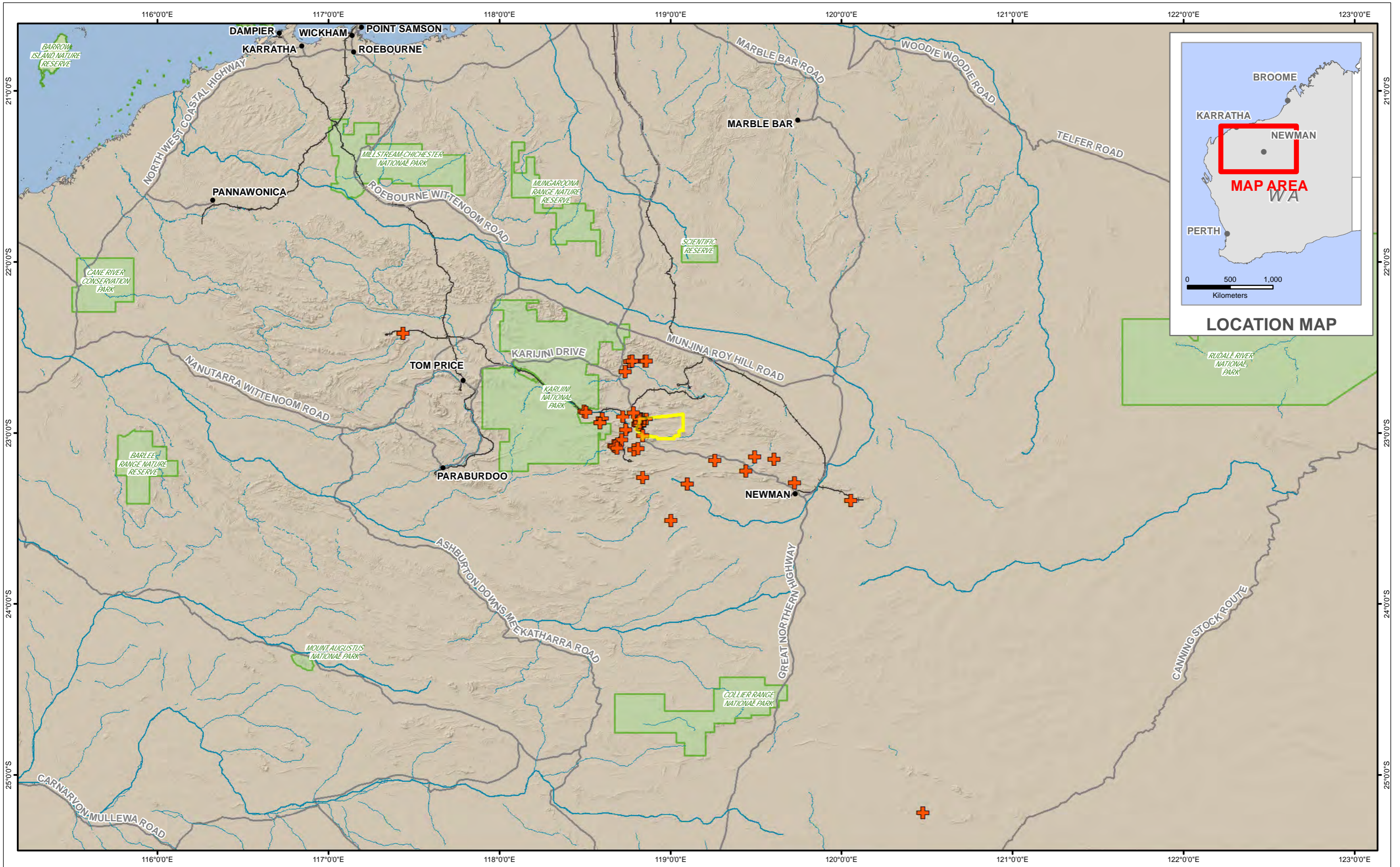
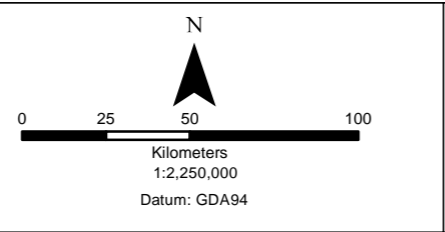


Figure: 3.3	Date: 15/08/2016
Sheet Size: A3	Status: FINAL
Drawn by: GSM	Requested by: DB
GSM Reference: MAC_Location Arista jerichoensis	



BHPBIO
Aristida jerichoensis var. *subspinulifera*
- distribution
Appendix 3

- Legend**
- Aristida jerichoensis* var. *subspinulifera*
 - Proposed Mining Area C Development Envelope
 - Nature Conservation Reserve

- Watercourses
- Roads
- Railways

PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

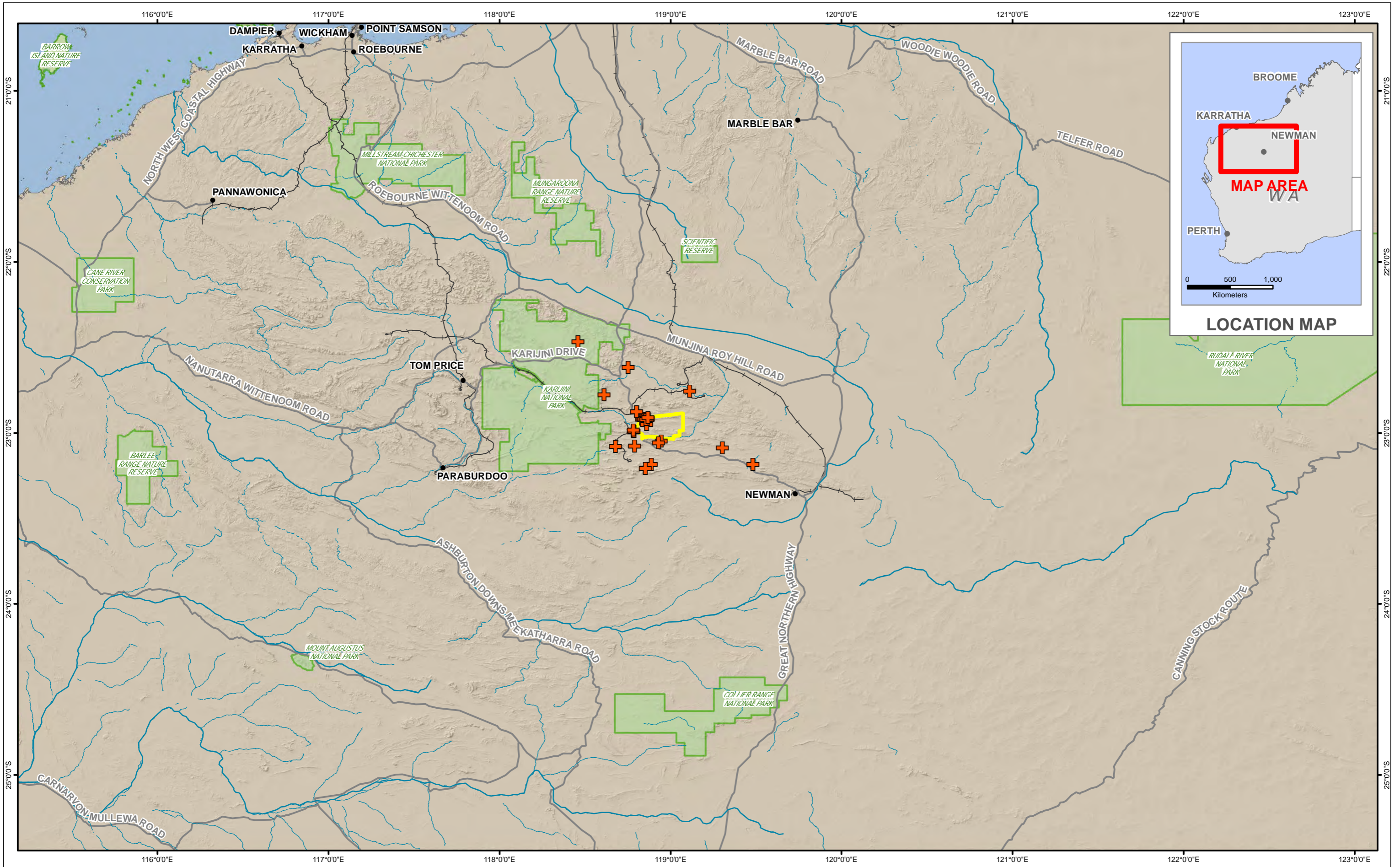





Figure:	3.2	Date:	15/08/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference		MAC_Location Aristida lazaridis	

N



Kilometers
1:2,250,000
Datum: GDA94

BHPBIO
Aristida lazaridis - distribution
Appendix 3

Legend

-  *Aristida lazaridis*
-  Proposed Mining Area C Development Envelope
-  Nature Conservation Reserve
-  Watercourses
-  Roads
-  Railways



PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

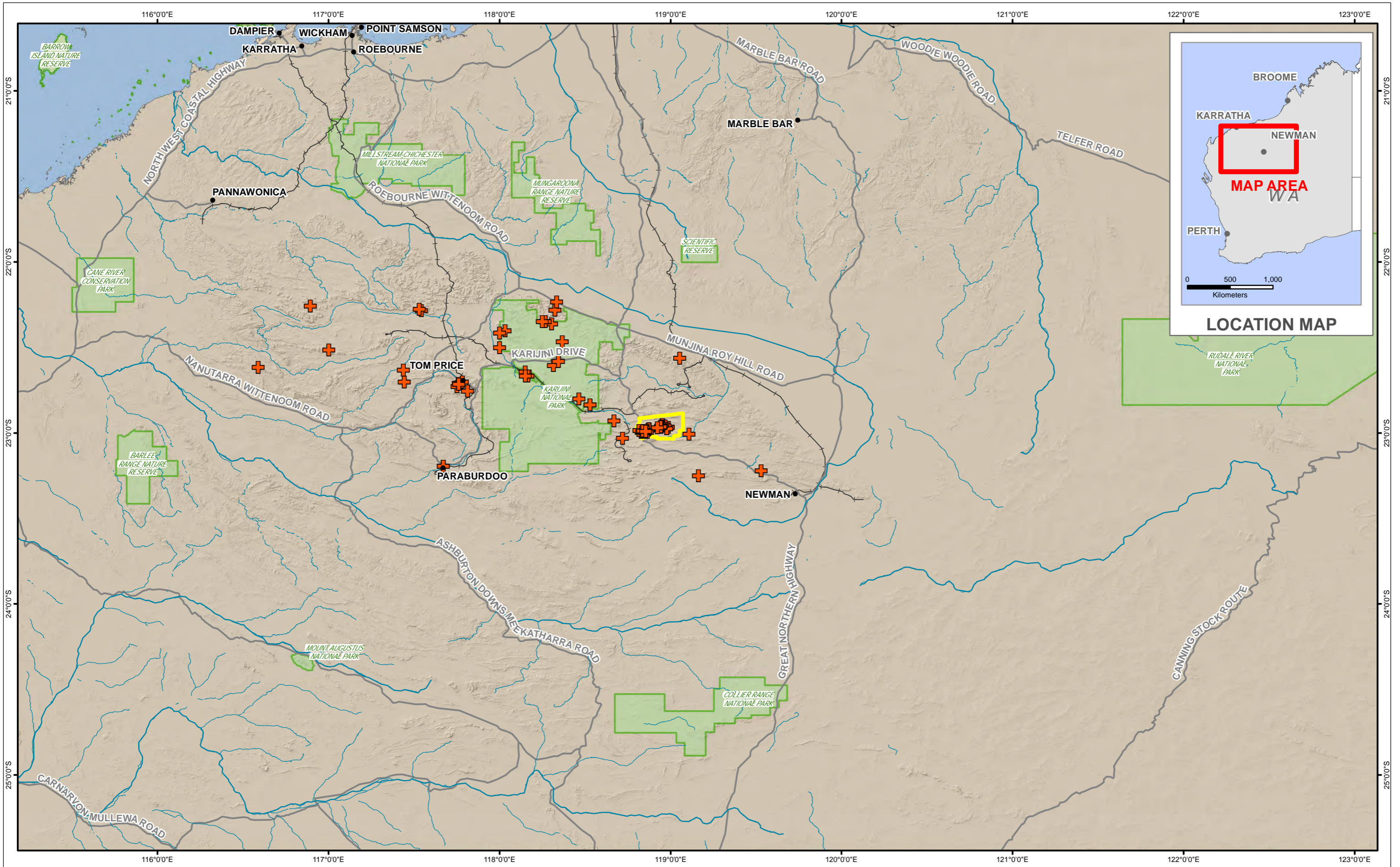




Figure:	3.4	Date:	15/08/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference		MAC_Location Eremophila magnifica	

N



Kilometers
1:2,250,000
Datum: GDA94

BHPBIO
Eremophila magnifica subsp. magnifica -
distribution
Appendix 3

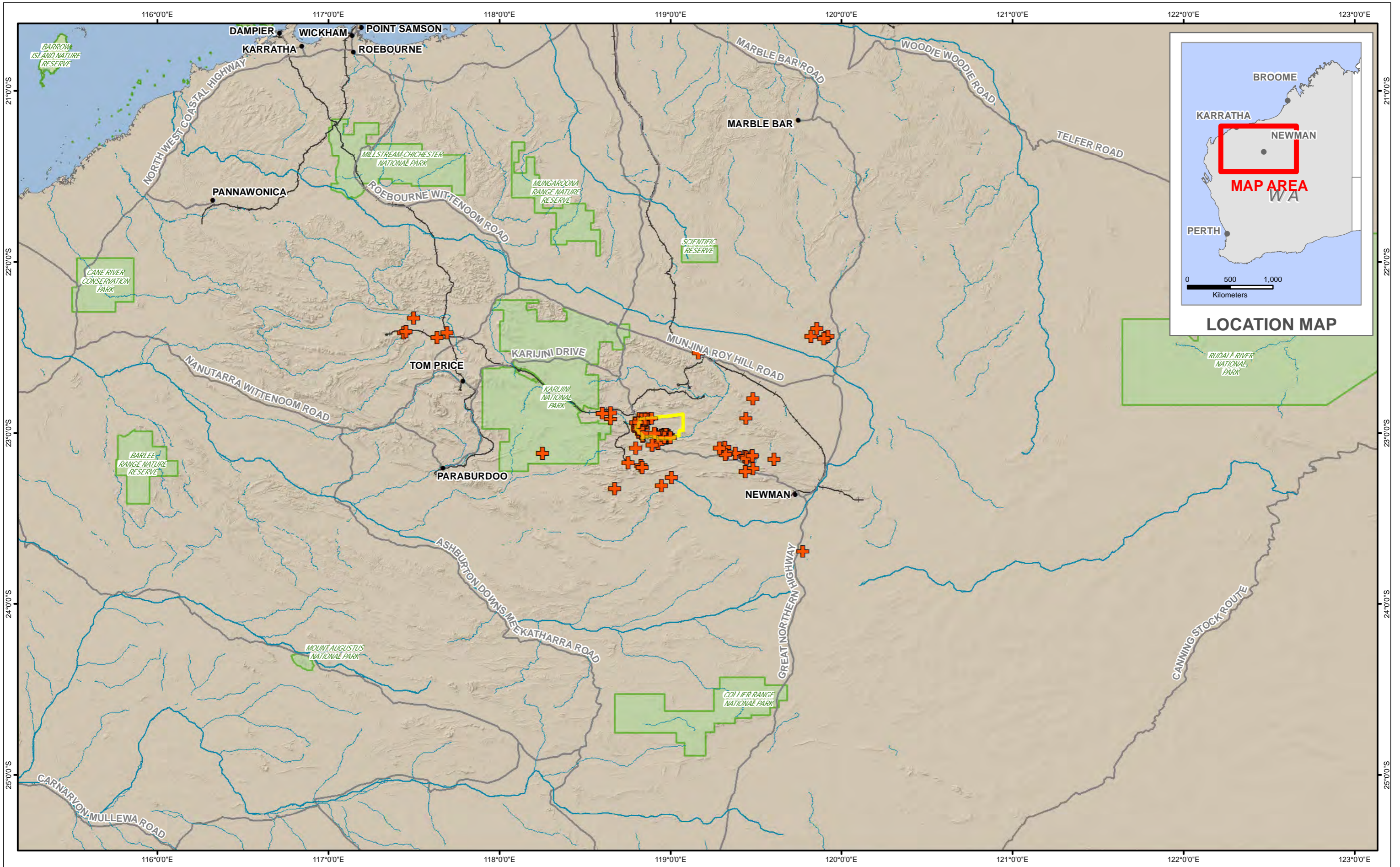
Legend

-  *Eremophila magnifica subsp. magnifica*
-  Proposed Mining Area C Development Envelope
-  Nature Conservation Reserve
-  Watercourses
-  Roads
-  Railways



GRIFIN
SPATIAL & MAPPING

PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213



ONSHORE ENVIRONMENTAL

Figure:	3.5	Date:	15/08/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
		GSM Reference:	MAC_Location Rhagodia sp. Hamersley

N

0 25 50 100
Kilometers
1:2,250,000
Datum: GDA94

BHPBIO
Rhagodia sp. Hamersley (M. Trudgen 17794) - distribution
Appendix 3

Legend

Rhagodia sp. Hamersley (M. Trudgen 17794)	Watercourses
Proposed Mining Area C Development Envelope	Roads
Nature Conservation Reserve	Railways

GRIFFIN
SPATIAL & MAPPING
PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

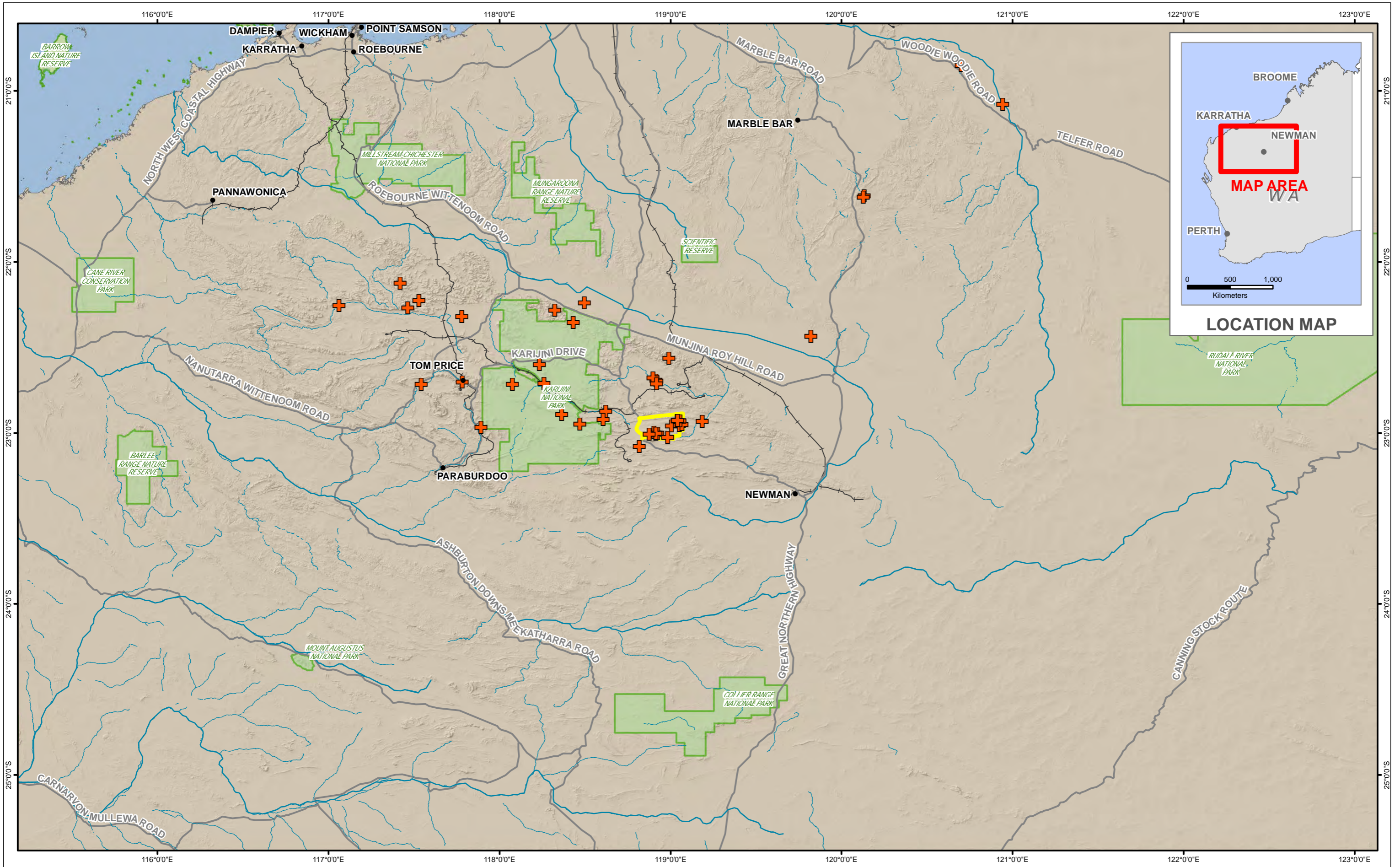
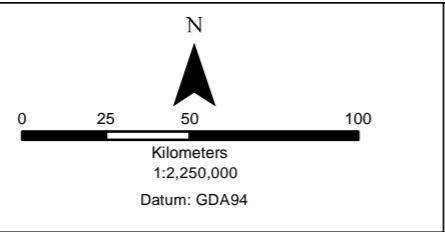


Figure:	3.6
Date:	15/08/2016
Sheet Size:	A3
Status:	FINAL
Drawn by:	GSM
Requested by:	DB
GSM Reference:	MAC_Location Rostellularia adscendens



BHPBIO
Rostellularia adscendens var. latifolia
 - distribution
Appendix 3

Legend	
	<i>Rostellularia adscendens var. latifolia</i>
	Proposed Mining Area C Development Envelope
	Nature Conservation Reserve
	Watercourses
	Roads
	Railways

PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213

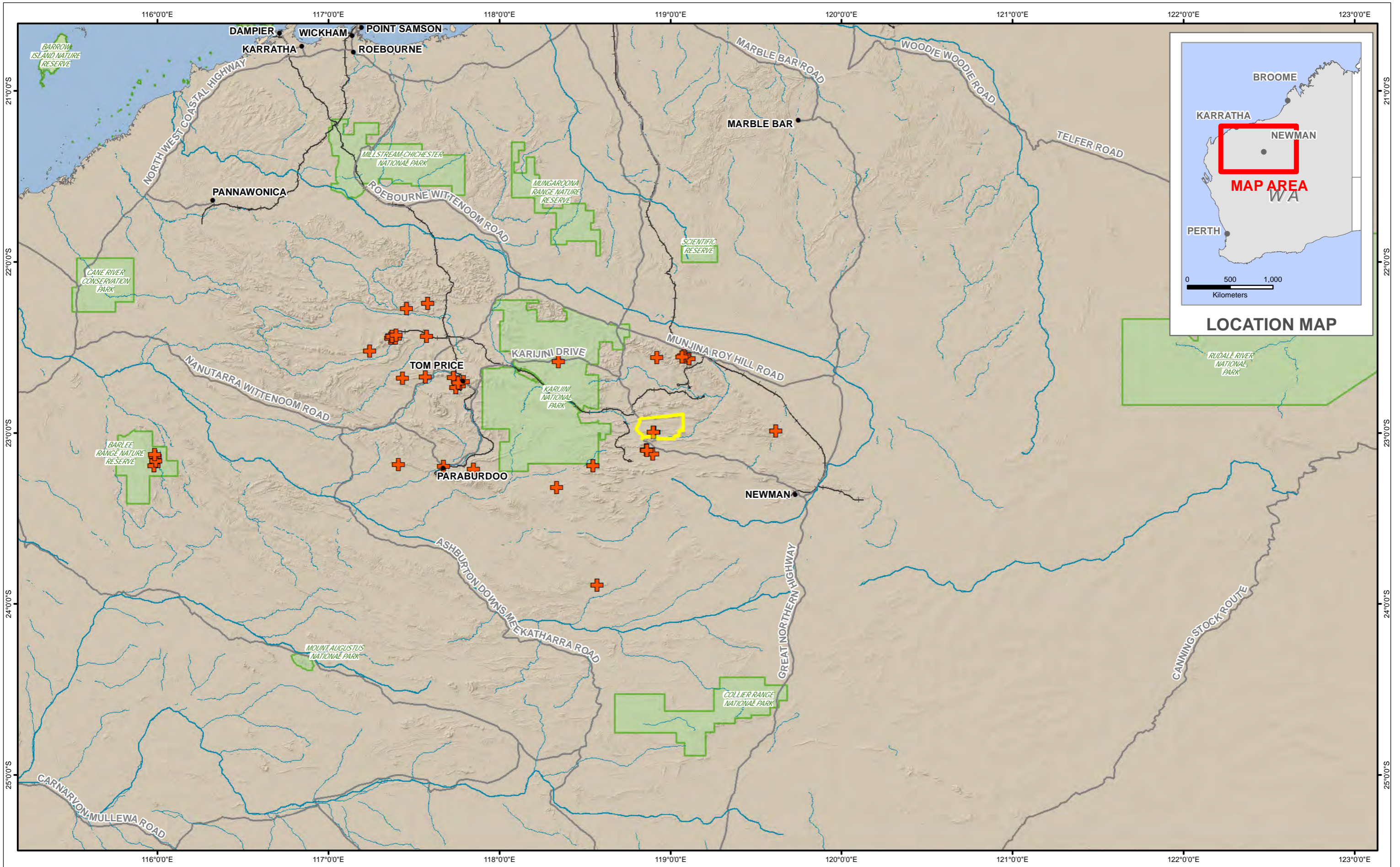





Figure:	3.7	Date:	15/08/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference		MAC_Location Sida sp. Barlee Range	







N



Kilometers
1:2,250,000
Datum: GDA94

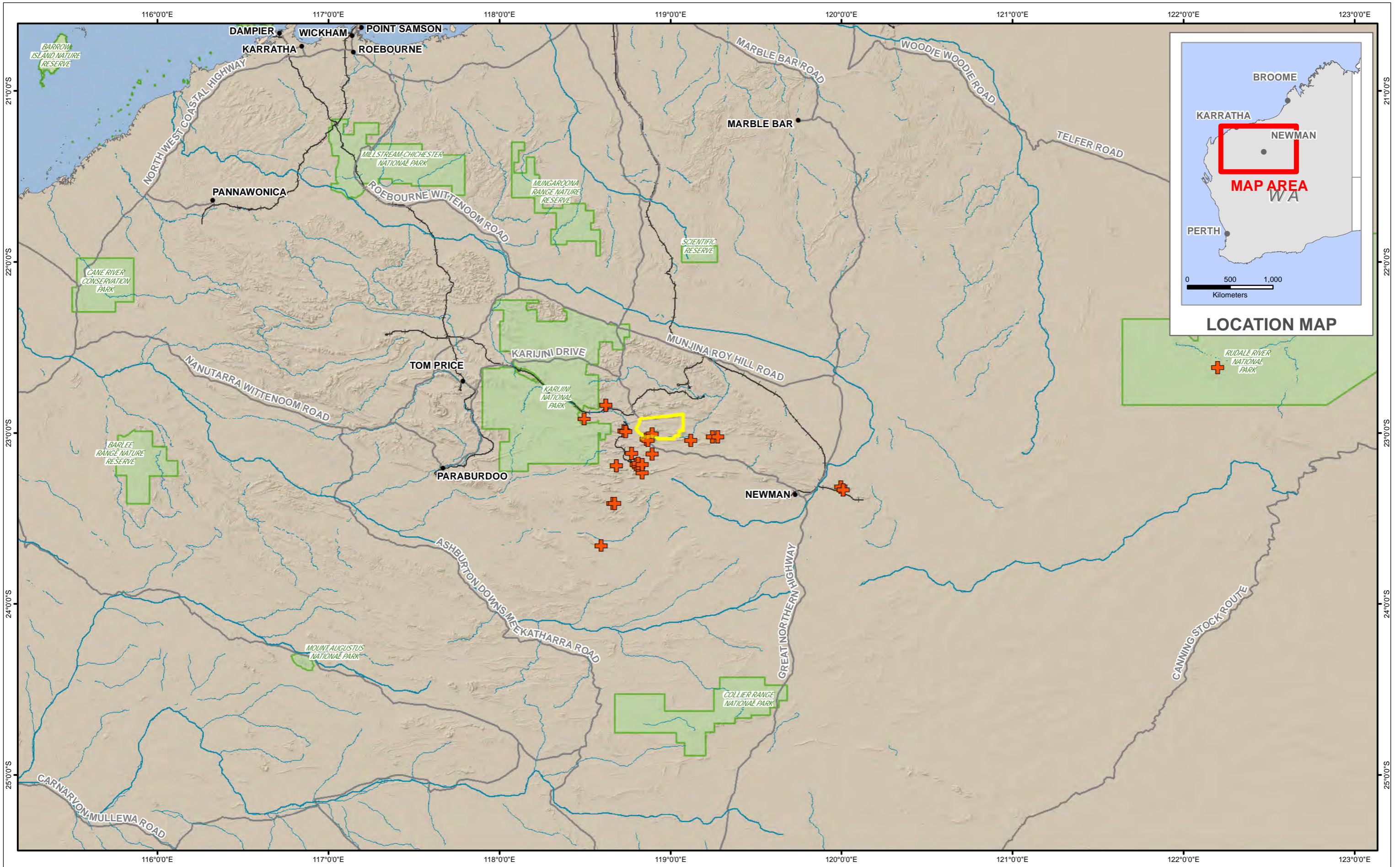
BHPBIO
Sida sp. Barlee Range (S. van Leeuwen 1642) -
distribution
Appendix 3

Legend

-  *Sida sp. Barlee Range (S. van Leeuwen 1642)*
-  Proposed Mining Area C Development Envelope
-  Nature Conservation Reserve
-  Watercourses
-  Roads
-  Railways



PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213



ONSHORE ENVIRONMENTAL

Figure:	3.8	Date:	15/08/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference		MAC_Location Triodia sp. Mt Ella	

N

0 25 50 100
Kilometers
1:2,250,000
Datum: GDA94

BHPBIO
Triodia sp. Mt Ella (M.E. Trudgen 12739)
- distribution
Appendix 3

Legend

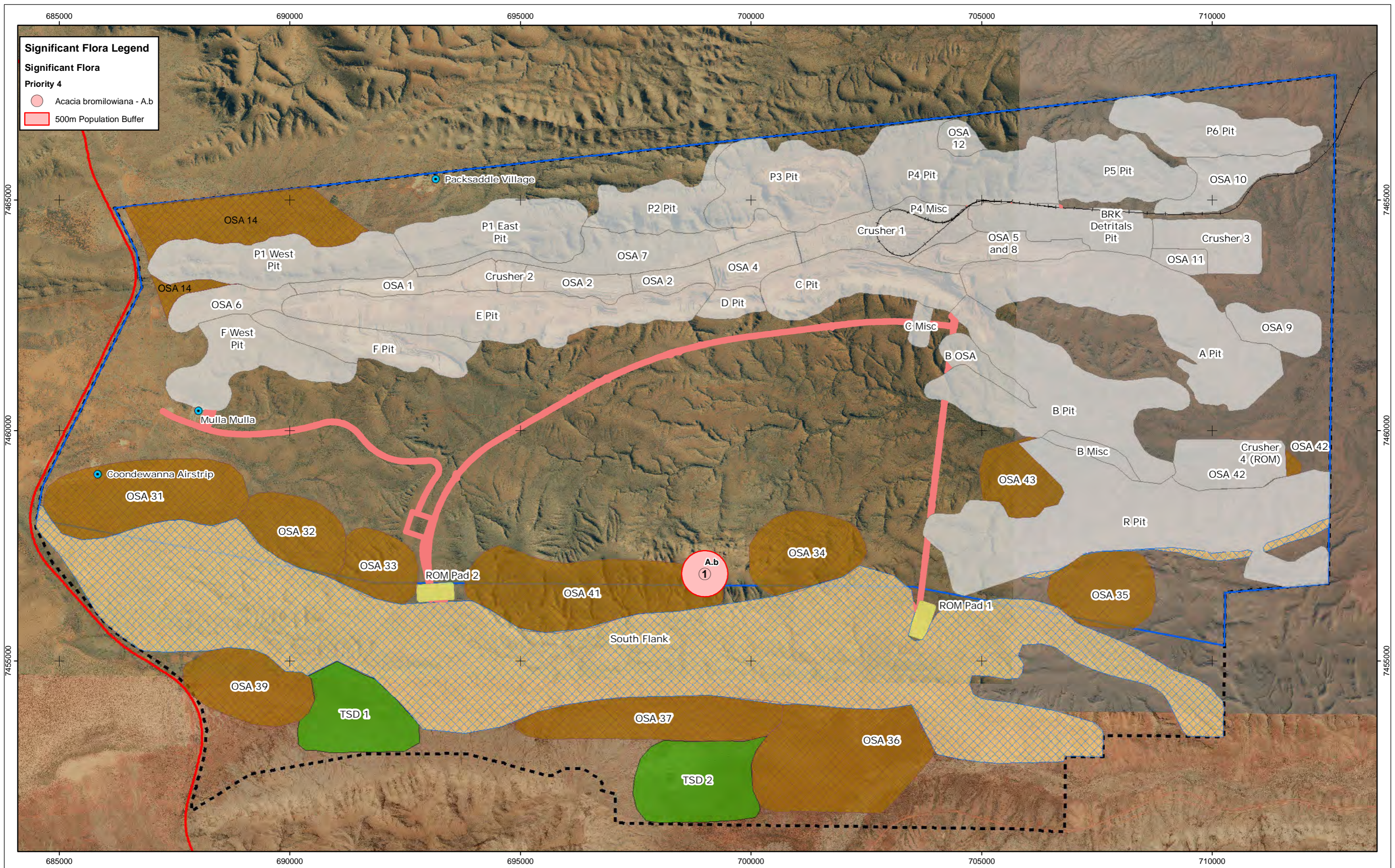
Triodia sp. Mt Ella (M.E. Trudgen 12739)	Watercourses
Proposed Mining Area C Development Envelope	Roads
Nature Conservation Reserve	Railways

GRIFFIN
SPATIAL & MAPPING

PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

APPENDIX 4

Significant flora populations defined within the MAC Development Envelope



Significant Flora Legend

Significant Flora

Priority 4

- Acacia bromilowiana - A.b
- 500m Population Buffer

Figure: 4.1 Date: 15/05/2016

Sheet Size: A3 Status: FINAL

Drawn by: GSM Requested by: DB

GSM Reference: MAC_SigF_Pop_Acacia bromilowiana

N

0 0.5 1 2 3 4

Kilometers
1:75,000

Datum: GDA94
Projection: MGA Zone 50

BHPBIO

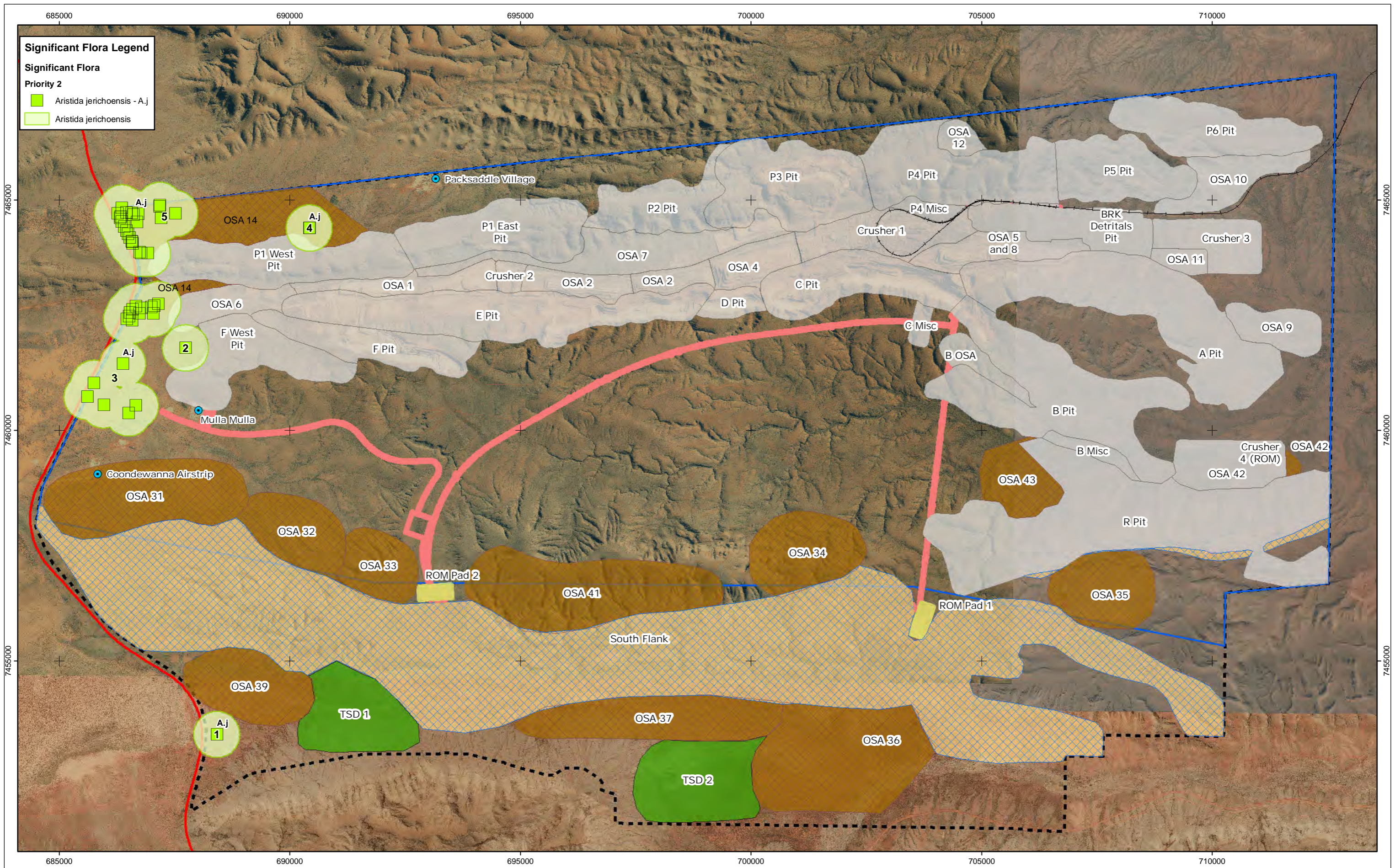
Acacia bromilowiana populations within the
Proposed MAC Development Envelope

Appendix 4

Legend

- Mine Accommodation
- Indicative OSA Area
- Indicative Additional Infrastructure
- Indicative Pit Area
- ROM
- Ministerial Statement 491 (Northern Flank)
- Topsoil
- Proposed Mining Area C Development Envelope
- TSD 1
- TSD 2
- Previously Approved Areas

PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213



Significant Flora Legend

Significant Flora

Priority 2

- Aristida jerichoensis - A.j
- Aristida jerichoensis

ONSHORE ENVIRONMENTAL

Figure:	4.2	Date:	15/05/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference		MAC_SigF_Pop_Aristida jerichoensis	

N

0 0.5 1 2 3 4
Kilometers
1:75,000

Datum: GDA94
Projection: MGA Zone 50

BHPBIO

Aristida jerichoensis var. *subspinulifera*
populations within the Proposed MAC
Development Envelope

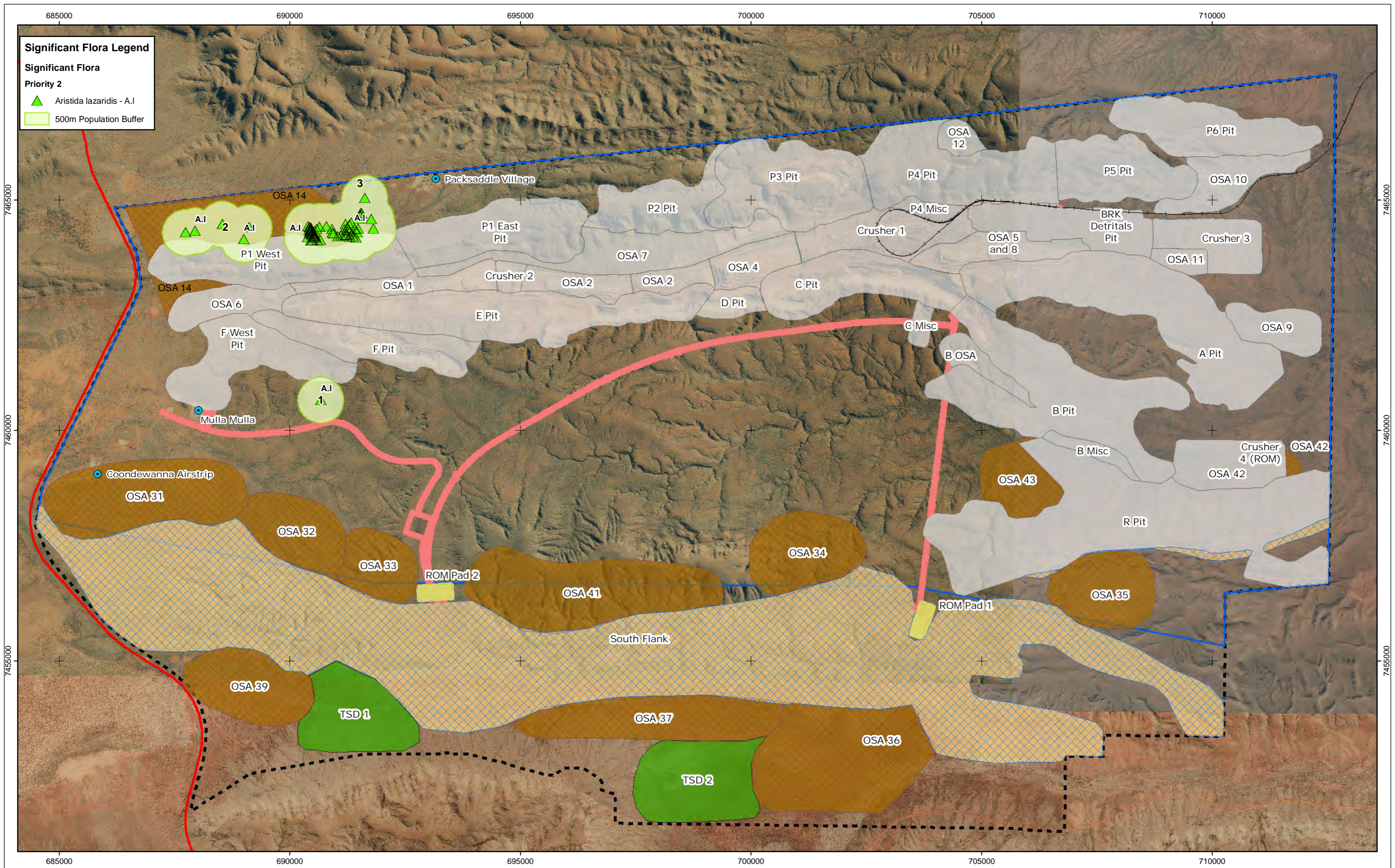
Appendix 4

Legend

- Mine Accommodation
- Indicative Additional Infrastructure Areas
- Indicative Additional OSA
- Indicative Additional Pits
- Indicative OSA Area
- Indicative Pit Area
- ROM
- Topsoil
- Previously Approved Areas
- Indicative Additional Infrastructure
- Ministerial Statement 491 (Northern Flank)
- Proposed Mining Area C Development Envelope

GRIFFIN
SPATIAL & MAPPING

PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213



ONSHORE ENVIRONMENTAL

Figure:	4.3	Date:	15/05/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference		MAC_SigF_Pop_Aristida lazaridis	

N

Kilometers
1:75,000

Datum: GDA94
Projection: MGA Zone 50

BHPBIO
Aristida lazaridis populations
 within the Proposed MAC Development Envelope

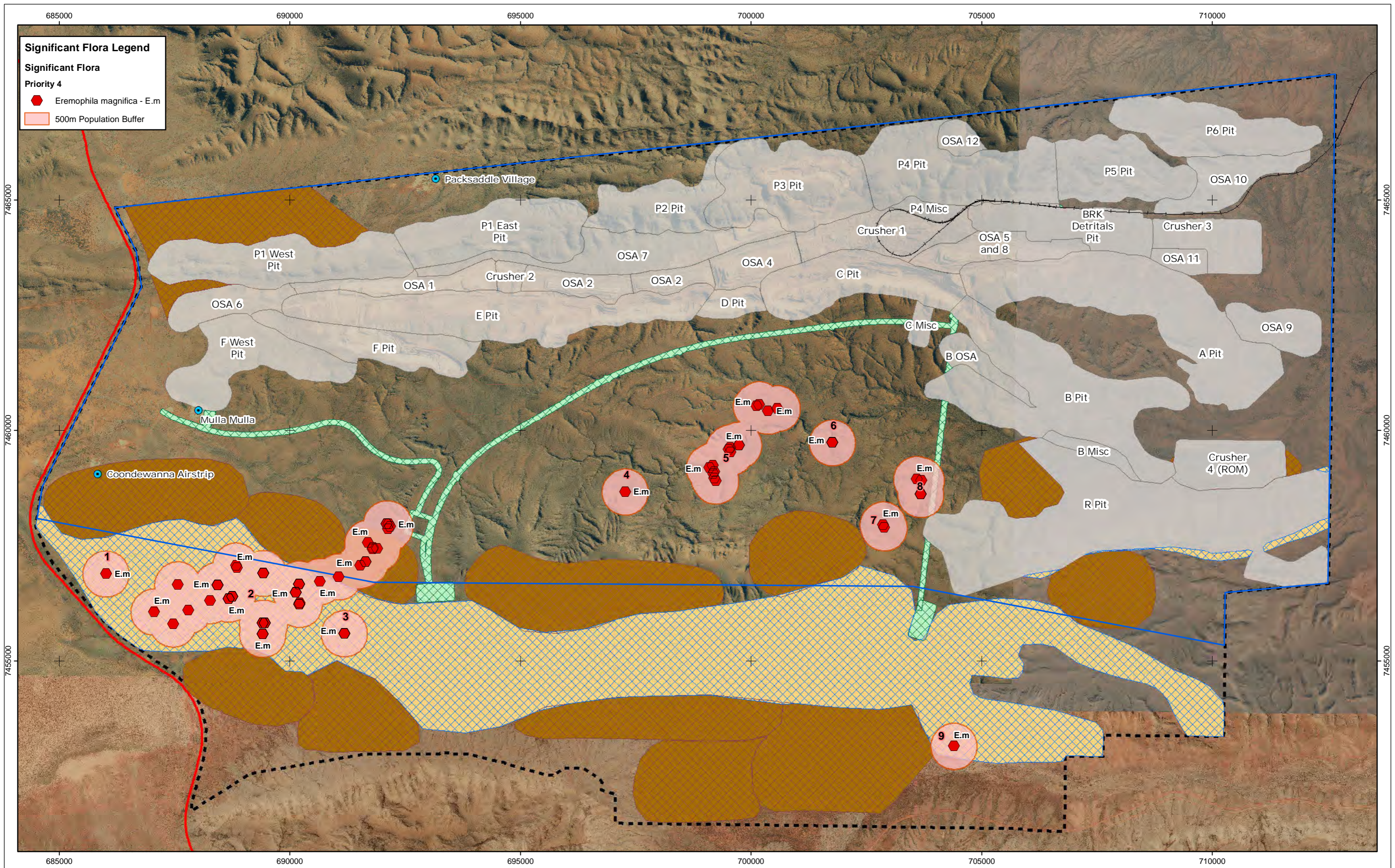
Appendix 4

Legend

Mine Accommodation	Indicative OSA Area	Indicative Additional Infrastructure
Indicative Additional Infrastructure Areas	Indicative Pit Area	Ministerial Statement 491 (Northern Flank)
Indicative Additional OSA	ROM	Proposed Mining Area C Development Envelope
Indicative Additional Pits	Topsoil	Previously Approved Areas

GRIFFIN
 SPATIAL & MAPPING

PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213



ONSHORE ENVIRONMENTAL

Figure:	4.4	Date:	23/09/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference		MAC_SigF_Pop_Eremophila magnifica	

N

0 0.5 1 2 3 4

Kilometers
1:75,000

Datum: GDA94
Projection: MGA Zone 50

BHPBIO

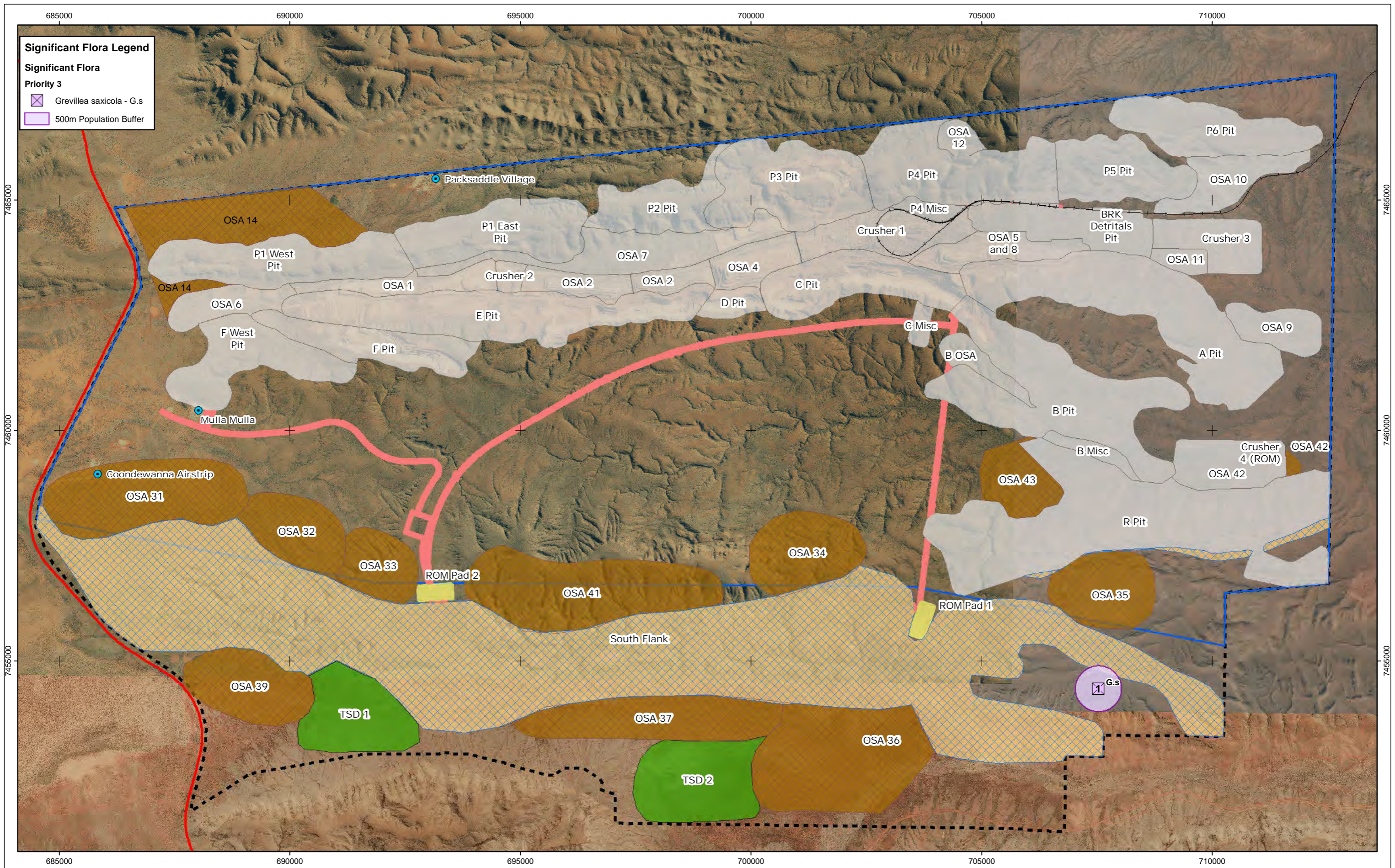
Eremophila magnifica subsp. *magnifica* populations
within the Proposed MAC Development Envelope
Appendix 4

Legend

Mine Accommodation	Indicative Additional Infrastructure Area	Ministerial Statement 491 (Northern Flank)
Previously Approved Areas	Indicative Additional OSA	Proposed Mining Area C Development Envelope
	Indicative Additional Pit Area	

GRIFFIN
SPATIAL & MAPPING

PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213



ONSHORE ENVIRONMENTAL

Figure: 4.5 Date: 15/05/2016
 Sheet Size: A3 Status: FINAL

Drawn by: GSM Requested by: DB
 GSM Reference: MAC_SigF_Pop_Grevillea saxicola

N

0 0.5 1 2 3 4
 Kilometers
 1:75,000

Datum: GDA94
 Projection: MGA Zone 50

BHPBIO

Grevillea saxicola populations within the Proposed MAC Development Envelope

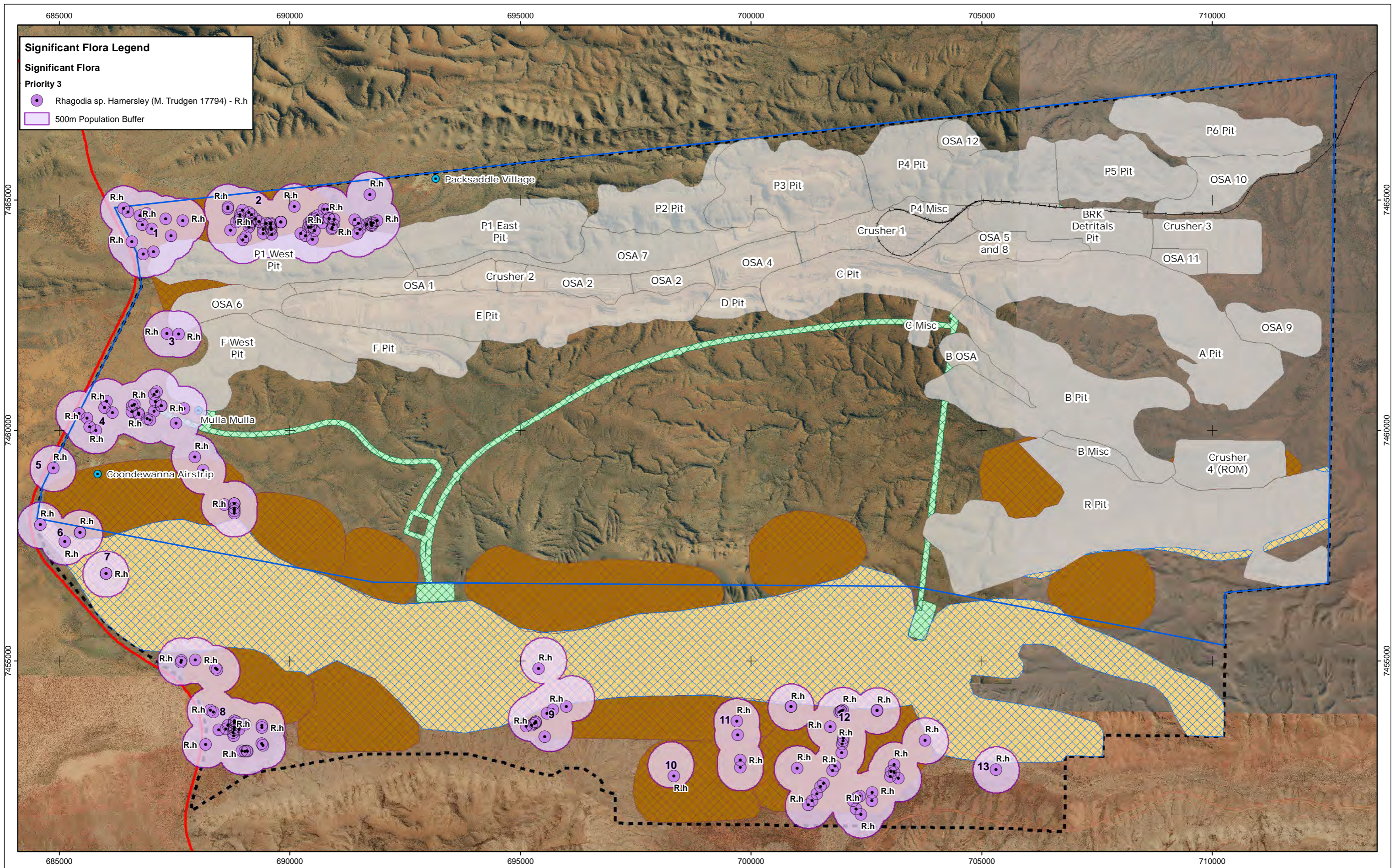
Appendix 4

Legend

- Mine Accommodation
- Indicative Additional Infrastructure Areas
- Indicative Additional OSA
- Indicative Additional Pits
- Indicative OSA Area
- Indicative Pit Area
- ROM
- Topsoil
- Previously Approved Areas
- Indicative Additional Infrastructure
- Ministerial Statement 491 (Northern Flank)
- Proposed Mining Area C Development Envelope

GRIFFIN SPATIAL & MAPPING

PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213



ONSHORE ENVIRONMENTAL

Figure:	4.6	Date:	15/05/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference		MAC_SigF_Pop_Rhagodia sp. Hamersley	

N

0 0.5 1 2 3 4
Kilometers
1:75,000

Datum: GDA94
Projection: MGA Zone 50

BHPBIO

Rhagodia sp. Hamersley (M. Trudgen 17794) populations within the Proposed MAC Development Envelope

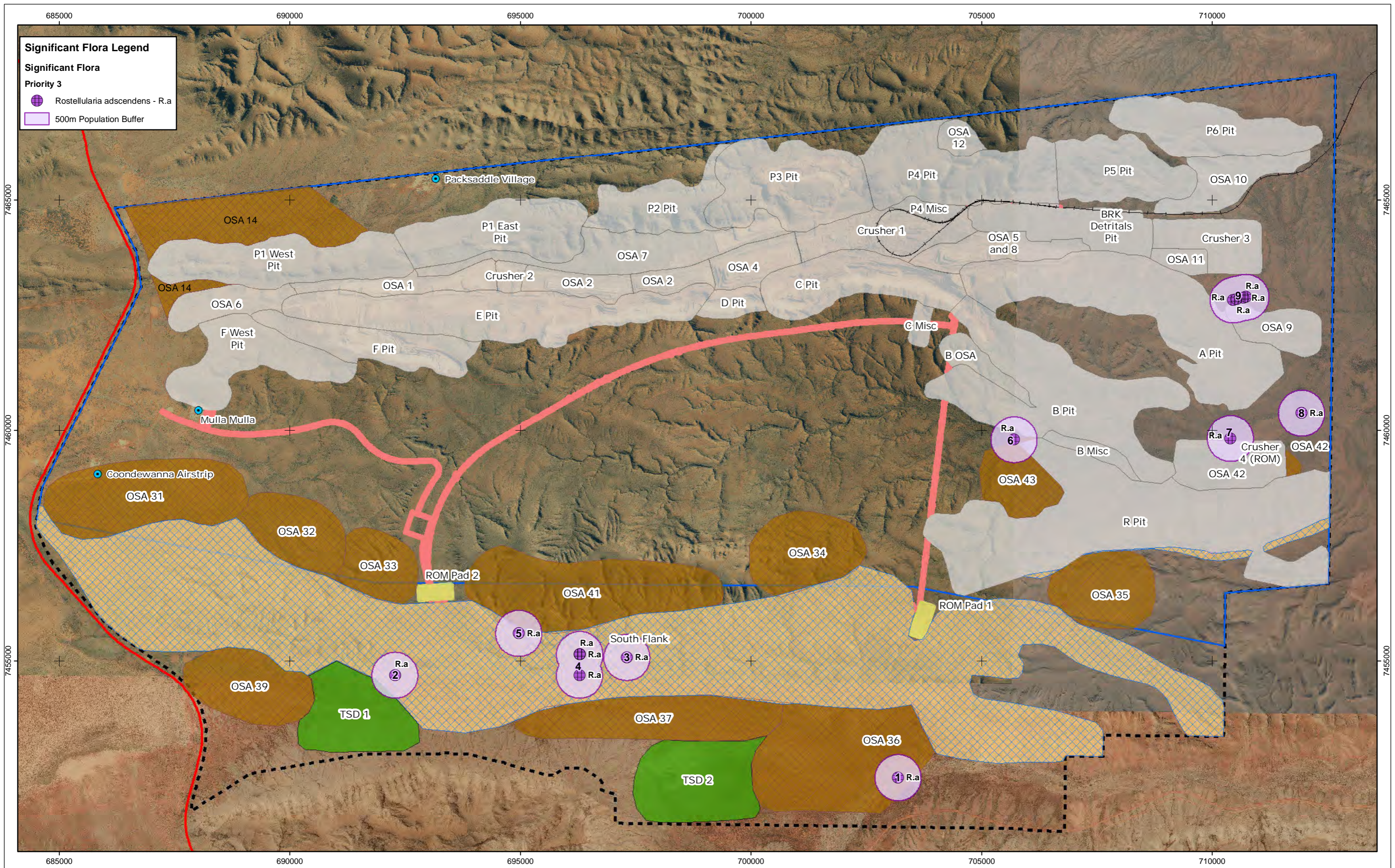
Appendix 4

Legend

- Mine Accommodation
- Previously Approved Areas
- Indicative Additional Infrastructure Area
- Indicative Additional OSA
- Indicative Additional Pit Area
- Ministerial Statement 491 (Northern Flank)
- Proposed Mining Area C Development Envelope

GRIFFIN SPATIAL & MAPPING

PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213



Significant Flora Legend

Significant Flora

Priority 3

- Rostellularia adscendens - R.a
- 500m Population Buffer

ONSHORE ENVIRONMENTAL

Figure: 4.7 Date: 15/05/2016

Sheet Size: A3 Status: FINAL

Drawn by: GSM Requested by: DB

GSM Reference: MAC_SigF_Pop_Rostellularia adscendens

N

0 0.5 1 2 3 4

Kilometers
1:75,000

Datum: GDA94
Projection: MGA Zone 50

BHPBIO

Rostellularia adscendens subsp. *adscendens*
populations within the Proposed MAC
Development Envelope

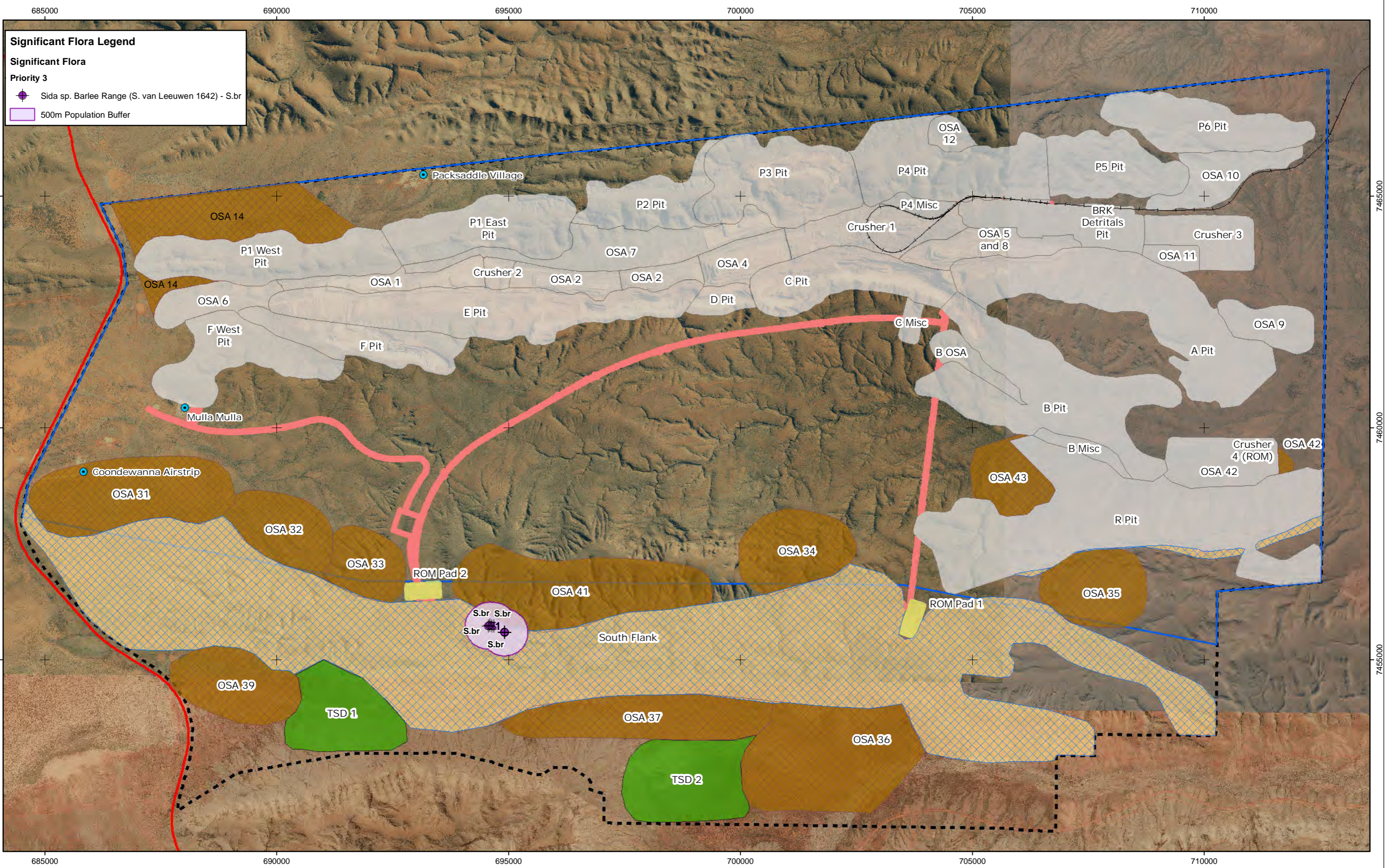
Appendix 4

Legend

- Mine Accommodation
- Indicative Additional Infrastructure Areas
- Indicative Additional OSA
- Indicative Additional Pits
- Indicative OSA Area
- Indicative Pit Area
- ROM
- Topsoil
- Previously Approved Areas
- Indicative Additional Infrastructure
- Ministerial Statement 491 (Northern Flank)
- Proposed Mining Area C Development Envelope

GRIFFIN SPATIAL & MAPPING

PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213



Significant Flora Legend

Significant Flora

Priority 3

- ◆ Sida sp. Barlee Range (S. van Leeuwen 1642) - S.br
- 500m Population Buffer

ONSHORE ENVIRONMENTAL

Figure: 4.8 Date: 15/05/2016

Sheet Size: A3 Status: FINAL

Drawn by: GSM Requested by: DB GSM Reference: MAC_SigF_Pop_Sida sp. Barlee Range

N

0 0.5 1 2 3 4

Kilometers
1:75,000

Datum: GDA94
Projection: MGA Zone 50

BHPBIO

Sida sp. Barlee Range (S. van Leeuwen 1642) populations within the Proposed MAC Development Envelope

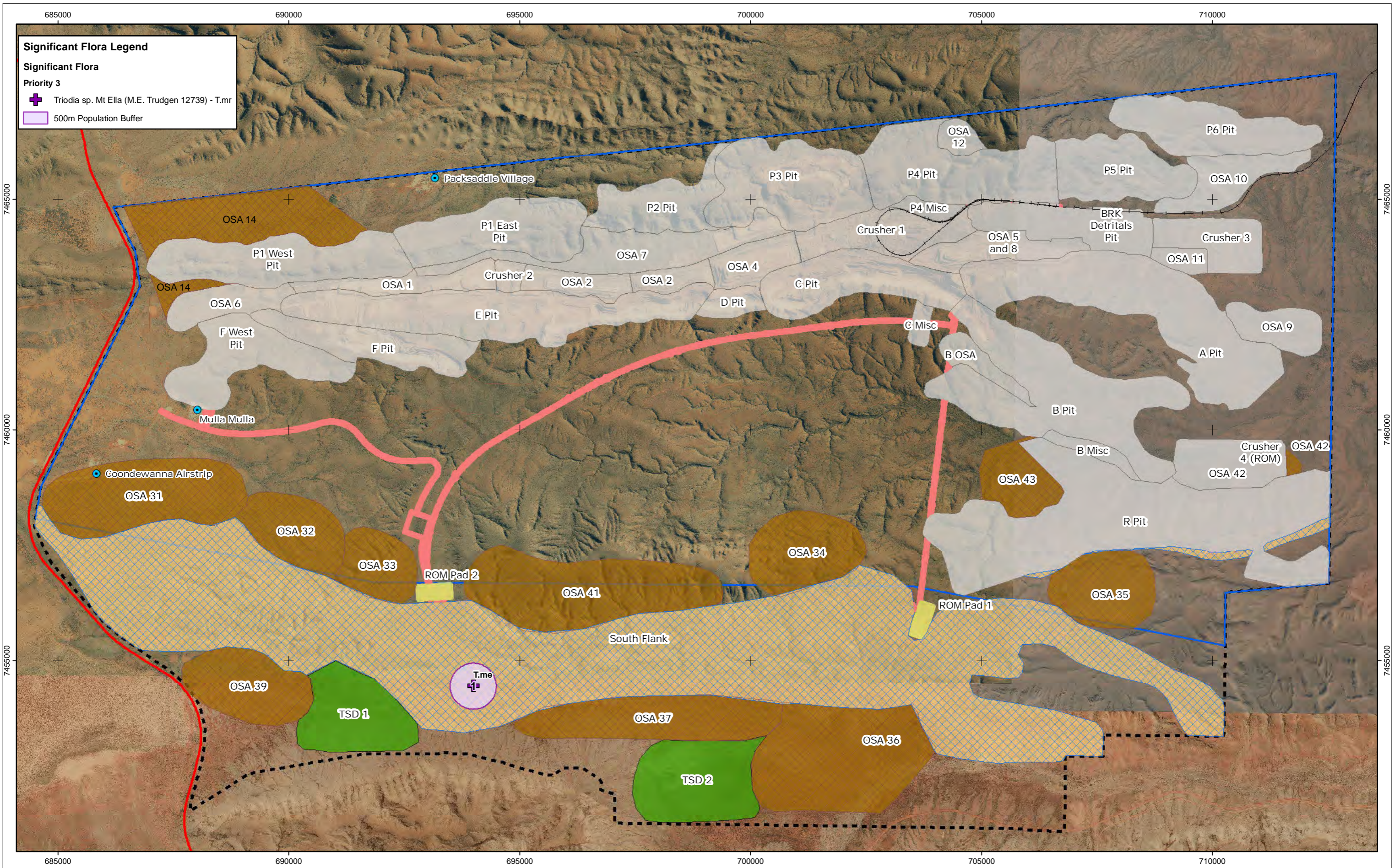
Appendix 4

Legend

- Mine Accommodation
- Indicative Additional Infrastructure Areas
- Indicative Additional OSA
- Indicative Additional Pits
- Indicative OSA Area
- Indicative Pit Area
- ROM
- Topsoil
- Previously Approved Areas
- Indicative Additional Infrastructure
- Ministerial Statement 491 (Northern Flank)
- Proposed Mining Area C Development Envelope

GRIFFIN SPATIAL & MAPPING

PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213



ONSHORE ENVIRONMENTAL

Figure:	4.9	Date:	15/05/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference		MAC_SigF_Pop_Triodia sp. Mt Ella	

N

0 0.5 1 2 3 4
Kilometers
1:75,000

Datum: GDA94
Projection: MGA Zone 50

BHPBIO

Triodia sp. Mt Ella (M.E. Trudgen 12739) populations within the Proposed MAC Development Envelope

Appendix 4

Legend

- Mine Accommodation
- Indicative Additional Infrastructure Areas
- Indicative Additional OSA
- Indicative Additional Pits
- Indicative OSA Area
- Indicative Pit Area
- ROM
- Topsoil
- Previously Approved Areas
- Indicative Additional Infrastructure
- Ministerial Statement 491 (Northern Flank)
- Proposed Mining Area C Development Envelope

GRIFFIN SPATIAL & MAPPING

PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

APPENDIX 5

Vegetation Classifications for the Pilbara based on Specht (1970),
as modified by Aplin (1979) and Trudgen (2009)

Height Class	Canopy Cover				
	100 - 70%	70 - 30%	30 - 10%	10 - 2%	< 2%
Trees > 30 m	High Closed Forest	High Open Forest	High Woodland	High Open Woodland	Scattered Tall Trees
Trees 10-30m	Closed Forest	Open Forest	Woodland	Open Woodland	Scattered Trees
Trees < 10 m	Low Closed Woodland	Low Open Forest	Low Woodland	Low Open Woodland	Scattered Low Trees
Mallee	Closed Mallee	Mallee	Open Mallee	Very Open Mallee	Scattered Mallees
Shrubs > 2 m	Closed Scrub	Open Scrub	High Shrubland	High Open Shrubland	Scattered Tall Shrubs
Shrubs 1-2 m	Closed Heath	Open Heath	Shrubland	Open Shrubland	Scattered Shrubs
Shrubs < 1 m	Low Closed Heath	Low Open Heath	Low Shrubland	Low Open Shrubland	Low Scattered Shrubs
Hummock Grass	Closed Hummock Grassland	Hummock Grassland	Open Hummock Grassland	Very Open Hummock Grassland	Scattered Hummock Grass
Tussock Grass	Closed Tussock Grassland	Tussock Grassland	Open Tussock Grassland	Very Open Tussock Grassland	Scattered Tussock Grass
Bunch Grass	Closed Bunch Grassland	Bunch Grassland	Open Bunch Grassland	Very Open Bunch Grassland	Scattered Bunch Grass
Sedges	Closed Sedges	Sedges	Open Sedges	Very Open Sedges	Scattered Sedges
Herbs	Closed Herbs	Herbs	Open Herbs	Very Open Herbs	Scattered Herbs

Source: S. Van Leeuwen (DPaW)

APPENDIX 6

Vegetation condition scale
(as developed by Keighery 1994)

Condition	Code	Description
Pristine	1	Pristine or nearly so, no obvious signs of disturbance.
Excellent	2	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	3	Vegetation structure altered; obvious signs of disturbance.
Good	4	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
Degraded	5	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching Very Good condition without intensive management.
Completely Degraded	6	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

APPENDIX 7

State-wide distribution of significant flora represented within the Indicative Additional Disturbance Areas, in relation to BHPBIO and Third Party cumulative impacts

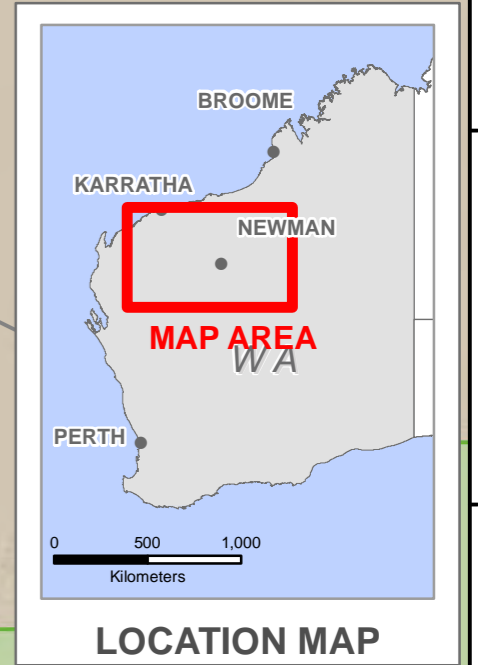
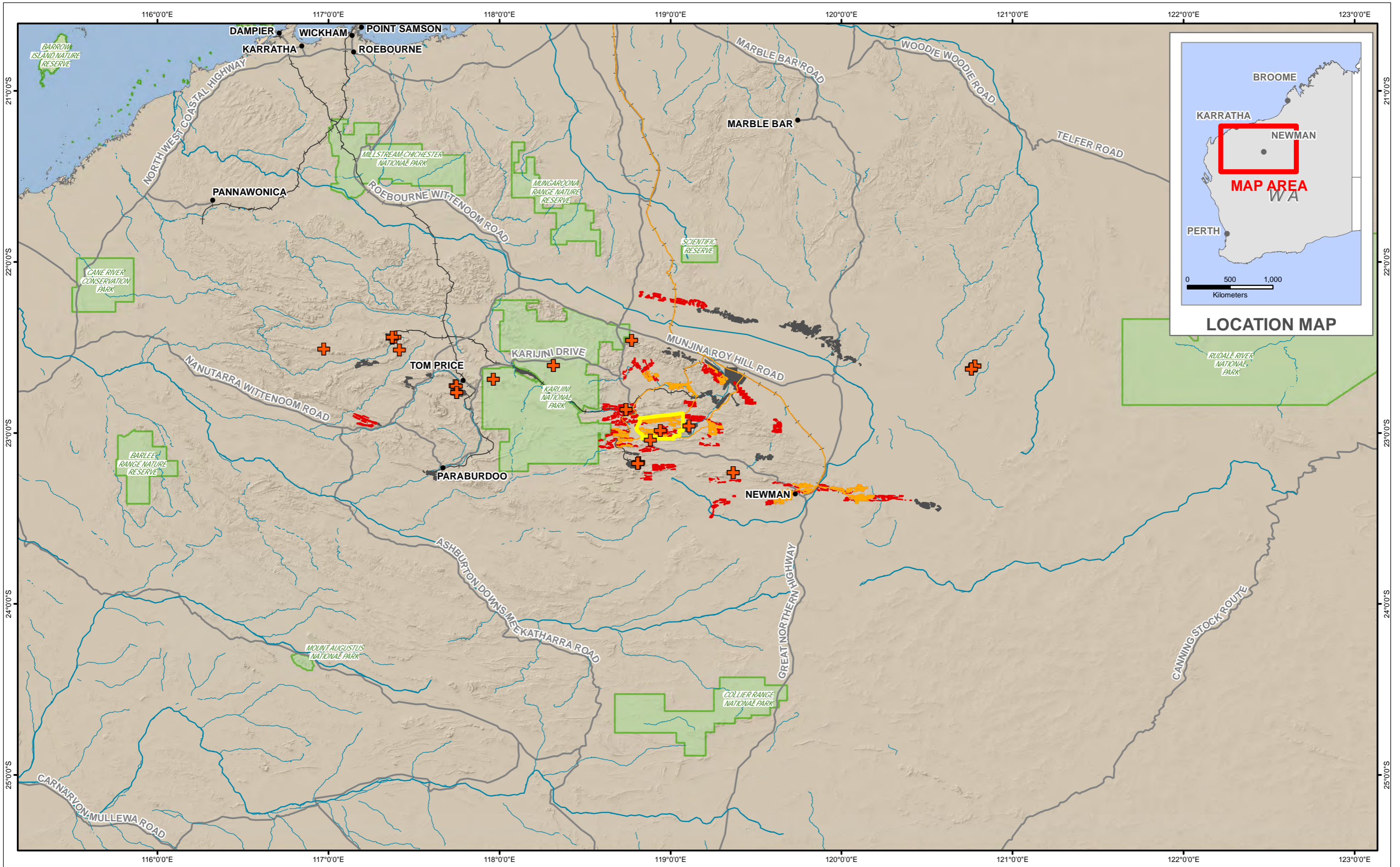
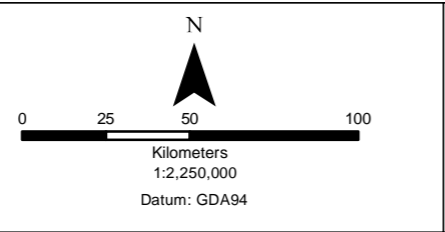


Figure:	7.1
Date:	15/08/2016
Sheet Size:	A3
Status:	FINAL
Drawn by:	GSM
Requested by:	DB
GSM Reference:	MAC_Location Acacia bromilowiana Cumaltive



BHPBIO
Acacia bromilowiana
Distribution against cumulative impacts
Appendix 7

Legend

- Acacia bromilowiana*
- Proposed Mining Area C Development Envelope
- Nature Conservation Reserve

Disturbance

- BHPBIO 30% General
- BHPBIO Life of Assest
- Third Party

PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213

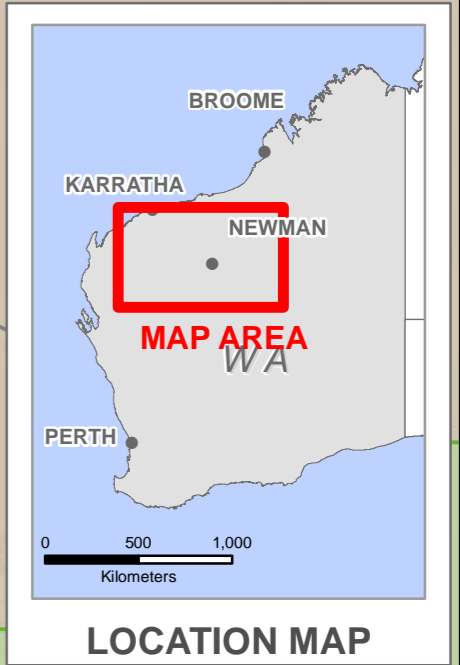
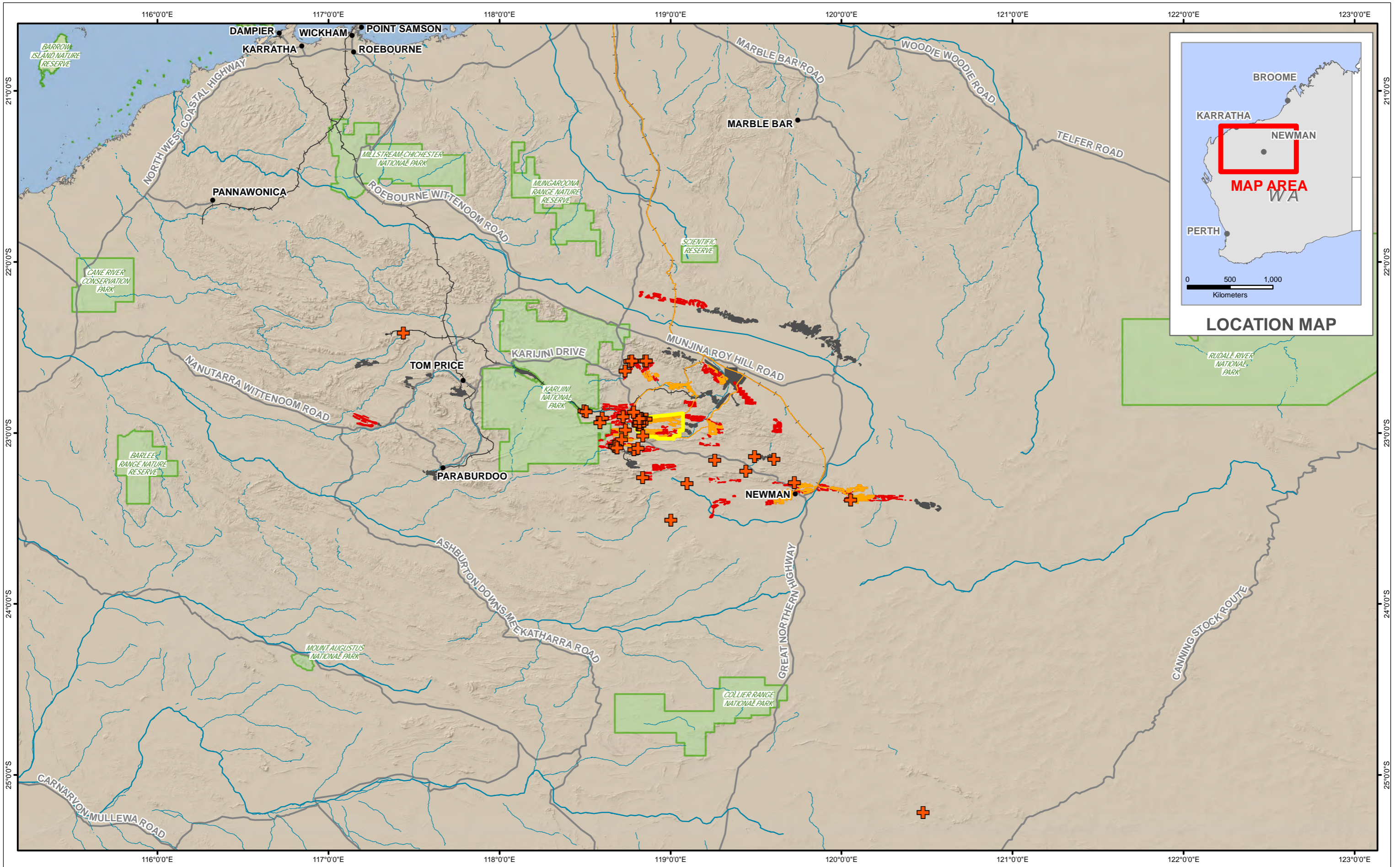
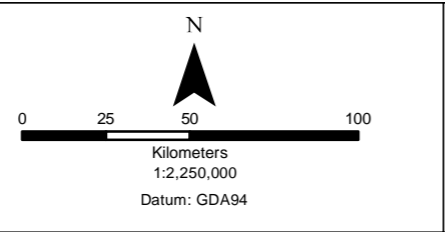


Figure: 7.2	Date: 15/08/2016
Sheet Size: A3	Status: FINAL
Drawn by: GSM	Requested by: DB
GSM Reference: MAC_Location Aristida jerichoensis Cumulative	



BHPBIO
Aristida jerichoensis var. *subspinulifera*
Distribution against cumulative impacts
Appendix 7

Legend

- Aristida jerichoensis* var. *subspinulifera*
- Proposed Mining Area C Development Envelope
- Nature Conservation Reserve
- Disturbance: BHPBIO 30% General
- Disturbance: BHPBIO Life of Assest
- Disturbance: Third Party

GRIFFIN
SPATIAL & MAPPING
PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

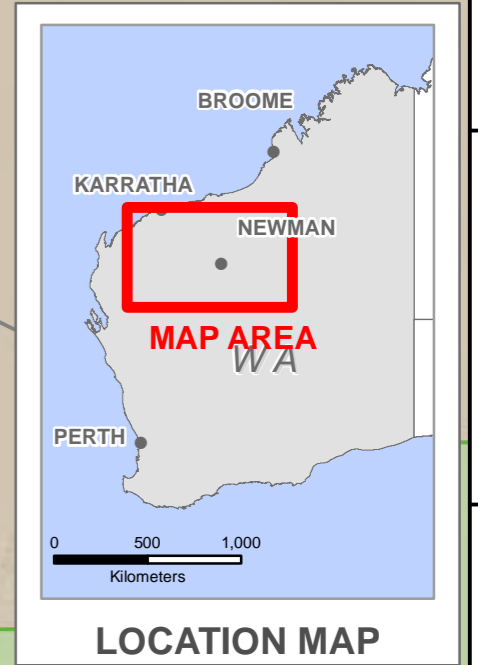
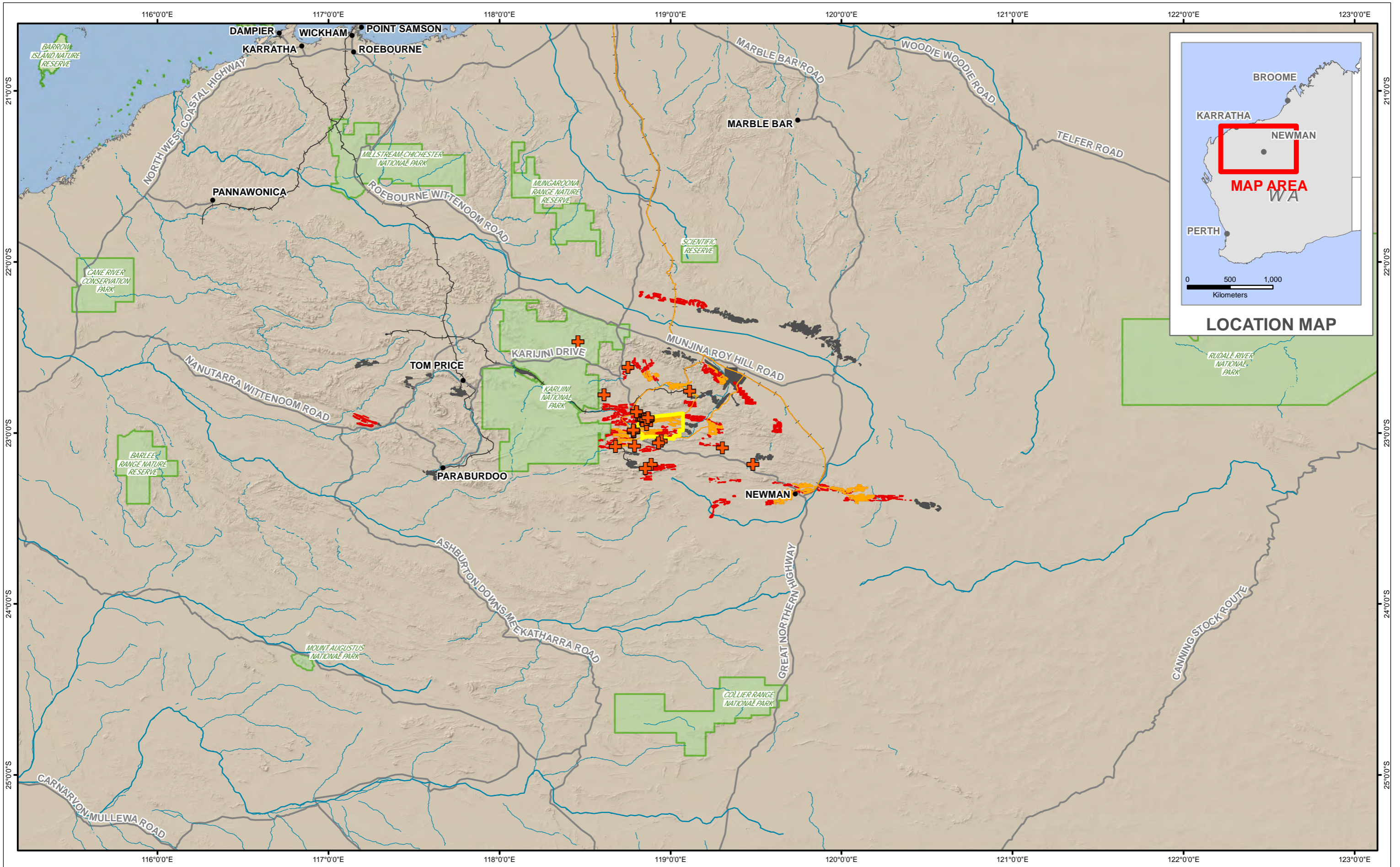
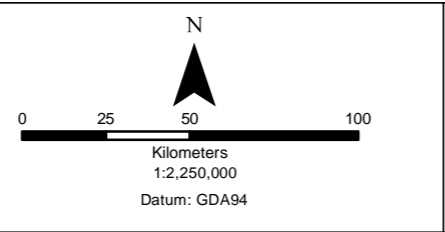


Figure: 7.3	Date: 15/08/2016
Sheet Size: A3	Status: FINAL
Drawn by: GSM	Requested by: DB
GSM Reference: MAC_Location Aristida lazaridis Cumulative	



BHPBIO
Aristida lazaridis
 Distribution against cumulative impacts
 Appendix 7

Legend	Disturbance
<i>Aristida lazaridis</i>	BHPBIO 30% General
Proposed Mining Area C Development Envelope	BHPBIO Life of Assest
Nature Conservation Reserve	Third Party

GRIFFIN
 SPATIAL & MAPPING
 PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213

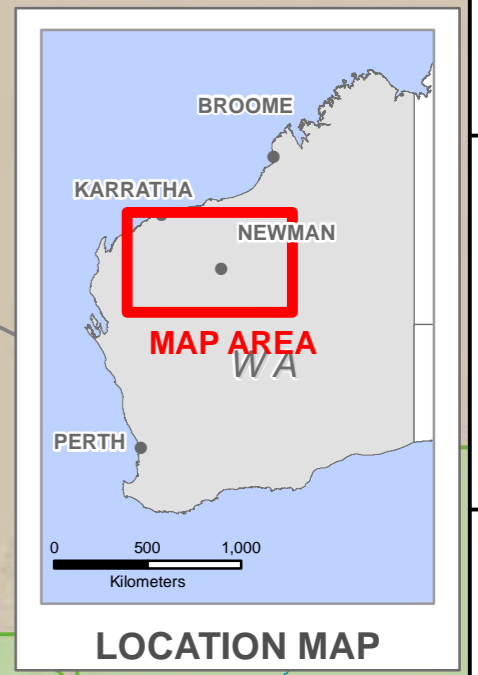
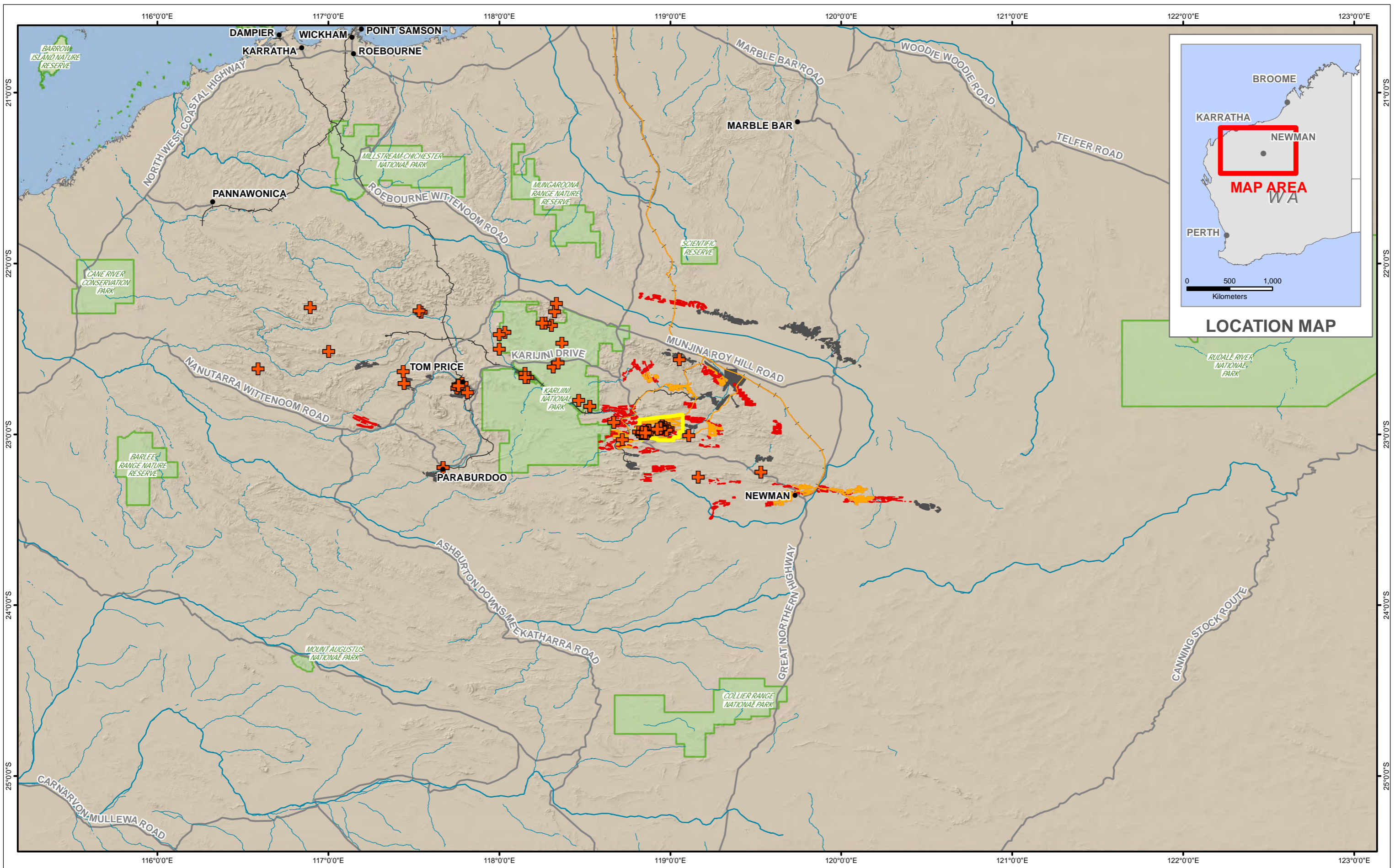
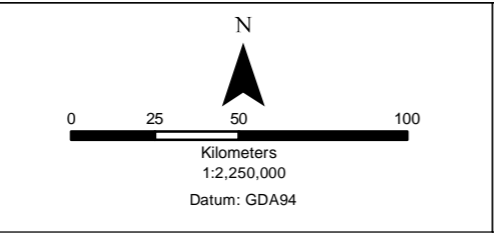


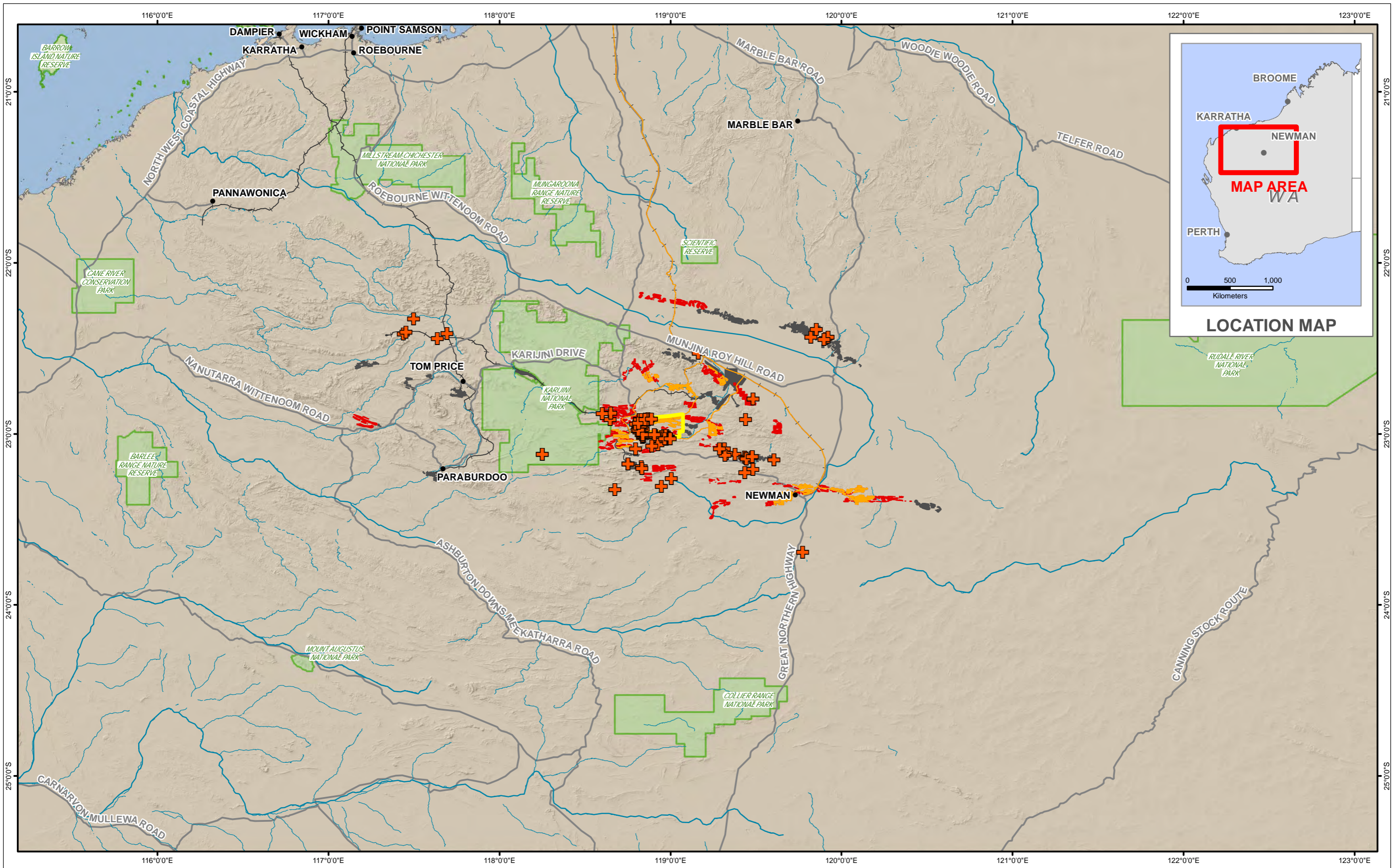
Figure: 7.4	Date: 15/08/2016
Sheet Size: A3	Status: FINAL
Drawn by: GSM	Requested by: DB
GSM Reference: MAC_Location Eremophila magnifica Cumaltive	



BHPBIO
Eremophila magnifica subsp. magnifica
Distribution against cumulative impacts
Appendix 7

Legend	Disturbance
<i>Eremophila magnifica subsp. magnifica</i>	BHPBIO 30% General
Proposed Mining Area C Development Envelope	BHPBIO Life of Assest
Nature Conservation Reserve	Third Party

GRIFFIN
 SPATIAL & MAPPING
 PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213



ONSHORE ENVIRONMENTAL

Figure:	7.5	Date:	15/08/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference		MAC_Location Rhagodia Hamersley Cumaltive	

N

0 25 50 100
Kilometers
1:2,250,000
Datum: GDA94

BHPBIO
Rhagodia sp. Hamersley (M. Trudgen 17794)
 Distribution against cumulative impacts
 Appendix 7

Legend

- Rhagodia sp. Hamersley (M. Trudgen 17794)*
- Proposed Mining Area C Development Envelope
- Nature Conservation Reserve
- BHPBIO 30% General
- BHPBIO Life of Assest
- Third Party

GRIFFIN
 SPATIAL & MAPPING
 PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213

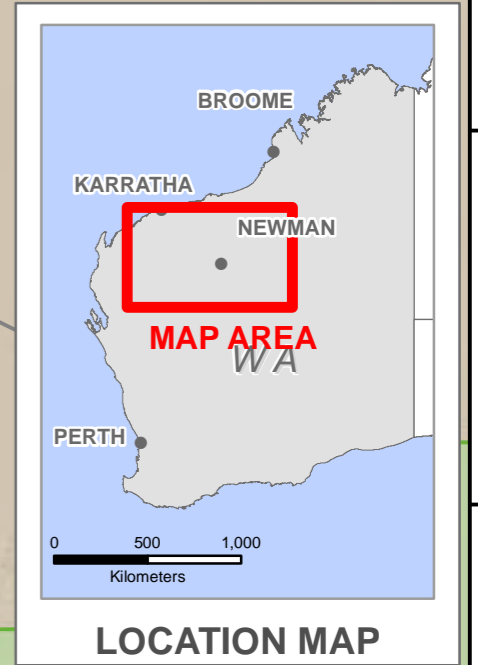
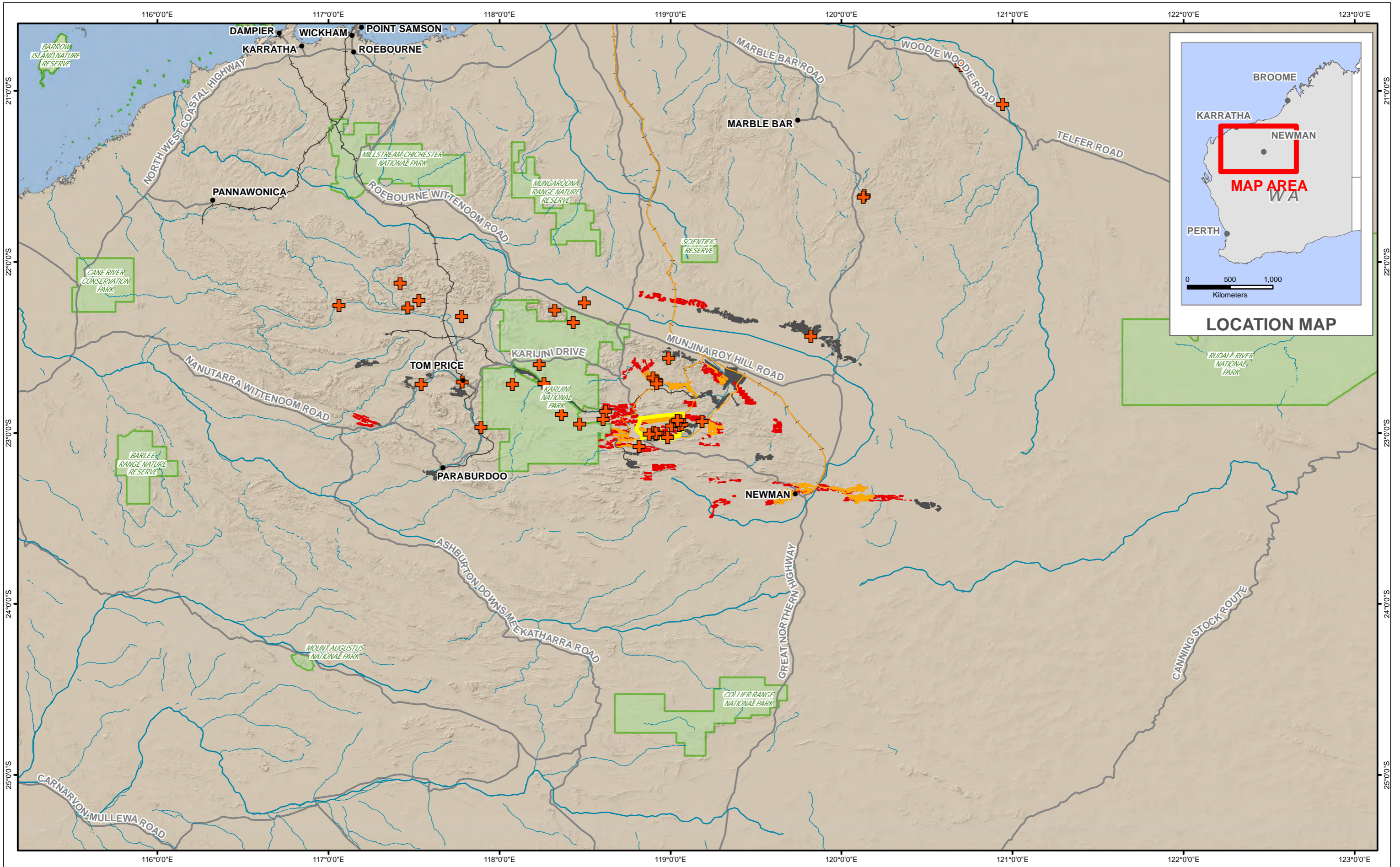
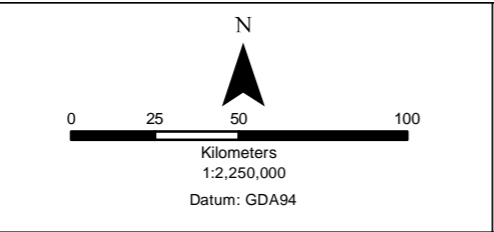


Figure:	7.6
Date:	15/08/2016
Sheet Size:	A3
Status:	FINAL
Drawn by:	GSM
Requested by:	DB
GSM Reference:	MAC_Location Rostellularia adscendens Cuml



BHPBIO
Rostellularia adscendens var. latifolia
 Distribution against cumulative impacts
 Appendix 7

Legend	Disturbance
<i>Rostellularia adscendens var. latifolia</i>	BHPBIO 30% General
Proposed Mining Area C Development Envelope	BHPBIO Life of Assest
Nature Conservation Reserve	Third Party

PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213

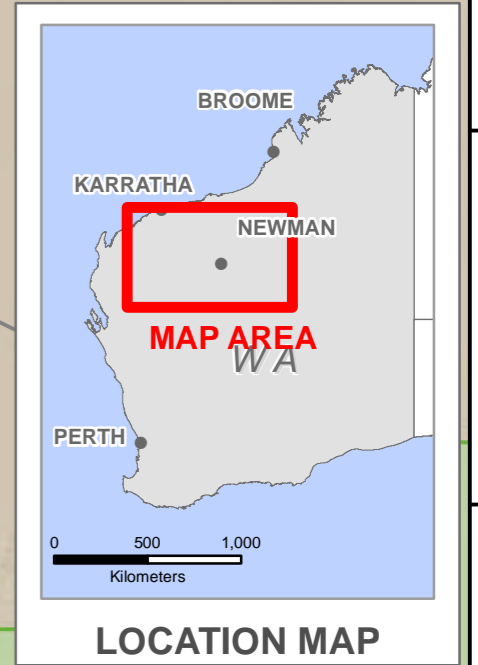
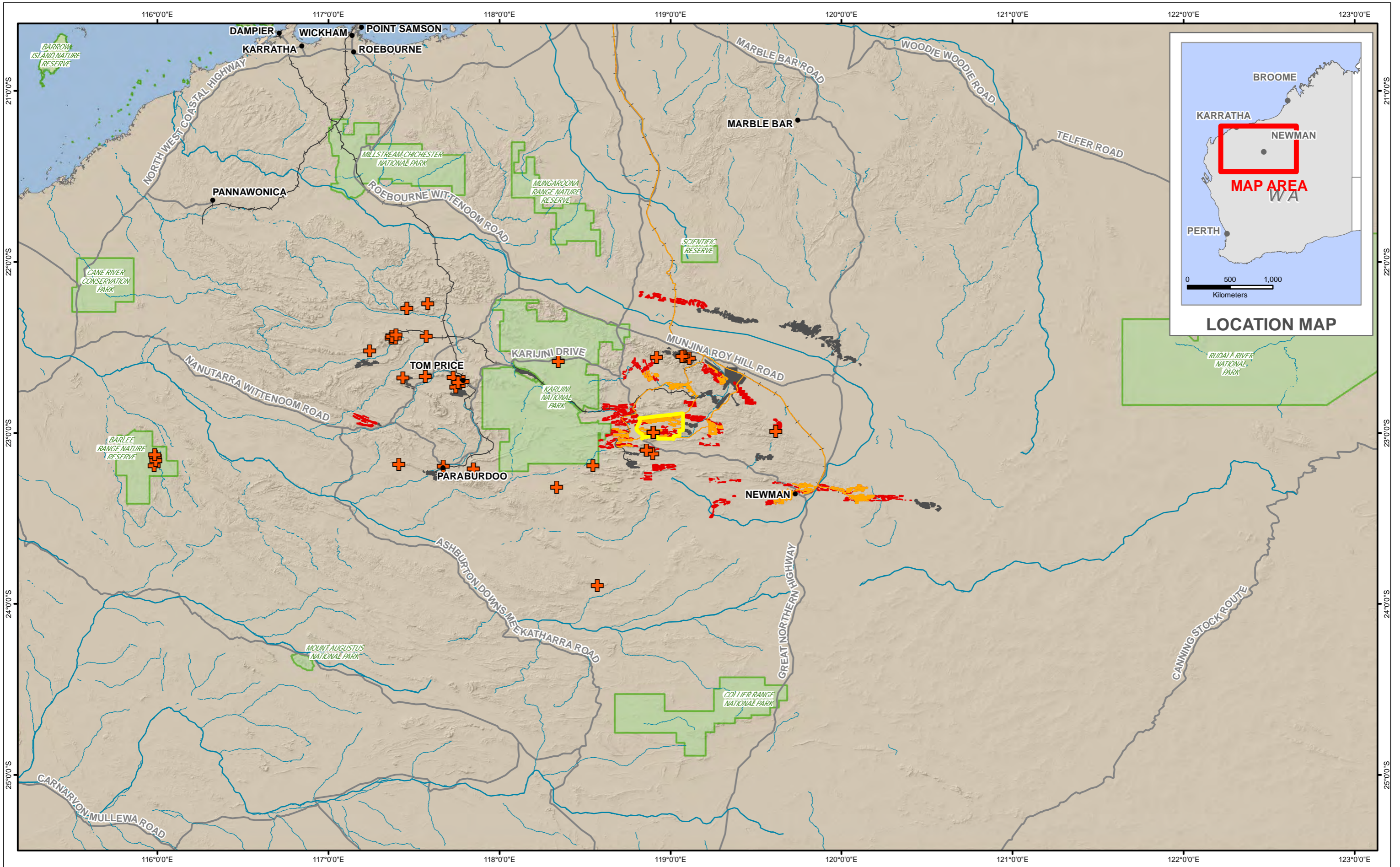
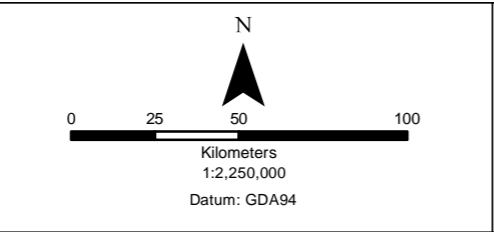


Figure: 7.7	Date: 15/08/2016
Sheet Size: A3	Status: FINAL
Drawn by: GSM	Requested by: DB
GSM Reference: MAC_Location Sida sp. Barlee Range Cumaltive	



BHPBIO
Sida sp. Barlee Range (S. van Leeuwen 1642)
Distribution against cumulative impacts
Appendix 7

<p>Legend</p> <ul style="list-style-type: none"> Sida sp. Barlee Range (S. van Leeuwen 1642) Proposed Mining Area C Development Envelope Nature Conservation Reserve 	<p>Disturbance</p> <ul style="list-style-type: none"> BHPBIO 30% General BHPBIO Life of Assest Third Party
---	---

PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213

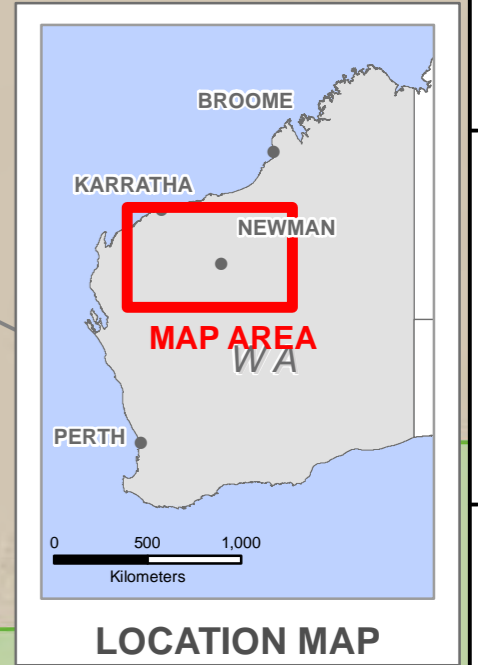
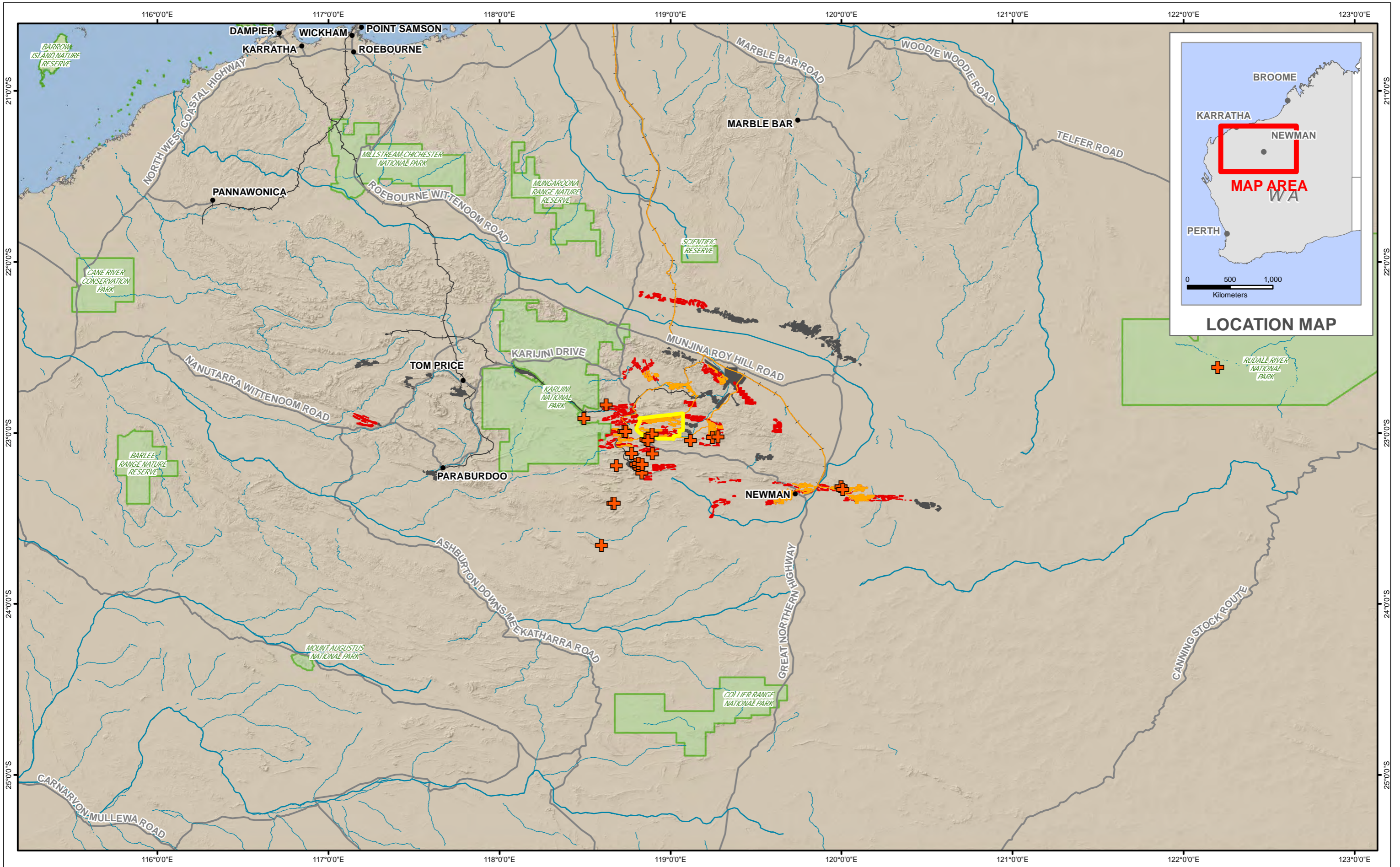
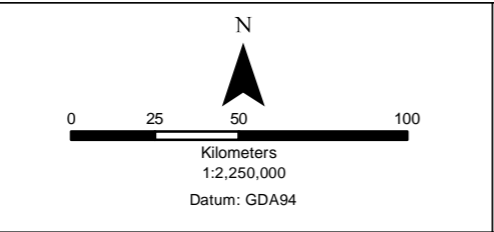


Figure: 7.8	Date: 15/08/2016
Sheet Size: A3	Status: FINAL
Drawn by: GSM	Requested by: DB
GSM Reference: MAC_Location Triodia sp Mt Ella Cumulative	



BHPBIO
***Triodia* sp. Mt Ella (M.E. Trudgen 12739)**
Distribution against cumulative impacts
Appendix 7

Legend	Disturbance
<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739)	BHPBIO 30% General
Proposed Mining Area C Development Envelope	BHPBIO Life of Asset
Nature Conservation Reserve	Third Party

GRIFFIN
 SPATIAL & MAPPING
 PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213

APPENDIX 8

Distribution of vegetation associations (as mapped by Beard,
1975) represented within the Proposed MAC Development
Envelope

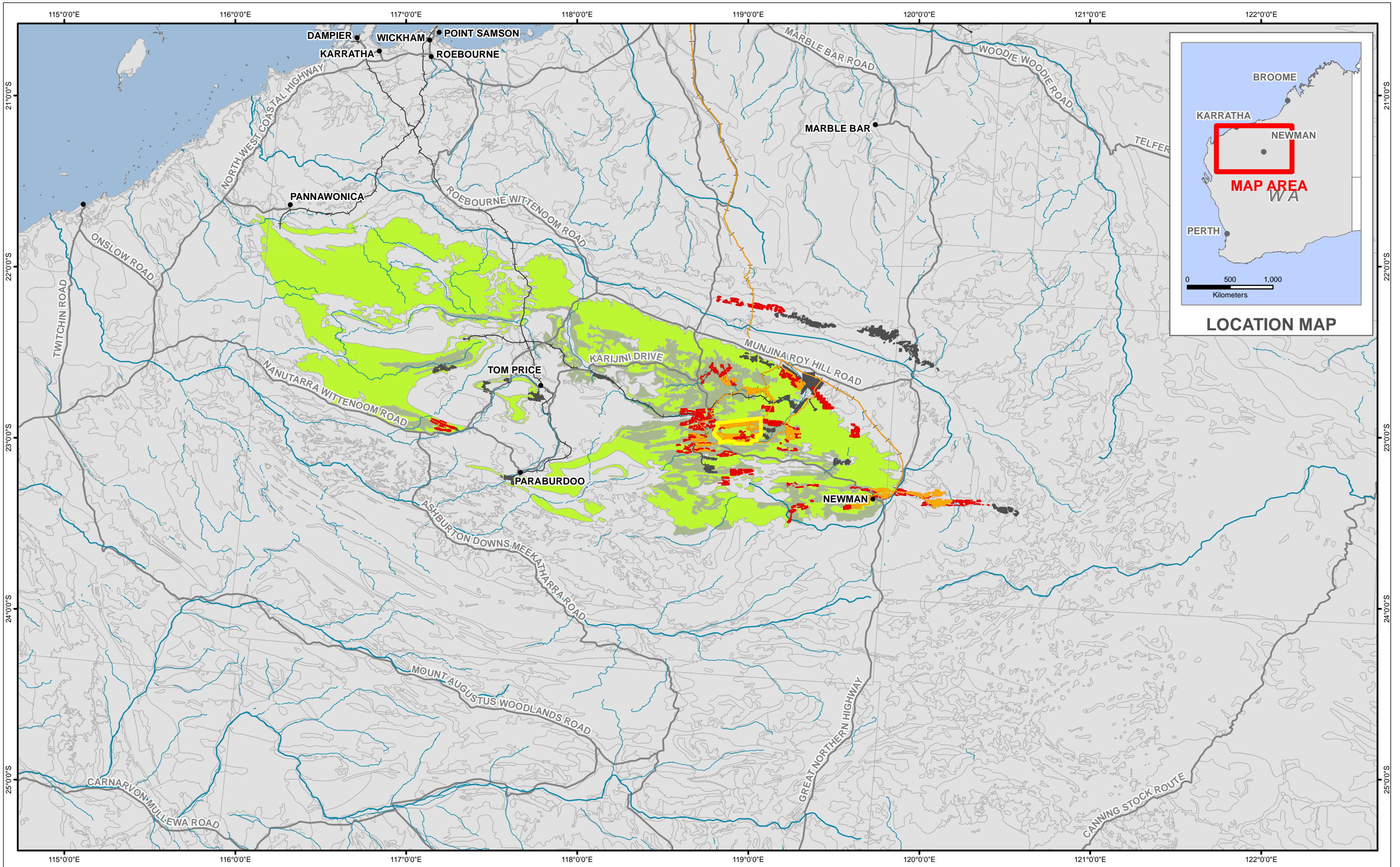
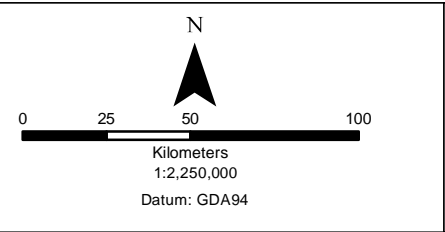


Figure: 8.1	Date: 15/08/2016
Sheet Size: A3	Status: FINAL
Drawn by: GSM	Requested by: DB
GSM Reference: MAC_Location Beard Cumulative	



BHPBio
Distribution of vegetation associations (as mapped by Beard, 1975) represented within the Proposed MAC Development Envelope
Appendix 8

Legend	
	Proposed Mining Area C Development Envelope
	BHPBio 30% General
	BHPBio Life of Asset
	Third Party
	Disturbance
Intersecting Pre-European Vegetation (Beard 1975)	
	Other Veg Types
	HAMMERSLEY_18
	HAMMERSLEY_82

GRIFFIN
SPATIAL & MAPPING
 PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213

APPENDIX 9

Distribution of land systems (as mapped by van Vreeswyk *et al.*
2004) represented within the Proposed MAC Development
Envelope

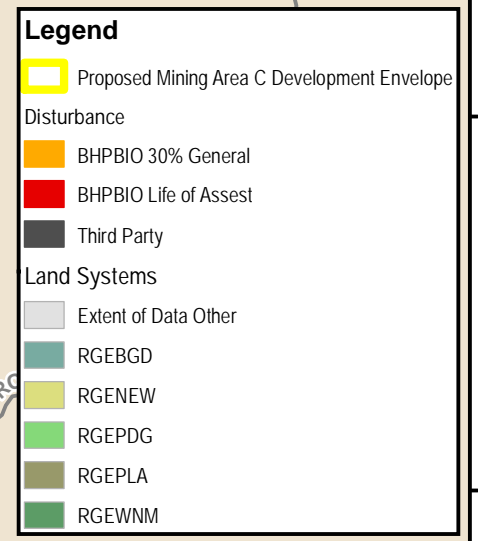
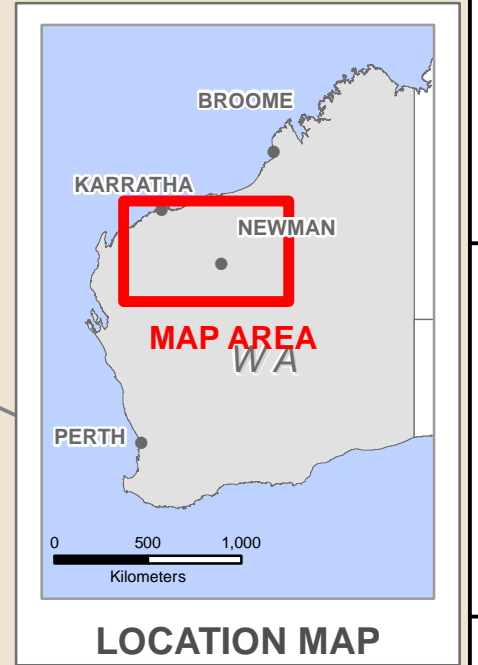
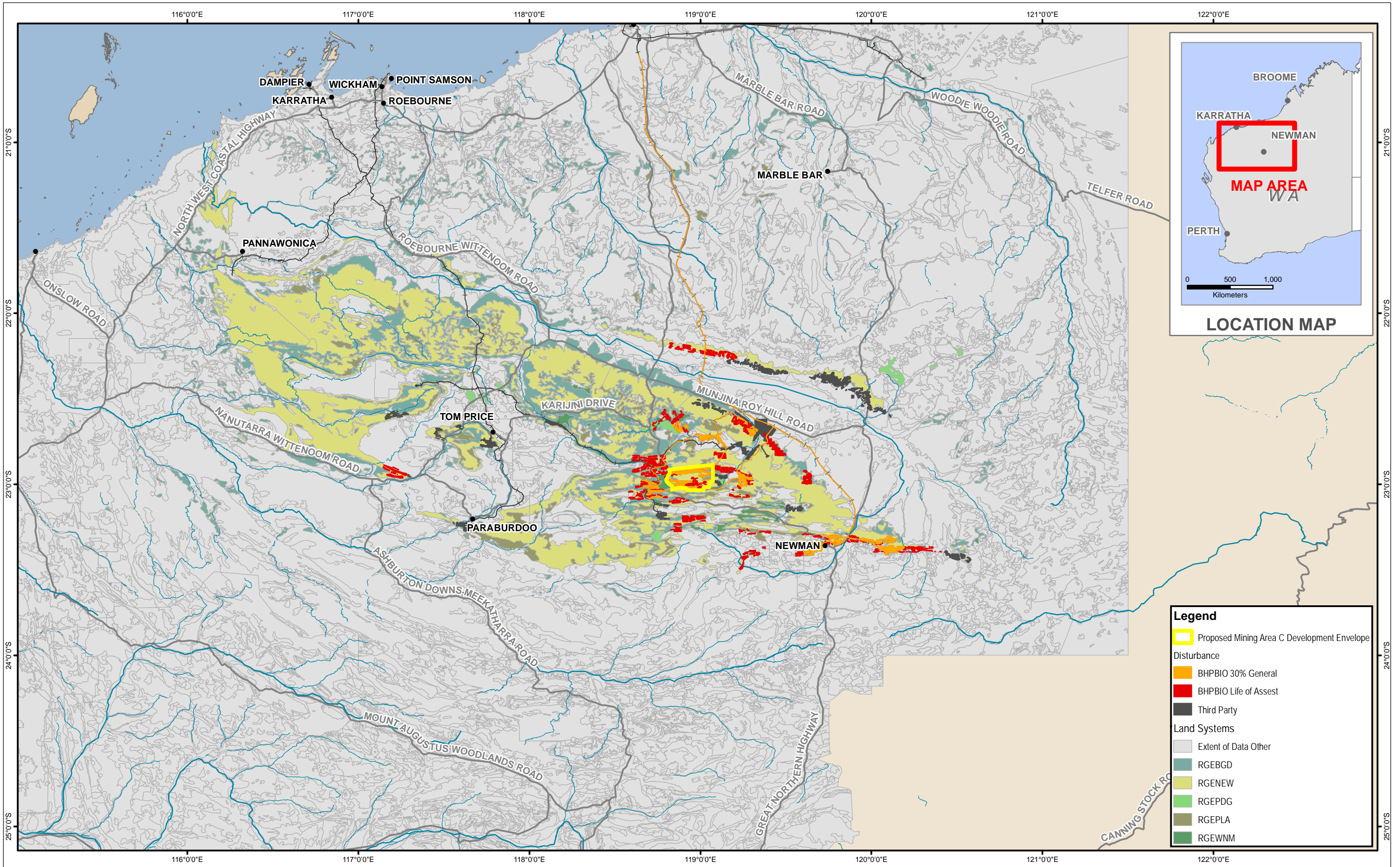
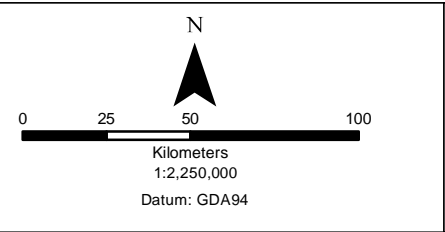



Figure:	9.1	Date:	15/08/2016
Sheet Size:	A3	Status:	FINAL
Drawn by:	GSM	Requested by:	DB
GSM Reference		MAC_Location Land Cumulative	



BHPBIO
 Distribution of land systems (as mapped by van Vreeswyk *et al.* 2004) represented within the Proposed MAC Development Envelope
 Appendix 9



PO Box 7215
 Eaton WA 6232
 admin@griffinspatial.com.au
 +61 8 9725 3213