



BHP Mitsui Coal Pty Ltd (BMC)
EPBC 2016/7788 (Commonwealth)
SDA-1116-035262 (State)

Offset Area Management Plan
Croydon Station

January 2017

© State of Queensland, Department of Natural Resources and Mines, 2012.

The Queensland Government supports and encourages the dissemination and exchange of its information. The copyright in this publication is licensed under a Creative Commons Attribution 3.0 Australia (CC BY) licence.



QR070:20161993D_20170112

Under this licence you are free, without having to seek permission from DNRM, to use this publication in accordance with the licence terms.

You must keep intact the copyright notice and attribute the State of Queensland, Department of Natural Resources and Mines as the source of the publication.

For more information on this licence visit <http://creativecommons.org/licenses/by/3.0/au/deed.en>

Table of Contents

Introduction	4
Part 1 – Summary information	4
Part 2 – Management plan	4
Part 3 – Attachment 1 Baseline data	4
Part 4 – Attachment 2 Land Manager’s Monitoring Guide	4
1. Summary information	5
1.1 Departmental reference details	5
1.2 Offset area details	5
1.3 Description of State impact and offset values	7
1.4 Ecological equivalence assessment for State Significant Biodiversity Values under QEOP	10
1.5 Description of Commonwealth impacts and offset values	14
2. Management plan	38
2.1 Management area objectives and outcomes	38
2.2 Detailed offset area mapping	39
3. Restrictions imposed on the use of the offset area	42
4. Analysis of risks to achieving management objectives and outcomes	43
5. Management actions	45
6. Monitoring requirements	58
7. Reporting	62
8. Consent	63
Appendix A: Location of MNES within Dragline Move Project disturbance footprint	64
Appendix A1: Impact Area Mapping – Ornamental Snake	64
Appendix A2: Impact Area Mapping – Yakka Skink	70
Appendix A3A: Offset Area Mapping Ornamental Snake	76
Appendix A3B: Offset Area Mapping Yakka Skink	77
Appendix A3C: Offset Area Mapping Yakka Brigalow TEC	78
Attachment 1: Offset Area Ecological Data	79
Attachment 1A: Supporting Technical Information – Offset Site	79
Attachment 1B: Detailed Field Data and Assessment Units	104
Attachment 1C: Weed Fact Sheets	118
Attachment 1D: Wildlife Online Extract	113
Attachment 2: Land Manager’s Monitoring Guide	132

Introduction

The purpose of this management plan is to identify the management objectives and outcomes, and the actions necessary to fulfil a statutory requirement for the provision of an offset under the *Queensland Environmental Offsets Policy (2014) (QEOP)* and the *Environment Protection & Biodiversity Conservation Act 1999 (Cth) (EPBC Act)*.

The plan is composed of four components:

Part 1 – Summary information

This section must be completed by all offset proposals and lists all of the following information:

1. Departmental reference details
2. Legislative triggers and impacts requiring an offset
3. Offset area details
4. Ecological Equivalence Assessment
5. Description of the values in the stage 1 impact area and the values located on the offset area

Part 2 – Management plan

This section contains the management plan details that must be completed based on the offsets triggered and requires at a minimum the following information:

1. The offset area management objectives and outcomes
2. Any restrictions imposed on the use of the offset area
3. The activities that will be undertaken to achieve the objectives and outcomes
4. Monitoring requirements
5. An analysis of the risks to achieve the management objectives and outcomes
6. A map that shows spatially the areas subject to the management plan
7. A reporting program
8. Consent between the Landholder and the delegate

Part 3 – Attachment 1 Baseline data

1. Ecological equivalence assessment of the offset area
2. Weed Fact Sheets
3. Flora and fauna present on the offset area or adjacent to offset area

Part 4 – Attachment 2 Land Manager's Monitoring Guide

1. The Land Manager's Monitoring Guide published by the State of Queensland (Department of Environment and Resource Management) 2010 (DERM)

1. Summary information

1.1 Departmental reference details

Departmental Reference Details for application that triggers offset	
Departmental Reference Number and Case Name:	DoEE reference: 2016/7788 SDA-1116-035262
Offset reference number (if applicable):	N/A
Tenure: Rolling Term Lease PH 35/4777 (State Lease)	Primary Local Government Area: Isaac Regional Council

Offset Triggers and Values	
Offset Trigger	Values requiring to be offset
<input type="checkbox"/> Regional Vegetation Management Code <input checked="" type="checkbox"/> Part P <input type="checkbox"/> Part S <input type="checkbox"/> Part Xa <input type="checkbox"/> Part Xb <input type="checkbox"/> Material Change of Use / Reconfiguration of a lot Policies (Table F1) <input checked="" type="checkbox"/> <i>Environment Protection & Biodiversity Conservation Act 1999 (Cth)</i>	<input checked="" type="checkbox"/> EPBC TEC and/or Protected Spp. <input type="checkbox"/> Assessable vegetation adjacent to a wetland, significant wetland <input checked="" type="checkbox"/> Assessable vegetation adjacent to a watercourse <input type="checkbox"/> Connectivity <input type="checkbox"/> Endangered regional ecosystem <input checked="" type="checkbox"/> Of concern regional ecosystem <input type="checkbox"/> Threshold regional ecosystem <input type="checkbox"/> Critically limited regional ecosystem <input type="checkbox"/> Essential habitat <input type="checkbox"/> Essential habitat for koalas in SEQ <input type="checkbox"/> Values within a highly-vegetated bioregion <input type="checkbox"/> Protected Plant under the <i>Nature Conservation Act 1992</i>

1.2 Offset area details

Landholder Details	
Registered Owner/s on Title: Jennifer Alison Acton	
Sub-lessee: 716936515 Australian Cattle & Beef Holdings	Trustee: N/A
Business/Company name: NA	
ABN/ACN: NA	
Phone number: NA	Mobile phone: rbrosnan@raywhite.com
Facsimile number: 0400361114	Contact person (if required): Richard Brosnan
Email: rbrosnan@raywhite.com	
Postal Address: Po Box 4088, Rockhampton QLD 4700	

Property Details			
Property name:	Croydon Station	Real property description	Lot 4 on KL210
Tenure:	PL 37/4777 (State Lease)	Primary Local Government Area:	Isaac Regional Council
Planning Scheme Zone:	Rural	Property area (ha):	58,900 ha
		Offset Area (ha):	346.3ha
Landzone / geology	<p>Landzone 3 - Recent Quaternary alluvial systems, including closed depressions, paleo-estuarine deposits currently under freshwater influence. Includes a diverse range of soils, predominantly vertosols and sodosols.</p> <p>Landzone 4 - Tertiary-early Quaternary clay deposits, usually forming level to gently undulating plains not related to recent Quaternary alluvial systems. Excludes clay plains formed in-situ on bedrock. Mainly vertosols with gilgai microrelief, but includes thin sandy or loamy surfaced sodosols and chromosols with the same paleo-clay subsoil deposits.</p>		
Soils	Mainly vertosols and sodosols		
Pre-clear regional ecosystem	11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.4.9		
Existing vegetation	Remnant: 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.4.9 Regrowth: 11.3.1, 11.3.3, 11.4.9, Non-remnant		
Estimated age of vegetation	Remnant – minimum of 25 years, Regrowth – minimum of 5 years, Non-remnant – minimum of 2 years of age		
Is there a PMAV currently over all or part of the property, Please detail	Yes – PMAV –2008/00679		
Legally Binding Mechanism			
<input checked="" type="checkbox"/> Voluntary Declaration (<i>Vegetation Management Act 1999</i>) <input type="checkbox"/> Covenant (<i>Land Act 1994/Land Title Act 1994</i>) <input type="checkbox"/> Nature Refuge (<i>Nature Conservation Act 1992</i>) <input type="checkbox"/> Other Reference Number:			

1.3 Description of State impact and offset values

Table 1 identifies the values impacted on and captured under the Queensland *Environmental Protection Act 1994* and Queensland *Nature Conservation Act 1992* (NCA) in the BMC Dragline move project impact area for which an offset is provided for within the offset areas. The location of remnant regional ecosystems across the Stage 1 impact area is shown in **Figure 1**.

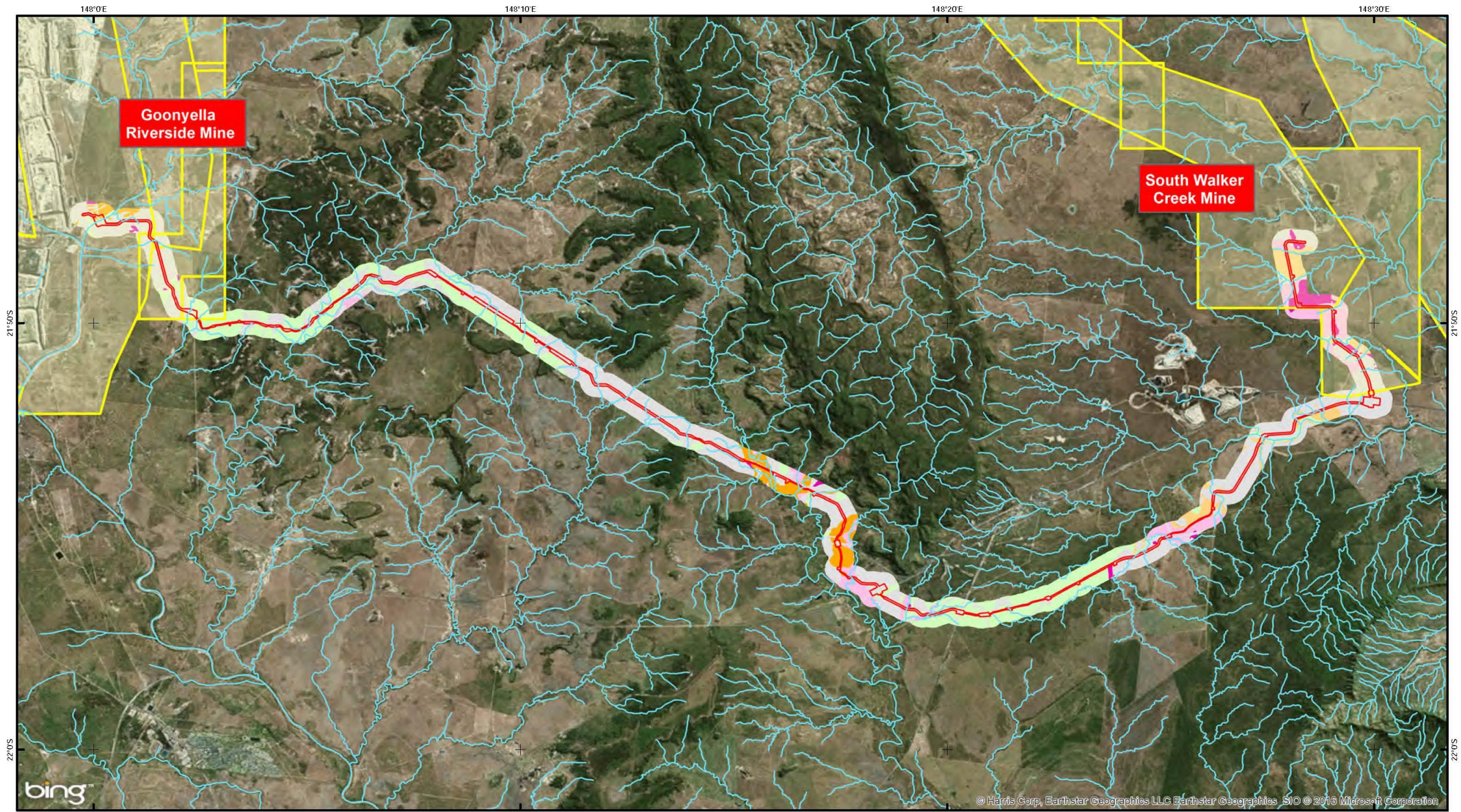
Table 1: Impact area values

Impact area			
Value (as identified in the offset policy)	VMA* or NCR status	Regional ecosystem	Area (ha)
Remnant endangered regional ecosystems <i>Impacts to these REs will be offset under the EPBC Act</i>	Endangered	RE 11.3.1 (BVG 25a)	0.05 ha
		RE 11.4.9 (BVG 25a)	7.95 ha
		RE 11.9.5 (BVG 25a)	1.98 ha
			Total 9.98 ha
Protected animal <i>Denisonia maculata</i> (Ornamental Snake) <i>Impacts to this species will be offset under the EPBC Act</i>	Vulnerable	RE 11.3.1 (BVG 25a)	0.01 ha
		RE 11.4.9 (BVG 25a)	3.45 ha
		RE 11.3.2 (BVG 17a)	0.72 ha
		RE 11.3.25 (BVG 16a)	0.15 ha
		RE 11.5.3 (BVG 17a)	1.97 ha
		RE 11.7.2 (BVG 24a)	0.34 ha
	Total 6.64ha		
Protected animal <i>Egernia rugosa</i> (Yakka Skink) <i>Impacts to this species will be offset under the EPBC Act</i>	Vulnerable	RE 11.3.1 (BVG 25a)	0.04 ha
		RE 11.4.9 (BVG 25a)	3.45 ha
		RE 11.3.2 (BVG 17a)	0.72 ha
		RE 11.3.25 (BVG 16a)	0.15 ha
		RE 11.5.3 (BVG 17a)	11.32 ha
		RE 11.7.2 (BVG 24a)	0.34 ha
	Total 99.35ha		
Protected animal <i>Geophaps scripta scripta</i> (Squatter pigeon (southern)) <i>Impacts to this species will be offset under the EPBC Act</i>	Vulnerable	RE 11.3.4 (BVG 16c)	0.82 ha
		RE 11.9.5 (BVG 25a)	0.98 ha
		RE 11.5.3 (BVG 17a)	10.15 ha
		RE 11.7.2 (BVG 24a)	2.06 ha
	Total: 14.1 ha		
Remnant of concern regional ecosystem	Of concern	RE-11.3.2 (BVG 17a)	5.31 ha
		RE-11.3.4 (BVG 16c)	5.07 ha
		RE-11.3.36 (BVG 18b)	0.03 ha
		Polygon – RE-11.9.7a (BVG 17a)	0.89 ha
	Total: 11.30 ha		

Impact area			
Value (as identified in the offset policy)	VMA* or NCR status	Regional ecosystem	Area (ha)
Watercourses	1 or 2	RE-11.3.2 - OC - (BVG 17a)	0.40
		RE-11.3.4 - OC - (BVG 16c)	0.45
		RE 11.3.25 - OLC - (BVG 16a)	1.14
		RE 11.5.3 - OLC - (BVG 17a)	2.56
		RE 11.5.9c - OLC - (BVG 18b)	0.23
		RE 11.7.2 - OLC - (BVG 24a)	0.42
		RE 11.7.3 - OLC - (BVG 19d)	0.02
		Total: 5.52 ha	
	3 or 4	RE 11.3.1 - E - (BVG 25a)	0.01
		RE 11.9.5 - E - (BVG 25a)	0.55
		RE-11.3.2 - OC - (BVG 17a)	0.24
		RE 11.3.25 - OLC - (BVG 16a)	0.98
		RE 11.5.3 - OLC - (BVG 17a)	0.12
		RE 11.5.9c - OLC - (BVG 18b)	0.48
		Total: 2.38 ha	
5+	RE-11.3.4 - OC - (BVG 16c)	0.65	
	RE 11.3.25 - OLC - (BVG 16a)	2.30	
	RE 11.5.3 - OLC - (BVG 17a)	1.51	
	Total: 4.46 ha		
			Total: 26.68 ha

* VMA status refers to the remnant vegetation's classification under the *Vegetation Management Act 1999* (Qld) (**VMA**)

Figure 1: Location of remnant regional ecosystems within the dragline move impact area



Notes:
 © Biodiversity Assessment and Management Pty Ltd. While every care is taken to ensure the accuracy of this data, Biodiversity Assessment and Management makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.
 Data Source: Image from ArcGIS Online Bing Maps data (c) 2010 Microsoft Corporation and its data suppliers. Regional Ecosystems V7 and RE Waterways sourced from QLD Government 2012.

Coordinate System: GCS GDA 1994
 Datum: GDA 1994
 Units: Degree



1:158,835 at A4
 0 875 1,750 3,500 5,250 7,000
 Meters

Legend










Vegetation Management Status		Of Concern-dominant		Least Concern		Dragline Transport Route	
	Endangered-dominant		Of Concern-subdominant		Non-remnant		BMA Mining Lease Areas
	Endangered-subdominant				Watercourse		

Figure: 3.1
 Title: Regional Ecosystem and Watercourse Mapping
 Project: BMC Dragline Move Project Terrestrial Ecology MSES Assessment
 Client: Advisian



Drawn By: MG Reviewed by: AC Date: 17-Oct-16

Document Location: C:\Users\Gwen\Documents\Clients\BAAM\Dragline\BAAM_A3_Landscape_Legend\Below_Dragline.mxd Date: 17-Oct-16 9:48:05 PM

1.4 Ecological equivalence assessment for State Significant Biodiversity Values under QEOP

Ecological Equivalence Assessment	
Impact area	Offset area
Date of Assessment: August, September, October 2016	Date of Assessment: March/April 2016
Ecological Condition assessment score:	Ecological Condition assessment score: see respective tables
Special Features indicators 1-14:	Special Features indicators 1-14: see respective tables
Undertaken using Ecological Equivalence Methodology V 1.1 Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Undertaken using Ecological Equivalence Methodology V 1.1 Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
Score sheets/assessment attached Yes: <input checked="" type="checkbox"/> No <input type="checkbox"/>	Score sheets/assessment attached Yes: <input checked="" type="checkbox"/> No <input type="checkbox"/>
Other comments: Refer to Appendix A from Field Assessment Report (Ecological Condition Scoresheets) for assessment scores.	Other comments: Refer to Appendix A from Field Assessment Report (Ecological Condition Scoresheets) for assessment scores.

Table 2A: Summarised MSES impact site vs offset sites

RE	BVG	Impact area (ha)	Habitat Quality Score	Offset Area (ha)	Habitat Quality Score	Regional Ecosystem (RE)	BVG	
Endangered Prescribed vegetation								
11.3.1	25a	0.05	7	Remnant 27.1ha	7	11.3.1/11.4.9	25a	
11.4.9		7.95	7					
11.9.5		1.98	7	Regrowth 86.6ha	5	11.3.1/11.4.9		
Of Concern Prescribed vegetation								
11.3.2	17a	1.30	7				17a	
11.9.7a		0.89	7					
11.3.4	16c	5.07	7	Remnant 153ha Regrowth 9.2ha	6 6	11.3.4/11.3.3	16c	
Watercourse vegetation								
1 or 2	BVG 17a	2.96	7	Remnant 13.6ha Regrowth 59.8ha	8	11.3.1	25a	
	BVG 16c	0.45			6	11.3.1		
	BVG 16a	1.14						
	BVG 18b	0.23						
	BVG 24a	0.42			6	11.3.4		16c
	BVG 19d	0.02						
		Total: 5.52 ha		Remnant 75.3ha	6	11.3.3	16c	
3 or 4	BVG 25a	0.56	7	Remnant 77.7ha Regrowth 9.2ha	6	11.3.3	16c	
	BVG 17a	0.36						
	BVG 16a	0.98						
	BVG 18b	0.48						
		Total: 2.38 ha						
5+	BVG 16c	0.65	7					
	BVG 16a	2.30						
	BVG 17a	1.51						
		Total: 4.46 ha						
				Total 235.6ha on a stream order 8				

Table 2B: Offset values endangered REs (For information only – offset under EPBC Act)

	Impact Area			Offset Area			
Assessment Unit:				AU1	AU2	AU3	AU4
Remnant/Regrowth:				Remnant	Regrowth	Remnant	Regrowth
Regional Ecosystem (RE)	11.3.1	11.4.9	11.9.5	11.3.1	11.31	11.4.9	11.4.9
VMA Status	E			E			
BVG1M:	25a			25a			
Polygon No.:							
Condition Score:				8	6	5	5
Polygon Size (ha):	0.05	7.95	1.98	13.6	59.8	13.5	26.8
Total area (ha):				113.7			
Site Context Score:				Remnant: 7		Regrowth: 6	
Possible Gain				2			
Ratio required				3.67			

Table 2C: Offset values Of Concern REs

	Impact Area			Offset Area		
Assessment Unit:				AU5	AU6	AU7
Remnant/ Regrowth:				Remnant	Remnant	Regrowth
Regional Ecosystem (RE)	11.3.2		11.3.4	11.3.4	11.3.3	11.3.3
VMA Status	OC			OC		
BVG1M:	17a		16c	16c		
Polygon No.:						
Condition Score:				6	6	6
Polygon Size (ha):	5.31		3.54	75.3	77.7	9.2
Total area:				162.2		
Site Context Score				Remnant: 6		Regrowth: 6
Possible Gain				2		
Ratio required				3.67		

Table 2D: Offset values – watercourses, stream orders

Impact Area				Offset Area				
Stream Order (SO):	SO 1 & 2	SO 3 & 4	SO 5+	SO 8	SO 8	SO 8	SO 8	SO 8
Assessment Unit				AU1	AU2	AU5	AU6	AU7
Remnant/ Regrowth:				Remnant	Regrowth	Remnant	Remnant	Regrowth
Regional Ecosystem (RE)				11.3.1	11.3.1	11.3.4	11.3.3	11.3.3
VMA Status				E	E	OC	OC	OC
BVG1M:	BVG 17a BVG 16c BVG 16a BVG 18b BVG 24a BVG 19d	BVG 25a BVG 17a BVG 16a BVG 18b	BVG 16c BVG 16a BVG 17a	25a	25a	16c	16c	16c
Habitat Quality Score Score:	7	7	7	8	6	6	6	6
Polygon size (ha):				13.6	59.8	75.3	77.7	9.2
Total area:	5.52 ha	2.38 ha	4.46 ha	235.6				
Site Context Score:				Remnant: 8 Regrowth: 6	Remnant: 6 Regrowth: 6			
Possible Gain				2				
Ratio required				3.67				

1.5 Description of Commonwealth impacts and offset values

Table 3 summarises the impacts to Matters of National Environmental Significance (**MNES**) under the EPBC Act in the BMC Dragline Move project area for which an offset is provided. These values are illustrated in the mapping provided in **Appendix A**. **Table 4A**, **Table 4B** and **Table 4C** show the impact assessments for each MNES. **Table 5A**, **Table 5B** and **Table 5C** provide a description of the input values used for calculation in the EPBC Offset Assessment Calculator.

Table 3: Summary BMC Dragline move impact and offset area values – Environment Protection & Biodiversity Conservation Act 1999

Protected Matter	Status	Impact Area (ha)	Habitat Quality Score	Offset Area (ha)	Habitat Quality Score	Regional Ecosystem (RE)	Offset Property
Threatened Species							
Protected animal - <i>Denisonia maculata</i> (Ornamental Snake). <i>Impacts to this species will be offset under the EPBC Act</i>	Vulnerable	52.33	7.0	254.6	Regrowth 6.0 Remnant 7.0	Remnant 11.3.1 (13.1ha) Regrowth 11.3.1 (7.9ha) Remnant 11.4.9 (13.5ha) Regrowth 11.4.9 (26.8ha) Remnant 11.3.4 (75.3ha) Remnant 11.3.3 (76.4ha) Regrowth 11.3.3 (6.4ha) Remnant 11.3.25 (21.5ha) Remnant 11.3.27 (13.7ha)	Croydon Station
Protected animal - <i>Egernia rugosa</i> (Yakka Skink) <i>Impacts to this species will be offset under the EPBC Act</i>	Vulnerable	99.35	7.0	245.8	Regrowth 5.0 Remnant 7.0	Remnant 11.3.1 (13.6ha) Regrowth 11.3.1 (59.8ha) Remnant 11.4.9 (13.5ha) Regrowth 11.4.9 (26.8ha) Remnant 11.3.4 (75.3ha) Remnant 11.3.25 (21.5ha) Remnant 11.5.3 (35.3ha)	Croydon Station
Protected animal - <i>Geophaps scripta scripta</i> (Squatter pigeon (southern))*	Vulnerable	89.2	7.0	306.1	Regrowth 6.0	Remnant 11.3.1 (13.6ha) Regrowth 11.3.1 (59.8ha)	Croydon Station

Protected Matter	Status	Impact Area (ha)	Habitat Quality Score	Offset Area (ha)	Habitat Quality Score	Regional Ecosystem (RE)	Offset Property
					Remnant 7.0	Remnant 11.3.4 (75.3ha) Remnant 11.3.3 (77.7ha) Regrowth 11.3.3 (9.2ha) Remnant 11.3.25 (21.5ha) Remnant 11.3.27 (13.7ha) Remnant 11.5.3 (35.3ha)	
Threatened Ecological Communities							
Threatened Ecological Community Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) **	Endangered	9.7	7.0	113.7	Regrowth 6.0 Remnant 7.0	Remnant 11.3.1 (13.6ha) Regrowth 11.3.1 (59.8ha) Remnant 11.4.9 (13.5ha) Regrowth 11.4.9 (26.8ha)	Croydon Station

*Note: Impacts to Squatter Pigeon (southern) are assessed by DoEE and the BMC commissioned ecologists to be not significant however BMC is including habitat suitable for Squatter Pigeon (southern) in the offset area as an additional contribution towards the environmental gains being secured.

**Note: Impacts to the Brigalow TEC are not considered by BMC to be significant, given pre-existing authorisations; but it is acknowledged that DoEE has a different view and therefore will be offset.

Table 4A: Impact assessment for primary habitat for the Ornamental Snake

Attribute	Value	Rationale/assumption
Impact Area	52.33 ha	
Description		The regional ecosystems in the impact area that are consistent with the habitat requirements for this species are 11.3.25, 11.4.2, 11.4.9 and 11.9.5, due to the presence of cracking clay soils and gilgai in these ecosystems.
Quality	7/10	The habitat quality score was derived using the <i>Guide to determining terrestrial habitat quality</i> and the scores averaged across the 12 sites surveyed. The score reflects the condition of the vegetation, the site in context to the landscape and the suitability for the species. The scores for the individual survey sites are derived from the filed report supplied previously as Attachment 3 to the Preliminary Documentation

Table 4B: Impact assessment for primary habitat for the Yakka Skink

Attribute	Value	Rationale/assumption
Impact Area	99.35 ha	
Description		Yakka Skink has a preferred habitat that is consistent with a number of plant species (<i>Brigalow Belt Reptiles Workshop 2010; Department of Environment 2016c</i>). There are 19 REs within the impact area that have at least one of the following species within their composition: brigalow, mulga, bendee, lancewood, belah, poplar box, ironbark, and white cypress. The 19 REs are: 11.3.1, 11.3.2, 11.3.4, 11.3.25, 11.4.2, 11.4.9, 11.5.3, 11.5.9, 11.5.15, 11.7.2, 11.7.3, 11.8.5, 11.9.3, 11.9.4a, 11.9.1, 11.9.2, 11.9.5, 11.9.7a, and 11.10.3.
Quality	7/10	The habitat quality score was derived using the <i>Guide to determining terrestrial habitat quality</i> and the scores averaged across the 12 sites surveyed. Site condition of the vegetation was highly variable scoring from 6 to 0 and averaging 5, whereas the site in context scores were more consistent and varied between 4 and 5. Suitability for the species was also more consistent between 3.5 and 4. The scores for the individual survey sites are derived from the field report supplied previously as Attachment 3 to the Preliminary Documentation

Table 4C: Impact assessment for Brigalow TEC

Attribute	Value	Rationale/assumption
Impact Area	9.7ha	
Description		Within the Project footprint, this TEC is restricted to ground verified RE's 11.4.9, 11.9.1 and 11.9.5. 8 patches were identified in total and were consistent with the attributes required of a remnant or regrowth Brigalow TEC. All the patches were generally in a good condition. See Attachment 3, Appendix E of the Preliminary Documentation.
Quality	7/10	The habitat quality score was derived using the <i>Guide to determining terrestrial habitat quality</i> and the scores averaged across the 14 sites surveyed. The score reflects the condition of the vegetation, the site in context to the landscape of the patch. The quality score is derived from Appendix E to the field report supplied previously as Attachment 3 to the Preliminary Documentation

Table 5A – Offset area calculator inputs - Croydon Station – Ornamental Snake

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Area (ha)	213.5	41.1	<p>Area verified in field assessments conducted by ELA (2016)</p> <p>The area comprises REs that are listed as Essential Habitat under the VMA for the Ornamental Snake habitat – see the list at Appendix C3. Some of the REs are not listed in Table 4.1 of the Impact site report as they do not have deep cracking soils. The Ornamental Snake has been found in the offset area within the REs listed for use as an offset and are suitable because of their proximity to water.</p> <p>Proposed offsets for the Ornamental Snake consist of the following vegetation and REs</p> <ul style="list-style-type: none"> • 11.3.1 (remnant AU1) • 11.3.3 (remnant AU6) • 11.3.4 (remnant AU5) • 11.3.25 (remnant AU8) • 11.3.27 (remnant AU9) • 11.4.9 (remnant AU3) <p>See Appendix C2 for photos and detailed field data of each of the Assessment Units (AU).</p>	<p>Area verified in field assessments conducted by ELA (2016).</p> <p>The area comprises REs that are listed as Essential Habitat under the VMA for the Ornamental Snake habitat - see the list at Appendix C3. Some of the REs are not listed in Table 4.1 of the Impact site report as they do not have deep cracking soils. The Ornamental Snake has been found in the offset area within the REs listed for use as an offset and are suitable because of their proximity to water.</p> <p>Proposed offsets for the Ornamental Snake consist of the following vegetation and REs</p> <ul style="list-style-type: none"> • 11.3.1 (non-remnant AU2) • 11.3.3 (non-remnant AU7) • 11.4.9 (non-remnant AU4). <p>See Appendix C2 for photos and detailed field data of each of the Assessment Units (AU).</p>
Quality				

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Start quality	7	5	<p>Site condition score – 3</p> <p>Vegetation condition is moderate with recruitment levels and structural complexity generally resembling an undisturbed community. However, weed incursion and therefore species diversity varies from low to high, canopy and shrub cover has been disturbed and in some areas, there is a lack of large mature trees.</p> <p>Habitat quality for Ornamental Snake is high due to moderate existing threats in the form of grazing, feral pig presence and some weed cover, and the abundance of foraging and sheltering resources. These areas within the offset area are likely to play an important role in the maintenance of the species in the region.</p> <p>Key habitat aspects for coarse woody debris, organic litter, weed cover, habitat shelter and quality as well as foraging abundance score from low to high with the major limiting factor being coarse woody debris scoring low in some sites and weed cover being moderate to high across most sites. These factors are then flow through to the quality and availability of shelter for the species.</p>	<p>Site condition score – 2</p> <p>The regrowth communities within the offset area were found to contain suitable aquatic habitat and therefore foraging resources for Ornamental Snake although in a poor to moderate condition due to the immature in the structure of the community and the associated habitat factors. The abundance of shelter habitat was not as high as remnant habitat areas; however deep soils cracks were present throughout regrowth areas. Habitat quality assessments found regrowth habitat to be in poor to moderate condition with the main limiting factors being a lack of shelter in the form of fallen woody debris which was absent on nearly all the regrowth sites and a higher weed cover was present. This is detailed in the field survey data at Appendix C2, - see “fallen woody debris” and “weed cover” in AUs 2, 4 and 7.</p> <p>Due to the higher grass cover in the regrowth areas, the grazing capacity/pressure is higher potentially impacting the soil structure via compaction, especially in wet conditions. The elevated weed cover in the form of grass exacerbates this threat along with an abundance of feral pigs utilising the area for foraging and wallowing.</p>
			<p>Site context score - 3</p> <p>Site context ranges from moderate to high due to varying levels of connectivity to surrounding vegetation. Some areas form large contiguous vegetation patches, whilst others are more fragmented and isolated. All areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor).</p>	<p>Site context score - 2</p> <p>The overall site context is generally moderate due to reduced connectivity to surrounding remnant vegetation (the regrowth offset assessment unit boundaries are predominantly only between 10-50% of the length of the boundaries area connected) as the individual offset assessment units are smaller and isolated vegetation patches with varying levels of connectivity to surrounding remnant vegetation. All areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor). raising the score to moderate. This is detailed in the field survey data at Appendix C2, - see “GIS based attributes” in AUs 2, 4 and 7.</p>
			<p>Species stocking rate = 1</p> <p>The offset area is within the known distribution of the Ornamental Snake in Queensland; it is known to occur and has been previously recorded in the offset area (ELA, 2016). It is known to be present as potential habitat is available, however, it is not assumed to be present in high numbers.</p>	<p>Species stocking rate = 1</p> <p>The offset area is within the known distribution of the Ornamental Snake in Queensland; it is known to occur and has been previously recorded in the offset area (ELA, 2016). It is known to be present as potential habitat is available, however, it is not assumed to be present in high numbers.</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Future quality without offset	6	3	<p>Site condition score – 2</p> <p>Part of the property’s routine management for grazing which is undertaken in on a 7-8-year cycle (ongoing purpose) is the thinning of remnant vegetation within the limits of the self-assessable codes under the Vegetation Management Act 1999 (Qld) and then a subsequent use of fire in summer to reduce the presence of coarse woody debris to enable easier access for livestock and to increase exotic grass cover by reducing the competition from shrubs and secondary canopy layers.</p> <p>This would cause a further reduction in the scores for coarse woody debris (sites with coarse woody debris would drop from a 5 or 2 to 0), weed cover (from 10 to 5) and for a shorter term, a reduction in organic litter although this would most likely recover within the ecological survey cycle depending on the time of surveys in comparison to the timing of thinning and burning.</p> <p>Further impacts would be expected due to the increased use of the remnant vegetation areas for shelter once the regrowth areas were re-cleared. There is considerable risk of soil compaction and subsequent effect on soil cracks and habitat quality due to the reduction in water quality for frogs that are the species preferred food source thus affecting the habitat shelter and foraging scores.</p> <p>Grazing during wet periods would continue without the restrictions within the Offset Area Management Plan as grazing without the offset is timed to only be excluded during the normal flood months of December to February.</p> <p>The site condition score is an indication of the average quality without the offset over a 20 year period taking into consideration the 7-8 year cycle of thinning, and burning.</p>	<p>Site condition score – 1</p> <p>As discussed in Section 3.3.2 of the EPBC Offset Delivery Plan, the regrowth areas on the property are scheduled for re-clearing and subsequent burning as part of the ongoing cycle of pasture maintenance. Plate 3 and Plate 4 in Section 3.3.3 illustrate the condition in which the pasture in the offset area is usually maintained. As can be seen from these images, there is no woody debris (scores would drop to 0), essentially 100% exotic pasture cover (weed cover scores would drop to 0) and a resultant higher grazing capacity and pasture utilisation. This clearing will remove any standing vegetation, however for this species, the greatest impact will be to the maintenance of an absence of coarse woody debris, a further reduction in organic litter (as a result of the use of fire) which is used for sheltering, as well as an increase in exotic grass cover. An increase in grazing pressure and compaction as a result of the increased grass cover, (the reason that re-clearing is undertaken), cattle can also compact soils and reduce soil cracks that provide shelter habitat for the species causing a further reduction in the associated abundance and quality of shelter scores. Additionally, there would be the increased impact of compaction due to increased grazing pressure, especially in the event of moist soil conditions being present. Under the “business as usual” scenario, the area is grazed on a continuous basis with cattle only being removed during December/January/February due to seasonal flooding conditions - thus “pugging” of wet soil especially in gullies is an increased threat to the habitat of the species.</p> <p>Continued presence of grazing can also lead to erosion and sedimentation of wetlands, waterways and gilgai areas impacting negatively on frog populations, which are a key prey item for the Ornamental Snake. There would also be an impact on the on food sources for the species (frogs) due to a reduction in water quality during these times. This would further impact on the already moderate to low foraging habitat scores.</p> <p>The site condition score is an indication of the average quality without the offset over a 20 year period taking into consideration the 7-8 year cycle of re-clearing burning and grazing.</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			<p>Site context – 3</p> <p>Site context score would be maintained as there would be no impact to the context with regards the amount of remnant vegetation within 1km of the offset, patch size or ecological corridor scores. There would be some impact to the connectivity of the patch with regards the loss of the regrowth adjacent to some patches, however the impact on the species within the remnant areas would not be excessive.</p>	<p>Site context – 1</p> <p>Under site context, the most limiting factors that would be impacted by “business as usual” (re-clearing and burning of the regrowth) would be patch size (would reduce the score substantially) and connectivity to adjacent remnant vegetation (a further reduction in scores). The re-clearing of the site would reduce the habitat extent and connectivity, impacting on the species ability to disperse.</p>
			<p>Species stocking rate – 1</p> <p>As a result of the above practices and impacts to habitat, as well as impacts to connectivity reducing the species ability to move across the landscape, it is anticipated that there would be an impact to species population, however the score remains at 1 as it would still be present, however not in high numbers</p>	<p>Species stocking rate – 1</p> <p>As a result of the above practices and impacts to habitat, food supply and foraging ability as well as impacts to connectivity reducing the species’ ability to move across the landscape, it is anticipated that there would be an impact to species population, however the score remains at 1 as it would still be present, however not in high numbers</p>
Future quality with offset	9*	7	<p>Site condition score – 4</p> <p>Protection and management of this area can improve the current condition, particularly by control of the existing weed levels, by allowing the improvement of habitat quality by ensuring continued natural succession and development of mature features such as the retention of coarse woody debris, the increase in organic litter and the reduction in the impacts of cattle grazing on the soil condition by grazing only being allowed during the dry season.</p> <p>Improvements in the following attributes that are related to the species habitat are expected over the course of the offset. Coarse woody debris (increases from a score of 0 to a score of 2), organic litter (maintains a score of 5), weed cover (increases from 0 and 3 in some sites to an average of a score of 5 across the entire offset area). This would lead to an increase in the abundance of shelter for the species and an increase in this relative score.</p> <p>It is also expected that there would be an increase in the quality and availability of the foraging habitat within RE 11.3.1 due to a decrease in the impacts of cattle on the water quality due to not grazing during wet periods, therefore improving the habitat of the preferred food source for the species being frogs.</p>	<p>Site condition score – 3</p> <p>Regrowth communities are generally on a trajectory of improvement. With active management, such as prevention of clearing, prevention of sowing exotic pasture species, reduced cattle grazing, use of fire and pest animal management, this improvement can be accelerated and degradation prevented and improve the quality and abundance of foraging and habitat.</p> <p>Attributes that are considered most reasonable related to the species requirements and would increase in score over the term of the offset would be coarse woody debris (increase in score from 0 to 2), organic litter (increase in score from 3 to a consistent 5 across the regrowth areas) and weed cover from a series of low scores to an average of 5 across the regrowth areas.</p> <p>Removal of stock during the wet season will decrease soil compaction, limit understorey trampling and improve water quality of frog habitat. This will in turn improve the quality and abundance of foraging and sheltering resources. This will have a positive impact on the scores for the abundance of shelter and foraging habitat available for the species.</p> <p>Control of pest species will also reduce potential threats to Ornamental Snake.</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			<p>*Note- a score of 8 is utilised in the offset calculator within Schedule 3 (EPBC Offset Assessment Guide Results) to provide a level of conservatism.</p>	
			<p>Site context – 4</p> <p>The site context is expected to increase as the scores for both connectivity and the amount of remnant vegetation within a 1km buffer would increase as the regrowth areas adjacent to the remnant areas became remnant areas therefore increasing the connectivity of the individual patches.</p>	<p>Site context – 3</p> <p>Protection from clearing will increase connectivity and patch size, which in turn would increase the area’s ability to sustain viable populations.</p>
			<p>Species stocking rate – 1</p> <p>The species is known to be present in the area (ELA 2016) and the improvement in condition and context should support a higher population. However, for conservative scoring, the future population estimate is left unchanged as being present but not in high numbers.</p>	<p>Species stocking rate – 1</p> <p>The species is known to be present in the area (ELA 2016) and the improvement in condition and context should support a higher population. However, for conservative scoring, the future population estimate is left unchanged as being present but not in high numbers.</p>
Time until ecological benefit	20	20	<p>Estimated time for weed and pest reduction, further development of features such as the amount of coarse woody debris, improvement in water quality for the food source (frogs) and the establishment of a good soil structure that enables the species to exploit soil cracks for shelter and for increase in Ornamental Snake abundance and breeding success (due to better quality habitat and more prey items).</p>	<p>Estimated time for canopy layer to mature and provide leaf litter and fallen woody debris for sheltering habitat, improvement in water quality for the food source (frogs) and the establishment of a good soil structure that enables the species to exploit soil cracks for shelter and for increase in Ornamental Snake abundance and breeding success (due to better quality habitat and more prey items). This timeframe also accommodates for an increase in Ornamental Snake abundance and breeding success (due to better quality habitat and more prey items).</p>
Confidence in quality scores	90%	90%	<p>The prevention of thinning activities, stick raking of coarse woody debris and the subsequent use of fire to remove this habitat feature have a high certainty under the Offset Area Management Plan. The field survey results (Appendix C2) demonstrate the amount of accumulated woody debris that would be retained under the management plan. The scores for the coarse woody debris present when the field surveys were undertaken we predominantly under half of the benchmark score and are detailed below.</p> <ul style="list-style-type: none"> 11.3.1 (remnant AU1) – survey site scores 2, 5, 2 with a maximum possible score of 5; 	<p>Improvement in quality and abundance of sheltering habitat is reliant on natural succession of the canopy, secondary layers and shrub layers of the vegetation community which will evolve as a result of the prevention of clearing, stick raking of coarse woody debris and burning of same, and the use of fire for woody regrowth control. The scores for coarse woody debris (shelter) and organic litter are low for this species in the regrowth areas and the control of the threats as per Section 3.3.2 of the EPBC Offset Delivery Plan would enable the vegetation community to mature which will lead to an increase in these scores over time.</p> <p>As the canopy establishes and increases in cover (currently low scores for canopy height and cover), there will be a resultant gradual decreasing of exotic grass and weed cover as the canopy closes. In parallel, there will be an increase in coarse woody debris, organic litter and native grass cover which are all low to</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			<ul style="list-style-type: none"> 11.3.3 (remnant AU6) - survey site scores 0, 2 with a maximum possible score of 5 (freshwater wetland); 11.3.4 (remnant AU5) - survey site scores 5, 5 with a maximum possible score of 5; 11.3.25 (remnant AU8) - survey site scores 2, 5, 5 with a maximum possible score of 5; and 11.3.27 (remnant AU9) - survey site scores 5, 0 with a maximum possible score of 5. <p>Weed cover varies significantly across the assessment units with a variation of a score of 0 (more than 50% weed cover) to a score of 10 – maximum 5% weed cover). The removal of the thinning, burning and stick raking threat in conjunction with the reduction in grazing pressure and time and the reduction in the use of the remnant areas as cattle shelter areas will assist in the increase in coarse woody debris, and native ground cover thus preventing further weed incursion in the remnant areas.</p>	<p>non-existent in the current scores. As exotic grass cover decreases, there will be a resultant reduction in grazing capacity and grazing pressure which will in turn reduce soil compaction and the resultant effect on soil cracking.</p> <p>Grazing under the Offset Area Management Plan is restricted to dry times thus further reducing the impacts on soil cracks via “pugging” as well as the impacts to water quality affecting the species primary food source being frogs. These factors will increase the scores for quality of shelter and foraging habitat which are predominantly moderate with some poor scores.</p> <p>Additionally, a pest animal and fire control program is detailed in the Offset Area Management Plan which will further decrease the risks associated with the offset achieving the required outcomes and increase the shelter quality and foraging scores for the regrowth areas.</p>
Raw gain	2	4	As per OAG	
Adjusted gain	1.8	3.6	As per OAG	
Risk of Loss				
Risk of loss without offset	10%	90%	Continuation of thinning of secondary canopy and shrub layers, the use if stick raking and burning of coarse woody debris (lower scores to 0 or 2 in most areas of remnant vegetation) (7-8-year cycle in line with the treatment of the regrowth areas) with the intent of increasing exotic grass cover and therefore allow for a higher grazing capacity in areas of Ornamental Snake habitat would degrade essential habitat features that are critical to supporting the species. These actions would not destroy the habitat, however would have a detrimental effect on the quality of that shelter and foraging habitat and abundance of the species in the remnant areas resulting in lower scores for these attributes. At this point in time, the quality of habitat is moderate for this species throughout the	The offset areas have been historically cleared since the early 1970s - see Plate 3, Plate 4, Section 3.3.2 and Section 3.3.3 of the EPBC Offset Delivery Plan. The recurring clearing undertaken periodically as described in those sections is scheduled to be undertaken again within the next 2-3 years with the clearing and subsequent burning and stick raking only being delayed until the end of the wet season. This recognised practice of woody weed control and pasture improvement results in the destruction of the native species richness, canopy and shrub layer with a result that the scores for these attributes (see Appendix C2) would decrease dramatically. The act of

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			<p>remnant area. These scores are connected to the lower scores associated with canopy cover which is then associated with the higher exotic grass (scores would reduce to average 3 across the site) cover and the consistent scores 0 or 2 being less than 10% and 50% coarse woody debris cover as compared to the benchmark for each regional ecosystem.</p> <p>These factors would then translate into lower scores for the abundance of shelter available for the species.</p> <p>As a result of the implementation of the offset, there would also be an increase in the context scores as the amount of remnant vegetation within the area would increase.</p>	<p>chaining and stick raking would also result in damage to the structure of the gilgai, soil cracks and levelling of the soil surface. This would result in a further decrease in the shelter and foraging quality scores associated with the regrowth areas.</p> <p>The treatment of the regrowth will result in an increase in exotic grass cover (increase in weed cover score). Subsequently this increase in pasture cover will enable an increase in grazing capacity with a subsequent increase in soil compaction and damage to soil cracks and a resultant decrease in the abundance and quality of the shelter scores for the regrowth areas.</p> <p>Additionally, impacts will be to the quality and abundance of foraging habitat for the preferred food source (frogs) for the species. This would be as a result of the physical actions of the re-clearing practices and then the subsequent higher grazing capacity affecting water quality as grazing would not be restricted to the dry season as it is under the Offset Area Management Plan.</p> <p>As the area was being used for grazing (and cleared for that purpose) well before the introduction of the EPBC Act in 1999, the landowner is exempt from the EPBC Act under section 43B as discussed in Section 3.3.3.</p> <p>Year of initial clearing – from historical photos is evidenced to have been between 1966 and 1975 – see Plate 3 and Plate 4</p> <p>Over the last 15 years:</p> <ul style="list-style-type: none"> • Regrowth was re-pulled and seeded during 1989 and 1990 • Oversown with exotic pasture grass in 1991 • The subsequent re-clearing cycle was to re-chain and burn every 7-8 years during the dry months with timing being dependent on seasonal conditions • Regrowth areas are programmed to be re-cleared, burnt and stick raked in the next 2-3 years. <p>The Risk of Loss without an Offset is very high due to these re-clearing, burning practices and there is 100% certainty that these practices will occur without the restrictions within the Offset Area Management Plan.</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Risk of loss with offset	2%	2%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be managed. Stochastic events such as natural fires and flooding will still pose a risk to the offset area. Management actions and remediation activities will be in place to assist in reducing these risks or the severity of outcomes.	
Time over which loss is averted	20	20	Maximum of 20 years.	
Confidence in risk scores	90%	90%	<p>The offset area will be legally secured, clearing activities will be prohibited and grazing will be undertaken for fire management purposes during the dry season. This will effectively reduce risk of loss in the quality of the offset site. – i.e., the banning of clearing and pasture improvement activities has a high averted loss factor as discussed in Section 3.3.2 and Section 3.3.3. These actions are effective immediately on securing the offset and will avert the immediate risk of re-clearing and the subsequent effect on habitat, shelter and foraging scores and attributes.</p> <p>There is little risk to the improvement in the quality of the offset site over time with the averted loss, management of fire and grazing times to be restrained to low intensity burns as per the recommendations in the Regional Ecosystem Description Database and grazing restricted to dry times where there is reduced risk associated with soil compaction and pugging which effects soil structure and the presence of cracks. The increase in canopy cover, coarse woody debris, organic litter and reduction in weed cover will also increase the scores for those attributes over time and subsequently be reflected in the shelter and foraging quality and abundance scores.</p> <p>This gives a high confidence in the outcome of the offset when managed as per the accompanying Offset Area Management Plan.</p> <p>This confidence is supported with a robust Monitoring and Reporting schedule within the OAMP which is based on an adaptive management strategy related directly to these measurable indicators (attributes).</p>	
Raw gain	17.08	36.17	As per OAG	
Adjusted gain	15.37	32.55	As per OAG	
Results				
Net present value	45.05	31.28	As per OAG	
% impact offset	122.72%	63.51%	As per OAG	
TOTAL % impact offset	186.23%		Proposed offset area offsets significant residual impacts on Ornamental Snake	

Table 5B: EPBC Act Offset Assessment Guide Inputs – Yakka Skink

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Area (ha)	159.2	86.6	<p>Area verified in field assessments conducted by ELA (2016)</p> <p>Proposed offsets for the Yakka Skink consist of the following vegetation and REs all of which are within the listed preferred land zones for habitat as per the <i>Approved Conservation Advice for Egernia rugosa (Yakka Skink)</i></p> <ul style="list-style-type: none"> • 11.3.1 (remnant AU1) • 11.3.4 (remnant AU5) • 11.3.25 (remnant AU8) • 11.4.9 (remnant AU3) • 11.5.3 (remnant AU10) 	<p>Area verified in field assessments conducted by ELA (2016)</p> <p>Proposed offsets for the Yakka Skink consist of the following vegetation and REs</p> <ul style="list-style-type: none"> • 11.3.1 (non-remnant AU2) • 11.4.9 (non-remnant AU4).
Quality				
Start quality	7	5	<p>Site condition - 3</p> <p>Vegetation condition is moderate with recruitment levels and structural complexity generally resembling an undisturbed community. However, weed incursion and therefore species diversity varies from low to high, canopy and shrub cover has been disturbed and in some areas, there is a lack of large mature trees.</p> <p>Threats to the species habitat are low apart from a moderate threat due to high weed cover and only moderate presence of coarse woody debris in RE 11.5.3 (AU10).</p> <p>Habitat shelter quality and availability for Yakka Skink is poor in 2 sites, moderate in 2 and high in 1 site (11.3.25 – AU8). This is due to the low (score of 2 being <10%) of coarse woody debris in 2 sites and only moderate levels in another 2 sites (score 5). Weed cover being moderate to high across most sites. These factors are then flow through to the quality and availability of shelter for the species.</p> <p>Foraging habitat scores moderate to high due to the large patch sizes and the abundance of foraging resources which enables movement of the species for foraging activities.</p>	<p>Site condition score – 2</p> <p>The regrowth communities within the offset area were found to contain suitable foraging resources for Yakka Skink although in a poor to moderate condition due to immaturity in the structure of the community and the associated habitat factors.</p> <p>Habitat quality assessments found regrowth habitat to be in poor (score 1) to moderate (score 5) condition with the main limiting factors being a lack of shelter in the form of fallen woody debris which was absent on nearly all the regrowth sites and a high weed cover being present. This is detailed in the field survey data at Appendix C2, - see “fallen woody debris” and “weed cover” in AUs 2 and 7.</p> <p>Due to the higher grass cover in the regrowth areas (weed cover scores 0 (>50% weed cover) and 5 (> 5% to 25% weed cover) and a coarse woody debris cover scoring 0 (<10% of the benchmark) there is a lack of shelter for the species which scores a 1 being a poor quality and abundance of shelter.</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			<p>Site context score - 3</p> <p>Site context ranges from low to high due to varying levels of connectivity to surrounding vegetation. Some areas form large contiguous vegetation patches, whilst other are more fragmented and isolated. All areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor).</p> <p>These areas within the offset area are likely to play an important role in the maintenance of the species in the region.</p>	<p>Site context score - 2</p> <p>The overall site context is generally moderate due to reduced connectivity to surrounding remnant vegetation (the regrowth offset assessment unit boundaries are predominantly only between 10-50% of the length of the boundaries area connected) as the individual offset assessment units are smaller and isolated vegetation patches with varying levels of connectivity to surrounding remnant vegetation. All areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor) raising the score to moderate.</p> <p>This is detailed in the field survey data at Appendix C2, - see "GIS based attributes" in AUs 2 and 7.</p>
			<p>Species stocking rate - 1</p> <p>The offset area is within the known distribution of the Yakka Skink being two hours north of Rockhampton.</p> <p>It is suspected to be present as potential habitat is available, however, it is not assumed to be present in high numbers</p>	<p>Species stocking rate - 1</p> <p>The offset area is within the known distribution of the Yakka Skink being two hours north of Rockhampton.</p> <p>It is suspected to be present as potential habitat is available, however, it is not assumed to be present in high numbers.</p>
Future quality without offset	6	3	<p>Site condition score - 2</p> <p>Part of the property's routine management for grazing which is undertaken in on a 7-8-year cycle (ongoing purpose) is the thinning of remnant vegetation within the limits of the self-assessable codes under the <i>Vegetation Management Act 1999 (Qld)</i> and then a subsequent use of fire in summer to reduce the presence of coarse woody debris to enable easier access for livestock and to increase exotic grass cover by reducing the competition from shrubs and secondary canopy layers. See Section 3.3.2 of the EPBC Offset Delivery Plan.</p> <p>This would cause a further reduction in the scores for coarse woody debris (sites with coarse woody debris would drop from a 5 or 2 to 0), weed cover (from 10 to 5) and for a shorter term, a reduction in organic litter although this would most likely recover within the ecological survey cycle depending on time of surveys in comparison to the timing of thinning and burning.</p> <p>Further impacts would be expected due to the increased use of the remnant vegetation areas for shelter once the regrowth areas were re-</p>	<p>Site condition score - 1</p> <p>As discussed in Section 3.3.2 of the EPBC Offset Delivery Plan, the regrowth areas on the property are scheduled for re-clearing and subsequent burning as part of the ongoing cycle of pasture maintenance. Plate 3 and Plate 4 in Section 3.3.3 illustrate the condition in which the pasture in the offset area is usually maintained, i.e., 100% pasture cover. As can be seen from these images, there is no woody debris (scores would remain at 0 for most sites and drop to 0 in RE 11.4.9), essentially 100% exotic pasture cover (weed cover scores would drop to 0) and a resultant higher grazing capacity and pasture utilisation. This clearing will remove any standing vegetation, however for this species, the greatest impact will be to the maintenance of an absence of coarse woody debris, a further reduction in organic litter (as a result of the use of fire) which is used for sheltering, as well as an increase in exotic grass cover. An increase in grazing pressure as a result of the increased grass cover, (the reason that re-clearing is undertaken) could also contribute to a further reduction in the associated abundance and quality of shelter scores.</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			<p>cleared. There is considerable risk to the availability and the quality habitat shelter scores 2 of which are already low (RE 11.3.1 and 11.4.9) due to the near lack of coarse woody debris (scores of 1 being less than 10% of the benchmark) as discussed above.</p> <p>There would be a corresponding increase in weed cover in these sites which already score between 0 and 5 being a weed cover of more than 50% to a weed cover of between 5-25%. This will further impact on the shelter available to the species although not to the same extent as the loss of woody debris however the increase in exotic pasture cover would increase fuel loads and therefore the impact of any fires on habitat availability.</p> <p>The site condition score is an indication of the average quality without the offset over a 20 year period taking into consideration the 7-8 year cycle of thinning, and burning.</p>	<p>Foraging habitat scores are already poor to moderate in the regrowth areas, at best these scores (predominantly score 1) would be maintained, and more probably, the scores in the more mature regrowth areas of a foraging abundance of 5 would be reduced to a score of 1, being poor.</p> <p>The site condition score is an indication of the average quality without the offset over a 20 year period taking into consideration the 7-8 year cycle of re-clearing burning and grazing</p>
			<p>Site context score – 3</p> <p>Site context score would be maintained as there would be no impact to the context with regards the amount of remnant vegetation within 1km of the offset, patch size or ecological corridor scores. There would be some impact to the connectivity of the patch with regards the loss of the regrowth adjacent to some patches, however the impact on the species within the remnant areas would not be excessive.</p>	<p>Site Context – 2</p> <p>Under site context, the most limiting factors that would be impacted by “business as usual” (re-clearing and burning of the regrowth areas) would be patch size (would reduce the score substantially) and connectivity to adjacent remnant vegetation (a further reduction in scores). The re-clearing of the site would reduce the extent of habitat and its connectivity, impacting on the species’ ability to disperse.</p>
			<p>Species stocking rate – 1</p> <p>As a result of the above practices and impacts to habitat, as well as impacts to connectivity reducing the species’ ability to move across the landscape, it is anticipated that there would be an impact to species population, however the score remains at 1 as it would still be present, however not in high numbers</p>	<p>Species Stocking Rate- 0</p> <p>Under the regrowth re-clearing and burning scenario with the resultant increase in non-native grass cover and higher stocking rate, significant impacts are anticipated to the core habitat requirements of coarse woody debris (already poor), organic litter (drop in scores from 5 to 3) and an increase in trampling effects of cattle there is a significant chance that the Yakka Skink would retreat to the remnant vegetation areas. Movement would be significantly reduced with no cover available and predation rates higher due to this lack of shelter availability.</p>
Future quality with offset	9*	7	<p>Site condition score – 4</p> <p>Protection and management of this area can improve the current condition, particularly by control of the existing weed levels, by allowing</p>	<p>Site condition score – 3</p> <p>With active management, such as prevention of clearing, prevention of sowing exotic pasture species, reduced cattle grazing, use of fire and pest</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			<p>the improvement of habitat quality by ensuring continued natural succession and development of mature features such as the retention of coarse woody debris, the increase in organic litter and the reduction in the impacts of cattle grazing on the soil condition by grazing only being allowed during the dry season thus preventing slumping and compaction of sandy soils and substrates that are conducive to burrow construction.</p> <p>Improvements in the following attributes that are related to the species habitat are expected over the course of the offset. Coarse woody debris (increase from a score of 0 to a score of 2), organic litter (maintain a score of 5), weed cover (increase from 0 and 3 in some sites to an average of a score of 5 across the entire offset area). This would lead to an increase in the abundance of shelter for the species and an increase in this relative habitat quality score.</p> <p>*Note- a score of 8 is utilised in the offset calculator within Schedule 3 (EPBC Offset Assessment Guide Results) to provide a level of conservatism.</p>	<p>animal management, the improvement seen to date in the start quality scores can be accelerated and degradation prevented to improve the quality and abundance of foraging and habitat.</p> <p>Attributes that are considered most reasonable related to the species requirements that would increase in score over the term of the offset would be coarse woody debris increase in score from 0 to 2, organic litter increase in score from 3 to a consistent 5 across the regrowth areas and weed cover from a series of low scores to an average of 5 across the regrowth areas. This in turn will have a positive impact on the abundance and quality of shelter available which scores a 1 or poor at the current time.</p> <p>Control of pest species will also reduce potential threats to Yakka Skink by reducing predation by wild pigs.</p>
			<p>Site context – 4</p> <p>The site context is expected to increase as the scores for both connectivity and the amount of remnant vegetation within a 1km buffer would increase as the regrowth areas adjacent to the remnant areas became remnant areas therefore increasing the connectivity of the individual patches.</p>	<p>Site context – 3</p> <p>Protection from clearing will increase connectivity and patch size, which in turn would increase the area's ability to sustain viable populations. Connectivity scores would improve as the regrowth areas achieve remnant status thus returning the entire offset area to remnant status resulting in greater ability for the species to traverse the landscape.</p>
			<p>Species stocking rate – 1</p> <p>The species is known to be present in the area (ELA 2016) and the improvement in condition and context should support a higher population. However, for conservative scoring, the future population estimate is left unchanged as being present but not in high numbers.</p>	<p>Species stocking rate – 1</p> <p>The species is known to be present in the area (ELA 2016) and the improvement in condition and context should support a higher population. However, for conservative scoring, the future population estimate is left unchanged as being present but not in high numbers.</p>
Confidence in quality scores	90%	90%	<p>The prevention of thinning activities, stick raking of fallen woody debris (coarse woody debris) and the resultant use of fire to remove this habitat feature have a high certainty under the Offset Area Management Plan. The field survey results in Appendix C2 demonstrate the amount of accumulated woody debris that would be retained under the management plan. The scores for the coarse woody debris present when the field surveys were undertaken are:</p>	<p>Improvement in quality and abundance of sheltering habitat is reliant on natural succession of the canopy, secondary layers and shrub layers of the vegetation community which will evolve as a result of the prevention of clearing, stick raking of coarse woody debris and burning of same, and the use of fire for woody regrowth and fallen timber control. The scores for coarse woody debris (shelter) and organic litter are low for this species in the regrowth areas and the control of the threats as per Section 3.3.2 of the</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			<ul style="list-style-type: none"> 11.3.1 (remnant AU1) – survey sites 2, 5, 2 with a maximum possible score of 5; 11.5.3 (remnant AU10) – survey sites 5, 5, 5 with a maximum possible score of 5; 11.3.4 (remnant AU5) - survey sites 5, 5 with a maximum possible score of 5; 11.3.25 (remnant AU8) - survey sites 2, 5, 5 with a maximum possible score of 5; and 11.4.9 (remnant AU3) - score of 0 with a maximum possible score of 5. <p>Weed cover varies significantly across the sites with a variation of a score of 0 (more than 50% weed cover) to a score of 10 – maximum 5% weed cover). The removal of the thinning, burning and stick raking threat will assist in the prevention of further weed incursion and increase in the remnant areas.</p> <p>Confidence in the ability to achieve an improvement in quality/condition in the remnant areas is high with the highest contributing attributes being the accumulation over time of coarse woody debris to increase those scores and the reduction of non-native plant cover. These attributes are achieved by removing the risk of thinning and the use of inappropriate fire regimes and the subsequent reduction in non-native plant cover as the canopy closes.</p>	<p>EPBC Offset Delivery Plan would enable the vegetation community to mature which will lead to an increase in these scores over time.</p> <p>As the canopy establishes and increases in cover (currently low scores for canopy height and cover), there will be a resultant gradual decreasing of exotic grass and weed cover as the canopy closes. In parallel, there will be an increase in coarse woody debris, organic litter and native grass cover which are all low to non-existent in the current scores. As exotic grass cover decreases, there will be a resultant reduction in grazing capacity and grazing pressure which will in turn reduce soil compaction and the resultant effect on burrowing ability.</p> <p>Confidence in the uplift in coarse woody debris scores, reduction in weed cover and the resultant increase in shelter abundance and quality scores is high as the threats to these will be removed by the Offset Area Management Plan by the removal of clearing and inappropriate burning. As the canopy layer increases in height and the canopy cover increases, there will be a natural decrease in the buffel grass cover (non-native plant cover) and an increase in these scores.</p> <p>Additionally, a pest animal and fire control program is detailed in the Offset Area Management Plan which will further decrease the risks associated with predation on the species.</p>
Raw Gain	2	4	As per OAG	
Adjusted Gain	1.8	3.6	As per OAG	
Risk of Loss				
Risk of loss without offset	10%	90%	Continuation of thinning of secondary canopy and shrub layers, the use if stick raking and burning of coarse woody debris (lower scores to 0 or 2 in most areas of remnant vegetation) (a 7-8-year cycle in line with the treatment of the regrowth areas) with the intent to increase exotic grass (non-native plant) cover and therefore allow for a higher grazing capacity,	The offset areas have been historically cleared since the early 1970s. See Plate 3, Plate 4, Section 3.3.2 and Section 3.3.3 . The recurring clearing undertaken periodically as described in those sections is scheduled to be undertaken again within the next 2-3 years only being delayed until the end of the wet season. This recognised practice of woody weed control and

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			<p>would degrade essential habitat features that are critical to supporting the species. These actions would not destroy the habitat, however would have a detrimental effect on the quality of that shelter and foraging habitat and abundance of the species in the remnant areas resulting in lower scores for these attributes. At this point in time, the quality and availability of habitat is moderate for this species throughout the remnant area. These scores are connected to the lower scores associated with canopy cover which is then associated with the higher non-native plant (scores would reduce to average 3 across the site) cover.</p> <p>Coarse woody debris, a key habitat element for the Yakka Skink, consistently scores 0 or 2 being less than 10% and 50% coarse woody debris cover as compared to the benchmark for each regional ecosystem. The continuing use of inappropriate fire regimes would translate in to lower scores for the abundance of shelter available for the species.</p> <p>There will be some loss of the quality and abundance of habitat over time within the remnant areas without the offset restrictions on thinning, burning and stick raking.</p>	<p>pasture improvement results in the destruction of the regrowth as well as the removal of coarse woody debris and organic litter via the subsequent use of fire to remove the fallen timber. See Plate 4 and Plate 5 in Section 3.3.3 as an illustration of the condition that the site is usually maintained. This practice is supplemented in later years with the use of fires to further suppress regrowth and to maintain a pasture free of fallen woody debris (scores are generally below 10% of the benchmark for the respective RE's). Therefore, the Yakka Skink habitat is at risk of being re-cleared, burnt and has a resultant increase in non-native grass cover which will increase the carrying and grazing capacity of the area. This will impact the essential habitat features for the species to the extent that they are lost. As the area was being used for grazing (and cleared for that purpose) well before the introduction of the EPBC Act in 1999, the landowner is exempt from the EPBC Act under section 43B as discussed in Section 3.3.3.</p> <p>The 100% confidence in the area being re-cleared if the offset is not in place and the subsequent loss of habitat gives a high confidence in the loss of the habitat for this species.</p>
Risk of loss with offset	2%	2%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be managed. Stochastic events such as natural fires and flooding will still pose a risk to the offset area. Management actions and remediation activities will be in place to assist in reducing these risks or the severity of outcomes.	
Time over which loss is averted	20	20	Maximum of 20 years	
Confidence in risk scores	90%	90%	<p>The offset area will be legally secured, clearing activities will be prohibited and grazing will be undertaken for fire management purposes during the dry season. This will effectively reduce risk of loss in the quality of the offset site. – i.e., the banning of clearing and pasture improvement activities has a high averted loss factor as discussed in Section 3.3.2 and Section 3.3.3. These actions are effective immediately on securing the offset and will avert the immediate risk of re-clearing and the subsequent effect on habitat, shelter and foraging scores and attributes.</p> <p>There is little risk to the improvement in the quality of the offset site over time with the averted loss, management of fire and grazing times to be restrained to low-intensity burns as per the recommendations in the Regional Ecosystem Description Database and grazing restricted to dry times where there are reduced effects on soil structure. The increase in canopy cover, coarse woody debris, organic litter and reduction in weed cover will also increase the scores for those attributes over time and subsequently be reflected in the shelter and foraging quality and abundance scores.</p> <p>This gives a high confidence in the outcome of the offset when managed as per the accompanying Offset Area Management Plan.</p>	

Attribute	Score		Rationale	
	Remnant	Regrowth	Regrowth	Remnant
			This confidence is supported with a robust Monitoring and Reporting schedule within the OAMP which is based on an adaptive management strategy related directly to these measurable indicators (attributes).	
Raw gain	12.74	76.21	As per OAG	
Adjusted gain	11.46	68.59	As per OAG	
Results				
Net present value	33.59	49.13	As per OAG	
% impact offset	53.00%	77.51%	As per OAG	
TOTAL % impact offset	130.51%		Proposed offset area offsets significant residual impacts on Yakka Skink	

Table 5C: EPBC Act Offset Assessment Guide Inputs – Brigalow TEC

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Area (ha)	27.1	86.6	<p>Area verified in field assessments conducted by ELA (2016)</p> <p>Proposed offsets for the Brigalow TEC consist of the following REs all of which are within the in the <i>Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community</i> dated 17th December 2013.</p> <ul style="list-style-type: none"> 11.3.1 (remnant AU1) 13.6ha 11.4.9 (remnant AU3) 13.5ha 	<p>Area verified in field assessments conducted by ELA (2016)</p> <p>Proposed offsets for the Brigalow TEC consist of the following RE's all of which are within the in the <i>Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant)</i></p> <ul style="list-style-type: none"> 11.3.1 (non-remnant AU2) 59.8ha 11.4.9 (non-remnant AU4) 26.8ha
Quality				
Start quality	7	6	<p>Site condition score – 3</p> <p>The condition of the Brigalow TEC remnant patches is moderate with recruitment levels of Native species being high, however there being an excess of canopy cover (over 200% of the benchmark), a lack of large trees (scored 5 being 0-50% of the benchmark) and a lack of coarse woody debris. Weed incursion is low in RE 11.3.1 but high in RE 11.4.9 suggesting some ongoing disturbance resulting in the lack of fallen timber and higher grass cover.</p>	<p>Site condition - 1</p> <p>Site condition is poor with all attributes apart from native species recruitment and richness and the number of trees. The balance of the attributes making the TEC scored poorly with a lack of canopy height, canopy cover (scores 3 and 2 respectively) the absence of large trees and coarse woody debris all scoring zero.</p>
			<p>Site context score - 3</p> <p>Site context ranges from moderate to high due to varying levels of connectivity to surrounding vegetation. Some areas form large contiguous vegetation patches, whilst others are more fragmented and isolated. All areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor).</p>	<p>Site context - 2</p> <p>Site context is generally moderate due to reduced connectivity to surrounding remnant vegetation resulting in smaller and isolated vegetation patches. However, all areas are situated within a mapped ecological corridor which raises the overall score.</p>
			<p>Species stocking rate = 1</p> <p>The remnant patches are not large and therefore only score 2 for patch size although connectivity to adjoining remnant vegetation is good.</p>	<p>Species stocking rate – 3</p> <p>Although the TEC is in a poor condition, the patches are a good size each scoring a 5 and adjoining remnant areas of vegetation increasing their value.</p>
Future quality without offset	6	6	<p>Site condition score – 2</p>	<p>Site condition - 1</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			The condition of the Brigalow TEC remnant patches will remain in a moderate condition however there is a consistent impact to coarse woody debris and weed cover in RE 11.4.9 suggesting some ongoing disturbance resulting in the lack of fallen timber and higher non-native plant cover. As the property development cycle is due to be renewed with the recovery in seasonal conditions and commodity prices, the use of thinning and fire to manage the excess in canopy cover and shrub cover would recommence resulting in a reduction in the overall structure of the TEC, and increase in weed cover (score lower to 5 being 5-25% weed cover) and the continuing lack of structure in the form of coarse woody debris (already scoring 2 and 0)	Site condition is poor with all attributes apart from native species recruitment and richness and the number of trees. The balance of the attributes making the TEC scored poorly with a lack of canopy height, canopy cover (scores 3 and 2 respectively) the absence of large trees and coarse woody debris all scoring zero. This will decrease further with the re-clearing of all standing regrowth thus lowering those scores to 0. Effectively, the scores without the offset will be low for all attributes that contribute to the structure and maturity of the TEC. Re-clearing is 100% certain within the next 2-3 years as per the development cycle discussed previously.
			Site context score - 3 Site context ranges from moderate to high due to varying levels of connectivity to surrounding vegetation. Some areas form large contiguous vegetation patches, whilst others are more fragmented and isolated. All areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor).	Site context - 2 Site context is generally moderate due to reduced connectivity to surrounding remnant vegetation resulting in smaller and isolated vegetation patches. However, all areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor) which raises the overall score.
			Species stocking rate = 1 The score remains as 1, due to the small patch size, although it will form part of a contiguous area of the brigalow TEC.	Species stocking rate - 3 Although the TEC is in a poor condition, the patches are a good size each scoring a 5 and adjoining remnant areas of vegetation increasing their value.
Future quality with offset	8	7	Site condition score - 3 Protection and management of this area can improve the current condition, particularly by removal of the threat of thinning and burning therefore by allowing the improvement of the TEC quality by ensuring continued improvement in the presence of large trees, canopy cover reducing to the benchmark levels as trees mature, the development of a secondary and shrub layer via natural succession and development of mature features such as the retention of coarse woody debris. Improvements in the following attributes that are related to the TEC are expected over the course of the offset. Improvement in canopy cover scores, shrub canopy scores, coarse woody debris (increase from a score of 0 to a score of 2), organic litter (maintain a score of 5), weed cover (increase from 0 and 3 in some sites to an average of a score of 5 across the entire offset area).	Site condition score - 3 Regrowth communities are generally on a trajectory of improvement. With active management, such as prevention of clearing, reduced cattle grazing, use of fire this improvement can be accelerated and the slow accumulation of coarse woody debris begun. Attributes that are considered most reasonable related to the TEC and that would increase in score over the term of the offset would be canopy height, canopy cover, coarse woody debris (increase in score from 0 to 2), organic litter (increase in score from 3 to a consistent 5 across the regrowth areas) and weed cover (from a series of low scores to an average of 5 across the regrowth areas).

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			<p>Site context – 4</p> <p>The site context is expected to increase as the scores for both connectivity and the amount of remnant vegetation within a 1km buffer would increase as the regrowth areas adjacent to the remnant areas became remnant areas therefore increasing the connectivity of the individual patches.</p>	<p>Site context – 3</p> <p>Protection from clearing will increase connectivity and patch size, and increase the amount of remnant vegetation within a 1 km area which is the measure for context in the landscape. This will be a contributing factor to the outcome of the implementation of the offset</p>
			<p>Species stocking rate – 1</p> <p>Patch size is not large and although connectivity will improve, the increase will not affect this scoring.</p>	<p>Species stocking rate – 1</p> <p>The patch sizes of the regrowth areas are substantial and there is the opportunity for this score to outperform during the term of the offset. However, a conservative score has been adopted in this case.</p>
Time until ecological benefit	10	20	<p>Estimated time for canopy improvement, some increase in coarse woody debris and a resultant decrease in non-native plant cover. Over time, there will be further development of features such as the amount of coarse woody debris, and the presence of large trees which will both improve the condition of the TEC.</p>	<p>Estimated time for canopy layer to mature and provide leaf litter and fallen woody debris increasing the condition of the TEC. Initially, the fastest response is expected to be in the height of the canopy, canopy cover and resultant decrease in non-native plant cover.</p>
Confidence in quality scores	90%	90%	<p>The prevention of thinning activities, stick raking of fallen woody debris (coarse woody debris) and the resultant use of fire to remove this element of the TEC have a high certainty under the Offset Area Management Plan. The field survey results (see Appendix C2) demonstrate the current lack of accumulated woody debris within the remnant areas and the high to moderate non-native plant cover. The Offset Area Management plan would restrict the threats to the accumulation of the coarse woody debris which would therefore be retained. The scores for the coarse woody debris present when the field surveys were undertaken are:</p> <ul style="list-style-type: none"> 11.3.1 (remnant AU1) – scores at the survey sites - 2, 5, 2 with a maximum possible score of 5 11.4.9 (remnant AU3) – survey site score - 0 with a maximum possible score of 5 <p>Weed cover varies significantly across the sites with a variation of a score of 0 (more than 50% weed cover) to a score of 10 – maximum 5% weed cover). The removal of the thinning, burning and stick raking threat</p>	<p>Improvement in quality of the community is time dependant once the threats have been addressed and will be as a result of the prevention of re-clearing, burning and stick raking of coarse woody debris, and the further use of fire in later years for woody regrowth control. The scores for canopy cover, canopy height, species richness would all increase by the removal of this major threat to the TEC. All of these scores would improve over time and importantly, would not fall to a poor to 0 condition if the re-clearing was to eventuate.</p> <p>The increase in height and canopy cover will also result in the gradual decreasing of non-native plant cover (grass cover) as the canopy closes and the resultant reduction in grazing capacity and grazing pressure.</p> <p>The prevention of clearing, appropriate use of fire and the accumulation of woody debris is detailed in the Offset Area Management Plan which will further the risks associated with the offset achieving the required outcomes.</p> <p>This results in a high confidence of success.</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			will assist in the prevention of further weed incursion and increase in the remnant areas.	
Raw gain	2	1	As per OAG	
Adjusted gain	1.8	0.9	As per OAG	
Risk of Loss				
Risk of loss without offset	10%	90%	<p>Continuation of thinning of secondary canopy and shrub layers, the use of stick raking and burning of coarse woody debris (lower scores to 0 or 2 in most areas of remnant vegetation) (7-8-year cycle in line with the treatment of the regrowth areas) with the intent to increasing exotic grass cover and therefore allow for a higher grazing capacity in the remnant areas would degrade the condition of the TEC. These actions would have a detrimental effect on the already lower scores associated with canopy cover which is then associated with the higher exotic grass (scores would reduce to average 3 across the site) cover and the consistent scores 0 or 2 being less than 10% and 50% coarse woody debris cover as compared to the benchmark for each regional ecosystem.</p> <p>These factors would then translate into lower scores for the condition of the TEC.</p>	<p>The offset areas have been historically cleared since the early 1970s - see Plate 3, Plate 4, Section 3.3.2 and Section 3.3.3 of the EPBC Offset Delivery Plan. The recurring clearing undertaken periodically as described in those sections is scheduled to be undertaken again within the next 2-3 years with the clearing and subsequent burning and stick raking only being delayed until the end of the wet season. This recognised practice of woody weed control and pasture improvement results in the destruction of the native species richness, canopy and shrub layer with a result that the scores for these attributes (see Appendix C2) would decrease dramatically.</p> <p>The treatment of the regrowth will result in an increase in exotic grass cover (increase in weed cover score).</p> <p>As the area was being used for grazing (and cleared for that purpose) well before the introduction of the EPBC Act in 1999, the landowner is exempt from the EPBC Act under section 43B as discussed in Section 3.3.3.</p> <p>Year of initial clearing – from historical photos is evidenced to have been between 1966 and 1975 – see Plate 3 and Plate 4.</p> <p>Over the last 15 years:</p> <ul style="list-style-type: none"> • Regrowth was re-pulled and seeded during 1989 and 1990 • Oversown with exotic pasture grass in 1991 • The subsequent re-clearing cycle was to re chain and burn every 7-8 years during the dry months with timing being dependent on seasonal conditions • Regrowth areas are programmed to be re-cleared, burnt and stick raked in the next 2-3 years.

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
				The Risk of Loss without an Offset is very high due to these re-clearing, burning practices and there is 100% certainty that these practices will occur without the restrictions within the Offset Area Management Plan.
Risk of loss with offset	2%	2%	The offset area will be legally secured and clearing activities will be prohibited. Stochastic events such as natural fires and flooding will still pose a risk to the offset area. Management actions and remediation activities will be in place to assist in reducing these risks or the severity of outcomes.	
Time over which loss is averted	20	20	Maximum of 20 years.	
Confidence in risk scores	90%	90%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be undertaken for fire management purposes during the dry season. This will effectively reduce risk of loss – i.e., the banning of clearing and pasture improvement activities has a high averted loss factor as discussed in Section 3.3.2 and Section 3.3.3 . These actions are effective immediately on securing the offset and will avert the immediate risk of treatment via re-clearing planned to occur within the next 12-18 months in the offset site. There is little risk to the improvement in the quality of the offset site over time with the averted loss, management of fire and grazing times. This gives a high confidence in the outcome of the offset when managed as per the accompanying Offset Area Management Plan. Part of this confidence is also attributed to the Monitoring and Reporting schedule within the OAMP which is based on an adaptive management strategy related directly to measurable indicators.	
Raw gain	2.17	76.21	As per OAG	
Adjusted gain	1.95	68.59	As per OAG	
Results				
Net present value	1.54	38.43	As per OAG	
% impact offset	75.50%	564.30%	As per OAG	
TOTAL % impact offset	639.80%		Proposed offset area substantially offsets significant residual impacts on Brigalow TEC	

2. Management plan

2.1 Management area objectives and outcomes

The management area objectives and outcomes identified below are estimated to be achieved within 15 years, or by 2031. It is recognised that the timeframes are subject to natural conditions and unexpected events, and the risks are identified in section 4, Risk Analysis.

Over time, there must be no net loss to the extent and condition of the Brigalow ecological community and habitat for the Ornamental Snake, Yakka Skink, Squatter Pigeon (southern) and Koala within the offset area.

The management area objectives and outcomes for the offset area are for the enhancement of the condition of the endangered regional ecosystems 11.3.1, 11.4.9, the Of Concern regional ecosystems 11.3.3 and 11.3.4, connectivity adjacent to the Connors River, watercourse vegetation and habitat for the Ornamental Snake, Yakka Skink and Squatter Pigeon (southern).

The habitat and regional ecosystems are currently in a moderate to degraded condition within the offset area (refer to *Section 1*).

2.1.1 Management area objectives

Environment Protection & Biodiversity Conservation Act 1999 (Commonwealth)

The management area objectives are to protect and improve the habitat conditions for listed threatened species *Denisonia maculata* (Ornamental Snake) and *Egernia rugosa* (Yakka Skink) under the EPBC Act approval. Management actions in the offset area will enable the natural regeneration of the habitat via the following:

- prevention of broad-scale clearing;
- weed management including control measures;
- fire management as per the guidelines provided in the Queensland Herbarium Regional Ecosystems Descriptions Database (REDD) for the respective regional ecosystems;
- livestock management to minimise grazing impacts; and
- pest animal management including control measures.

A legally-binding mechanism, in the form of a Voluntary Declaration under the VMA will protect this offset area from clearing and require the actions within the management plan to be implemented. The areas will be actively managed until 30 December 2031, or until the outcomes of the management plan are achieved, whichever comes first.

If due to natural conditions and/or unexpected events the offset has not achieved the future quality as detailed in **Tables 5A-5C**, then the actions detailed in **Table 6** and **Table 8** will be continued until the outcomes of the management plan are achieved or until 30 December 2036, whichever comes first.

Environmental Protection Act 1994 (Queensland)

The offset area for impacts to of concern regional ecosystems 11.3.3 and 11.3.4, watercourse vegetation and connectivity are managed to maintain and enhance the condition of those regional ecosystems and the associated habitat, specifically:

- the ecosystem attains and, or retains, remnant status as defined under the VMA and remains mapped on a Regulated Vegetation Management Map (RVMP), or a map published by the Queensland Government that supersedes the RVMP;
- prevention of broad-scale clearing;
- weed management including control measures;
- fire management as per the guidelines provided in the Queensland Herbarium Regional Ecosystems Descriptions Database (REDD) for the respective regional ecosystems;
- livestock management to minimise grazing impacts; and
- pest animal management including control measures.

2.1.2 Offset area outcomes

- (a) **Site Condition:** The offset area is managed to improve the ecological condition of the vegetation through appropriate management actions as detailed in **Table 8**. These actions include the exclusion of any forestry and/or timber harvesting operations which will allow natural regeneration of canopy and sub-canopy species and protect large hollow bearing trees, weed control and fire management as per the guidelines provided in the Queensland Herbarium Regional Ecosystems Descriptions Database (REDD) for the respective regional ecosystems.
- (b) **Offset Start Condition** scores as shown in **Tables 5A – 5C** align with the scores recorded as the baseline at the monitoring and reporting locations as detailed in **Table 10: Monitoring Sites**. The baseline data is provided in **Attachment 1** of this management plan.
- (c) **Site Context:** the offset area is managed to enable the natural regeneration process of the vegetation and associated habitat to occur and to therefore achieve enhanced connectivity along the Suttor River and Suttor Creek corridors.

2.2 Detailed offset area mapping

The proximity of the offset area to the Dragline Move Project and within the region is illustrated in **Figure 2**. The explicit location of the offset area on Croydon Station and the location of offsets under the EPBC Act and EOP are shown on **Figure 3**.

Figure 2: BMC dragline move Project: Croydon Station and offset area location map

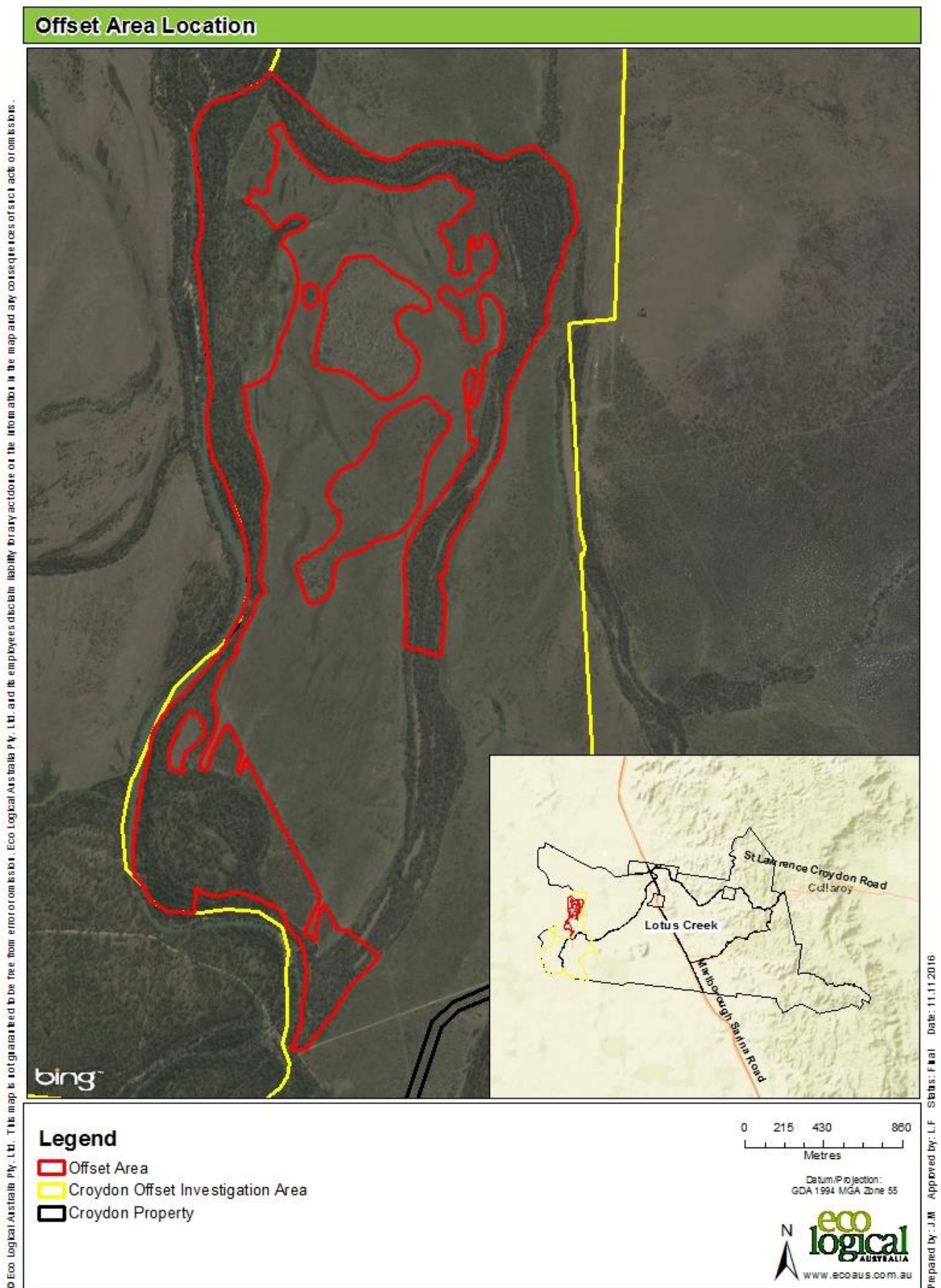
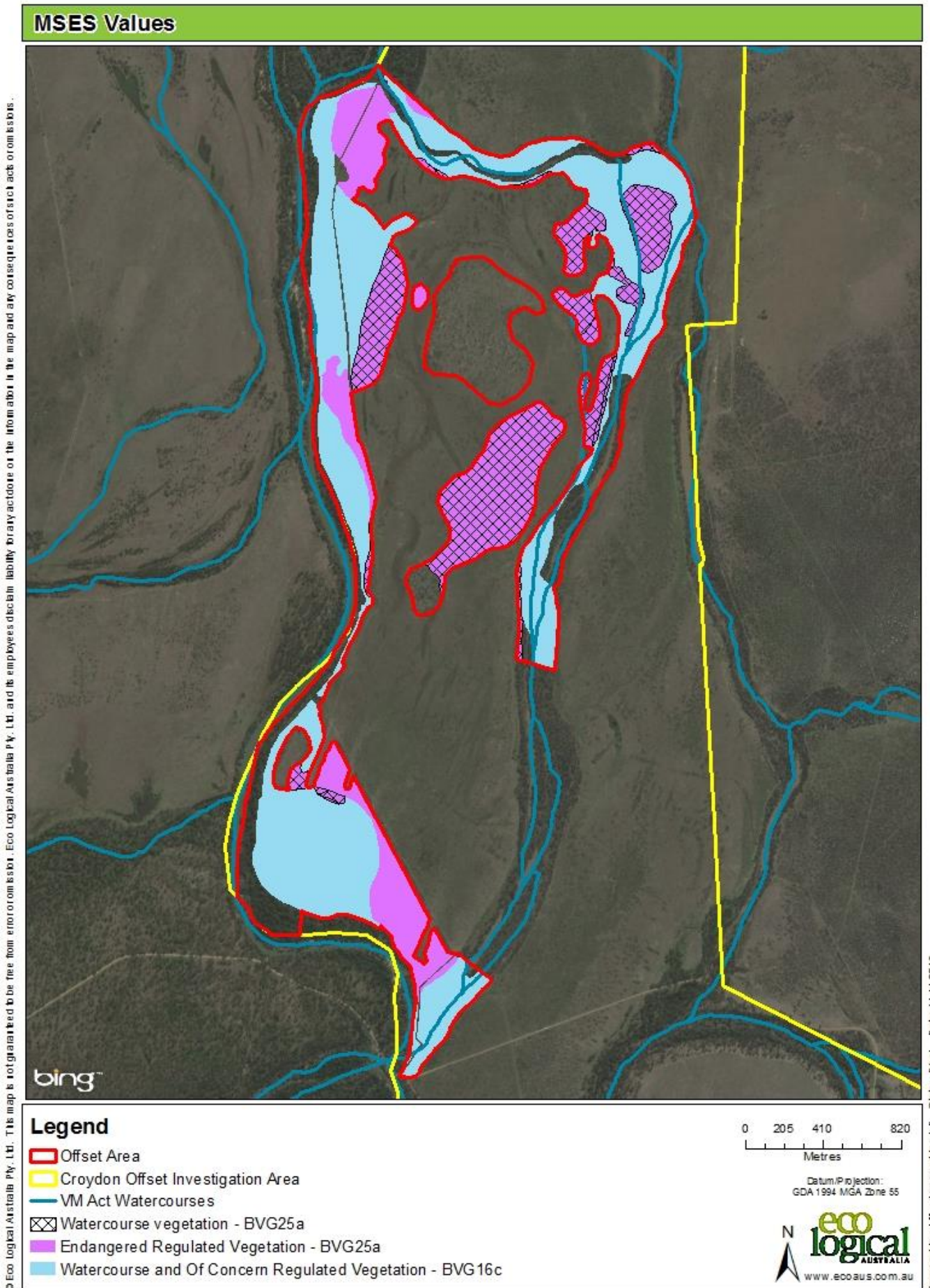


Figure 3: MSES Offset area on Croydon Station



3. Restrictions imposed on the use of the offset area

The restrictions below (**Table 6**) will be implemented within the Offset Area Management Plan (**OAMP**).

Table 6: Offset area restrictions

Restriction	Details
Vegetation clearing is restricted and to be undertaken only by the exemptions in the <i>Vegetation Management Act 1999</i> for point 1	<p>1. Vegetation clearing on the offset area is restricted to:</p> <ol style="list-style-type: none"> a) that necessary for the removal of non-native weeds or declared pests b) ensure public safety c) maintenance of existing roads, fence lines, water pipelines and firebreaks; and d) that necessary to establish and maintain access to Ecological Equivalence assessment and photo point monitoring sites. <p>Where vegetation clearing is sought for any other purpose, the Landholder must contact the relevant department administering the <i>Vegetation Management Act 1999 (Qld)</i>.</p> <p>2. Native forest practice (harvesting of timber for forestry purposes) <u>is not</u> allowed under this Offset Area Management Plan.</p> <p>3. Clearing for new fencing will be on the outside of the offset area boundary or along the property boundary.</p> <p>Note: Any vegetation clearing must be undertaken in accordance with:</p> <ul style="list-style-type: none"> • best practice management methods; and • any applicable legislative requirements. For example, the clearing of endangered, vulnerable or near-threatened plant species or the tampering with animal breeding places under <i>Nature Conservation Act 1992 (Qld)</i> <p>Under the <i>Vegetation Management Act 1999</i>, clearing in Least Concern regional ecosystems for fences, roads or tracks is exempt clearing if it is less than 10 m in width. Any new fences, roads or tracks will be less than 10 m in width for each piece of infrastructure. Clearing to establish or maintain a necessary firebreak to protect infrastructure (other than fences, roads and tracks) to a maximum width of 20 m or 1.5 times the height of the tallest adjacent tree, whichever is the greater.</p>
Grazing	<p>Grazing of domestic livestock (cattle) will occur in the offset area under the following arrangements:</p> <ol style="list-style-type: none"> 1. for fuel reduction purposes only during the dry season; and 2. Graze stock during the dry season, at rates and times necessary to reduce the fuel load in the offset areas with a minimum grass cover to be present at the end of the dry season as follows: <ul style="list-style-type: none"> • Brigalow communities 60% groundcover or 1500kg/ha pasture biomass • Eucalypt Communities 60% groundcover or 850kg/ha pasture biomass. <p>The ground cover is to be determined as per the <i>Land Manager's Monitoring Guide</i> published by the State of Queensland (DERM) 2010 (Attachment 2), or any subsequent published version of this document;</p> 3. the grazing regime should allow native grasses to flower and set seed at least every two years (6-8 week period during the wet/summer season); 4. cattle are excluded from the offset area during the wet season and during the early dry season
Fire	<ol style="list-style-type: none"> 1. Fire is excluded from the offset area except for low intensity ecological burns at the end of the wet season by: <ol style="list-style-type: none"> a) maintaining firebreaks relative to the offset areas; b) using a low intensity fire >7 years interval; and c) firebreaks are to be co-located with roads and fence lines on the property where possible. <p>Note: Fire is not to be used as a tool for regrowth management on the offset areas.</p>

Restriction	Details
Pest animals and weeds	<p>Animal</p> <p>Minimise the introduction of pest animals and control of existing populations of pest animals within the offset area in accordance with <i>the Land Protection (Pest and Stock Route Management) Act 2002</i> (Qld).</p> <ol style="list-style-type: none"> 1. Monitor and manage pest animal populations and subsequently adapt control effort with populations with regards to wild pigs, dogs, foxes and cats. <p>Weeds</p> <ol style="list-style-type: none"> 1. Keep the introduction, establishment and spread of non-native weeds including Declared Pest Plants listed under the <i>Land Protection (Pest and Stock Route Management) Act 2002</i> (Qld) to no more than 10% weed cover over the offset area. 2. Control any existing infestations of non-native weeds including Declared Pest Plants under the <i>Land Protection (Pest and Stock Route Management) Act 2002</i> (Qld) to ensure that the non-native weeds do not cover more than 10% of the offset areas, e.g., Parthenium. 3. Minimise the spread of any non-native pasture species within the offset area in accordance with Table 8: Management Actions. <p>Note: Any weed control required will be undertaken as early as practicable within the natural regeneration process throughout the offset area and then periodically as required to treat the weeds at the optimum time in their life cycles to control and minimise the spread of the existing weed species.</p>

4. Analysis of risks to achieving management objectives and outcomes

The following risk assessment (**Table 7**) has considered:

- any real or potential risks associated with achieving the management objectives and outcomes;
- the actions taken to minimise those risks; and
- remedial action that will be undertaken if any of the risks occur.

Table 7: Risk analysis

Number	Risk	Level of Risk (Extreme, High, Moderate or Low)	Actions to Minimise Risk	Remedial Actions if Risk Occurs
1	Fire	<p>Low</p> <p>The offset area contains both non-remnant (>5 years old) and remnant vegetation although in a degraded condition with a ground layer of mixed native and exotic pasture grasses. Inappropriate fire events will delay the development of more mature trees and affect groundcover however will not destroy the habitat.</p>	<p>Maintaining firebreaks at appropriate widths to enable fires in adjoining areas to be prevented from impacting on the offset area.</p> <p>Manage fuel loads through controlled grazing during the dry season.</p> <p><i>Force majeure</i> events are acknowledged being separate from general fire use practices.</p> <p>Fire control lines to be checked quarterly for condition and adequacy, and maintenance work is to be undertaken biennially at a minimum (i.e. once every two years).</p>	<p>Fire to be excluded wherever possible from the offset area with low intensity fires immediately after the wet season at a >7 year intervals.</p> <p>Remedial action: Destock the offset area, re-establish fire breaks and control lines and if appropriate, widen fire control lines and reassess fuel load reduction practices.</p>
2	Forestry	<p>Low</p> <p>Standard forestry and native timber harvesting practices remove large trees that contain hollows and deadwood from the environment and are hence considered a potential threat to</p>	<p>Forestry and native timber harvesting are excluded from the offset area.</p> <p>Signage along the offset area perimeter informs the public that it is an offset area and that any harvesting of timber is prohibited.</p>	<p>Clearing of native trees will not occur within the offset area.</p> <p>Remedial action: Reassess access protocols for any lessees etc., signage and general access.</p>

Number	Risk	Level of Risk (Extreme, High, Moderate or Low)	Actions to Minimise Risk	Remedial Actions if Risk Occurs
		the quality of the vegetation community, habitat and to the accumulation of groundcover.		
3	Grazing	<p>Low</p> <p>Low groundcover and shrubs provide habitat and cover for the Squatter Pigeon (southern). High density grazing destroys shrubs and native grass cover and slows the regeneration of the habitat.</p> <p>The natural condition of the native ground cover is a moderate cover and hence any grazing undertaken is to be enable the retention of a minimum of 60% grass cover at the end of the dry season.</p>	<p>Grazing of domestic livestock will occur in the offset area during the dry season for fuel reduction purposes with a minimum grass cover to be present at the end of the dry season as follows of 20%.</p> <p>Offset area boundary fencing to be inspected quarterly and maintained in a stock proof condition.</p>	<p>Grazing is determined by the amount of dry matter available and is used conservatively for that necessary for fuel reduction purposes only.</p> <p>Remedial action: Any entry points due to fencing breaks etc. to be repaired to a stock proof condition as soon as possible and within 30 days.</p>
4	Erosion	<p>Low</p>	<p>Maintain grass cover at levels specified in (3) above at the end of the dry season. This will ensure groundcover is high due to the presence of fallen woody debris, organic matter etc. thus minimising the risk of sheet erosion.</p>	<p>Remedial action: Further reduction of grazing levels and inspections to identify the cause of any point source erosion (such as illegal vehicle access), and rectifying accessibility as required.</p>
5	Drought	<p>Low</p> <p>The risk posed by drought would also increase the likelihood of fire due to the dry conditions and accumulated fuel loads.</p>	<p>Maintain fire control lines and manage grazing levels according to the amount of dry matter available for grazing.</p>	<p>Remedial action: Allow offset area to recover post drought/fire, particularly through the control of weeds. Maintaining grass cover at levels specified in (3) above at the end of the dry season.</p>

5. Management actions

The following table (**Table 8**) identifies the actions which will be undertaken for the offset area, by whom, when and more specific information relating to the action. It is noted that all costs and responsibilities associated with the implementation of the management plan rests with the landholder. The cost of monitoring and reporting (section 6) lies wholly with BMC.

Table 8: Schedule of management actions

Management action	How the action will be carried out	Where the action will be carried out	When the action will be carried out	Who will be carrying out the action	Progress/ measurable outcomes	Comments/ corrective actions
<p>Forestry Operations, Native Timber Harvesting and general vegetation impacts</p> <p>Consistent with the risk of clearing as identified in the Brigalow Conservation Advice and Draft Recovery Plan, Conservation Advice for Reptiles of the Brigalow Belt and Conservation Advice for the Squatter Pigeon (Southern)</p>	<p>4. Vegetation clearing on the offset area is restricted to:</p> <ul style="list-style-type: none"> e) that necessary for the removal of non-native weeds or declared pests f) ensure public safety g) maintenance of existing roads, fence lines, water pipelines and firebreaks; and h) that necessary to establish and maintain access to BioCondition assessment and photo point monitoring sites. <p>Where vegetation clearing is sought for any other purpose, the Landholder must contact the relevant department administering the <i>Vegetation Management Act 1999 (Qld)</i>.</p> <p>5. Native forest practice (harvesting of timber for forestry purposes) <u>is not</u> allowed under this Offset Area Management Plan.</p> <p>6. Clearing for new fencing will be on the outside of the offset area boundary or along the property boundary.</p> <p>Note: Any vegetation clearing must be undertaken in accordance with:</p> <ul style="list-style-type: none"> • best practice management methods; and • any applicable legislative requirements. For example, the clearing of endangered, vulnerable 	<p>Only in those areas subject to non-native weed control, fire control lines and fences.</p>	<p>Vegetation clearing for approved purposes may occur as required.</p>	<p>Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder.</p>	<p>No evidence of recent forestry or timber harvesting activities are evident during term of the offset area management plan.</p> <p>Vegetation clearing for any purpose to be recorded as part of the quarterly inspection conducted by the Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder.</p> <p>Trigger for remedial action and reassessment of the management actions detailed: detection of illegal clearing</p>	<p>Upon being notified or becoming aware of prohibited vegetation clearing in the offset area, the Landholder is to reassess access protocols for any lessees etc. and general access within one fortnight.</p> <p>The Offset Area Report will document any known prohibited vegetation clearing that has occurred during the reporting period and the correlating responsive actions.</p> <p>Residual Risk: Low</p>

Management action	How the action will be carried out	Where the action will be carried out	When the action will be carried out	Who will be carrying out the action	Progress/ measurable outcomes	Comments/ corrective actions
	<p>or near-threatened plant species or the tampering with animal breeding places under <i>Nature Conservation Act 1992 (Qld)</i></p> <p>Under the <i>Vegetation Management Act 1999</i>, clearing in Least Concern regional ecosystems for fences, roads or tracks is exempt clearing if it is less than 10 m in width. Any new fences, roads or tracks will be less than 10 m in width for each piece of infrastructure. Clearing to establish or maintain a necessary firebreak to protect infrastructure (other than fences, roads and tracks) to a maximum width of 20 m or 1.5 times the height of the tallest adjacent tree, whichever is the greater.</p>					
<p>Fire</p> <p>Consistent with the risk of inappropriate fire regimes as identified in the Brigalow Conservation Advice and Draft Recovery Plan, Conservation Advice for Reptiles of the Brigalow Belt and Conservation Advice for the Squatter Pigeon (Southern)</p>	<p>2. Fire is to be excluded from the offset area except for low intensity ecological burns at the end of the wet season by:</p> <p>d) maintaining firebreaks relative to the offset areas;</p> <p>e) using a low intensity fire >7 years interval; and</p> <p>f) firebreaks are to be co-located with roads and fence lines on the property where possible.</p> <p>Note:</p> <p>Fire is not to be used as a tool for regrowth management on the offset areas.</p>	<p>May be undertaken throughout the offset areas.</p>	<p>All fire (apart from force majeure events) will be excluded from the offset area during Squatter pigeon (southern) breeding and nesting times being mostly the dry season (April to October).</p> <p>Fire control lines must be inspected quarterly. Maintenance must be undertaken as required and at</p>	<p>Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder.</p> <p>The undertaking of an ecological burn will be by a suitably qualified person in consultation with an ecologist.</p>	<p>Evidence of fire is not observed during the term of the offset area management plan, except for prescribed low intensity ecological burns.</p> <p>Any observed incidence of wild fire, prohibited burning or force majeure events will be recorded during quarterly inspections conducted by the Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder.</p>	<p>Upon being notified or becoming aware of prohibited fire in the offset area, the Landholder is to reassess access protocols for any lessees etc., signage and general access within one fortnight.</p> <p>After any occurrence of fire in the offset area, the Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder will:</p> <ol style="list-style-type: none"> inspect and repair, and widen if necessary, all firebreaks; and reassess fuel load reduction practices; and exclude grazing until the grass cover present at the

Management action	How the action will be carried out	Where the action will be carried out	When the action will be carried out	Who will be carrying out the action	Progress/ measurable outcomes	Comments/ corrective actions
			<p>least every two years.</p> <p>If fire is used, it must be a low intensity fire at >7 years interval immediately after the end of the wet season, which is generally March to April. Ecological burns should not cover more than 30% of the offset area.</p>		<p>Trigger for remedial action and reassessment of the management actions detailed: destruction of regrowth, fallen timber and the occurrence of deliberately lit hot fires</p>	<p>end of the dry season is a minimum:</p> <ul style="list-style-type: none"> ○ Brigalow communities 60% groundcover or 1500kg/ha pasture biomass ○ Eucalypt Communities 60% groundcover or 850kg/ha pasture biomass. <p><i>Note that groundcover is used to accommodate the change in the structure of the community over time from pasture to a reginal ecosystem</i></p> <p>Grass cover measurements must be in accordance with the methodology stated in the <i>Land Manager's Monitoring Guide</i> (Department of Environment and Resource Management, 2010) (DERM)ⁱ (or any subsequent published version of this document) as attached to the OAMP, or any subsequent published version of this document.</p> <p>If a low intensity ecological burn exceeds 30% of the offset area, then control measures to contain the fire are to be implemented immediately. Controlled back burning from the next fire control line is the preferred method.</p>

ⁱ *Land Manager's Monitoring Guide: Ground cover indicator*, Department of Environment and Resource Management, 2010, Queensland Government, Brisbane, available at <http://qldgov.softlinkhosting.com.au/liberty/opac/search.do#>

Management action	How the action will be carried out	Where the action will be carried out	When the action will be carried out	Who will be carrying out the action	Progress/ measurable outcomes	Comments/ corrective actions
						<p>The Offset Area Report will document any known incidences of fire that have occurred during the reporting period and the correlating responsive actions.</p> <p>Residual Risk: Low</p>
<p>Fencing</p> <p>Consistent with the risk of excess fire as identified in the Brigalow Conservation Advice and Draft Recovery Plan, and overgrazing as identified in the Conservation Advice for Reptiles of the Brigalow Belt and Conservation Advice for the Squatter Pigeon (Southern)</p>	<p>Install and routinely inspect fencing to secure the offset area and prevent unauthorised access.</p>	<p>All external boundaries of the offset area. Where the boundary coincides with the property boundary, the fence may align with the property boundary. A fenced area may include non-offset areas.</p>	<p>Fencing of offset areas will be established within three months of the Queensland Government approving the voluntary declaration.</p> <p>If cattle are grazing the offset area, fencing must be inspected monthly. During non-grazing periods, fencing must be inspected quarterly.</p>	<p>Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder.</p>	<p>Quarterly inspections will identify if fences are preventing cattle and unauthorised people from accessing the offset area. These inspections may be conducted by the Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder.</p> <p>Trigger for remedial action and reassessment of the management actions detailed: detection of illegal access, cattle grazing out of allowed times and thresholds, overgrazing</p>	<p>Upon being notified or becoming aware of an unsecure offset area, the Pastoral Manager is to undertake fence maintenance and repairs to resecure the offset area as soon as possible and within 30 days.</p> <p>The Offset Area Report will document the installation, maintenance and repair of fences during the reporting period.</p> <p>Residual Risk: Low</p>

Management action	How the action will be carried out	Where the action will be carried out	When the action will be carried out	Who will be carrying out the action	Progress/ measurable outcomes	Comments/ corrective actions
<p>Following extreme weather conditions of drought, flood and cyclones</p> <p>Consistent with the general risks as identified in the Brigalow Conservation Advice and Draft Recovery Plan, Conservation Advice for Reptiles of the Brigalow Belt and Conservation Advice for the Squatter Pigeon (Southern)</p>	Determine the extent of damage to the offset area and fencing caused by the event.	Throughout the offset area with attention paid to riparian areas and the boundary fencing.	As soon as safely possible post a flood or cyclone event. For a drought event, inspections must be monthly.	Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder.	<p>Within one week after the cessation of a flood or cyclone event, an inspection conducted by the Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder will determine if the offset area is secure.</p> <p>During drought events, monthly inspections will be conducted by the Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder to record the vegetation condition in the offset area.</p>	<p>Upon being notified or becoming aware of flood and cyclone event occurring in offset area, the Pastoral Manager is to undertake fence maintenance and repairs to resecure the offset area within one fortnight.</p> <p>Upon being notified or becoming aware of a drought event occurring in offset area, the Pastoral Manager is to remove cattle from the offset area within one fortnight.</p> <p>The Offset Area Report will document the repair of fences and removal of cattle from offset areas, because of extreme weather conditions, during the reporting period.</p> <p>Residual Risk: Low</p>

Management action	How the action will be carried out	Where the action will be carried out	When the action will be carried out	Who will be carrying out the action	Progress/ measurable outcomes	Comments/ corrective actions
<p>Grazing</p> <p>Consistent with the risk of excess fire as identified in the Brigalow Conservation Advice and Draft Recovery Plan, and overgrazing/habitat destruction as identified in the Conservation Advice for Reptiles of the Brigalow Belt and habitat destruction and food competition Conservation Advice for the Squatter Pigeon (Southern)</p>	<p>Stocking rates are not fixed as this region is subject to significant changes in grass cover with seasonal conditions.</p> <p>The use of cattle in larger numbers for a short period of time in the late dry season and prior to the wet season and if required, again during winter is the preferred method of controlled grazing.</p> <p>Fire and grazing management relating to the Ornamental Snake offset area: A fire in the offset area is foreseen under one of two scenarios:</p> <ol style="list-style-type: none"> a natural event beyond the control of the approval holder or the landholder a low intensity ecological burn permitted by the Pastoral Manager, Landholder or suitably qualified person appointed by the Landholder <p>A low intensity ecological burn permitted under the OAMP may not occur more frequently than once every seven years and the timing of such burns may only occur immediately after the end of the wet season (usually March or April). Furthermore, these low intensity ecological burns are prohibited during the Squatter Pigeon (southern) breeding and nesting times (i.e. the dry season). Consequently,</p>	<p>Stock will be grazed in the offset areas for fuel reduction purposes only during the dry season.</p>	<p>As required when grass fuel loads exceed 50% during the dry season.</p> <p>The dry season is normally between April and October; however, if unseasonal rainfall should occur, then grazing is to be allowed only if there is no evidence of moisture in the stream order 1 gullies to ensure that “pugging” of the soil by livestock does not occur.</p>	<p>Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder.</p>	<p>During grazing periods, monthly inspections will be conducted by the Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder to record the minimum grass cover and security (i.e. fences) of the offset area.</p> <p>Graze stock during the dry season, at rates and times necessary to reduce the fuel load in the offset areas with a minimum grass cover to be present at the end of the dry season as follows:</p> <ul style="list-style-type: none"> Brigalow communities 60% groundcover or 1500kg/ha pasture biomass Eucalypt Communities 60% groundcover or 850kg/ha pasture biomass. <p><i>Note that groundcover is used to accommodate the change in the structure of the community over time from pasture to a reginal ecosystem</i></p>	<p>Upon being notified or becoming aware of grass cover falling below the stated percentage in the offset area, the Pastoral Manager is to remove cattle from the offset area within one fortnight. Grazing period may recommence when the grass cover has increased to the levels listed for each RE using the methodology in the <i>Land Manager's Monitoring Guide</i> (DERM, 2010) as attached, or any subsequent published version of this document.</p> <p>Upon being notified or becoming aware of cattle causing significant adverse impacts to low-lying offset areas, the Pastoral Manager is to remove cattle from the offset area within 72 hours.</p> <p>Upon being notified or becoming aware of an unsecure offset area, the Pastoral Manager is to undertake fence maintenance and repairs to resecure the offset area within one fortnight.</p> <p>The Offset Area Report will document the grazing periods that occurred in the offset areas during the reporting period and the correlating responsive actions that</p>

	<p>the opportunity to conduct low intensity ecological burns will be very infrequent.</p> <p>Throughout the offset area, management actions for fire and grazing are interlinked due to the necessity to manage increased fuel loads that will establish as a consequence of reduced grazing intensity. As Brigalow trees in the offset area establish and mature, their resulting canopy cover will naturally diminish the fuel load as Buffel grass will decline in extent as the canopy cover increases. Until such time, intervention in the form of both low intensity grazing and infrequent low intensity ecological burns will achieve this outcome.</p> <p>The use of stock grazing in the Ornamental Snake offset area has the potential to adversely impact on the species' habitat <i>if poorly managed</i>. At the time of the ecological survey, stock grazing in the offset area was permitted and the area was assessed as suitable habitat for the Ornamental Snake. Therefore the continued use of stock in the area, albeit with a more restricted approach, is expected to support the enhancement of the offset area.</p> <p>The management actions seek to avoid adverse impacts by monitoring the offset area more frequently during grazing periods. The Ornamental Snake offset area is comprised of regional ecosystems (RE) 11.3.1, 11.4.9, 11.3.3 and 11.3.4. Stock occupation will impact on grass cover, therefore upon a predefined minimum grass cover percentage being reached in each of these communities, stock must be removed from the offset area. Stock may not be reintroduced unless the grass cover (again) exceeds 80% during the dry season. Importantly, any sign of significant adverse impacts to low-lying offset areas as a result</p>				<p>No evidence of "pugging" is to occur in stream order 1 gullies.</p> <p>Trigger for remedial action and reassessment of the management actions detailed: detection of cattle grazing out of allowed times and thresholds, overgrazing, pugging from cattle in wet conditions</p>	<p>occurred as part of grazing management.</p> <p>Residual Risk: Low</p>
--	--	--	--	--	---	---

Management action	How the action will be carried out	Where the action will be carried out	When the action will be carried out	Who will be carrying out the action	Progress/ measurable outcomes	Comments/ corrective actions
	<p>of stock use (e.g. pugging) will trigger the removal of stock from the offset area.</p> <p>The allowance of stock to the offset area triggers a higher management intensity to mitigate the increased risk of adverse impacts. This management approach will identify adverse impacts as they arise and trigger remedial action as necessary. The success of stock grazing in the Ornamental Snake offset area will become apparent during the first dry season under offset area management in either 2017 or 2018 (management actions will commence upon grant of the voluntary declaration).</p>					

Management action	How the action will be carried out	Where the action will be carried out	When the action will be carried out	Who will be carrying out the action	Progress/ measurable outcomes	Comments/ corrective actions
<p>Pest animals</p> <p>Consistent with the risk of habitat damage and predation identified in the Conservation Advice for Reptiles of the Brigalow Belt and Conservation Advice for the Squatter Pigeon (Southern)</p>	<p>Minimise the introduction of pest animals and control of existing populations of pest animals (wild dogs, pigs, feral cats and foxes) within the offset areas in accordance with the <i>Land Protection (Pest and Stock Route Management) Act 2002</i> (Qld).</p> <p>Wild pig, deer and dog populations are generally small and highly transient, and therefore the scale of impact is small. Major damage to the environment/habitat occurs when large numbers of animals congregate in the area.</p> <p>Current control of pigs and wild dogs is undertaken via a baiting program on the property. Additional to this measure, the Pastoral Manager, during quarterly inspections of the offset area may remove any wild pigs, deer or wild dogs that are seen. If an increase in pig, deer or dog activity is noted, an additional trapping, baiting and/or control program is to be instigated until the increased activity has ceased.</p> <p>There was no evidence of extensive damage from deer, foxes, rabbits or wild cats detected during surveys as part of the Environmental Impact Assessment, however, if the occurrence of these animals is detected, a control program integrated with that for wild pigs and dogs will be implemented.</p>	All offset areas.	<p>Preferably in the winter and spring months to minimise impacts to the Squatter Pigeon (southern) during breeding and nesting.</p> <p>Destruction of wetland habitat by feral pigs is also a threat to the Ornamental Snake, along with the associated destruction of frog habitat and direct competition for their food source (frogs).</p> <p>When a group of animals is observed, a control program will be implemented. The timing of control program will address the threats to both species.</p>	Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder.	<p>Quarterly inspections to record the presence of wallow holes, tracks and visual incidents in the offset area. These inspections may be conducted by the Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder.</p> <p>Baseline levels for pest animals are not able to be established due to the transient nature of the animals. Numbers are established via visual signs recorded during quarterly inspections.</p> <p>Trigger for remedial action and reassessment of the management actions detailed: detection of large numbers of feral animals as per the thresholds detailed</p>	<p>Upon being notified or becoming aware of pest animals causing damage to the offset area, the Pastoral Manager is to implement pest control measures within one month.</p> <p>If twelve or more half grown and/or mature wild pigs, deer or dogs are noted during the quarterly inspections, then a control program will be initiated. The Croydon Station Pastoral Manager or Landholder may approach neighbouring landowners to discuss the increased pest animal presence and an integrated control program may be developed.</p> <p>The Offset Area Report will document the indications or sightings of pest animals during the reporting period and the correlating responsive actions.</p> <p>Residual Risk: Low</p>

Management action	How the action will be carried out	Where the action will be carried out	When the action will be carried out	Who will be carrying out the action	Progress/ measurable outcomes	Comments/ corrective actions
<p>Pest plants (i.e. weeds)</p> <p>Consistent with the risk of excess fire from excessive weed cover as identified in the Brigalow Conservation Advice and Draft Recovery Plan as at section 5.1.3, and and competition food sources and inappropriate habitat as per the Conservation Advice for the Squatter Pigeon (Southern) at section 5.1.4</p>	<p>Keep the introduction, establishment and spread of non-native weeds including Declared Pest Plants listed under the <i>Land Protection (Pest and Stock Route Management) Act 2002</i> (Qld) to less than 10% weed cover in the offset area.</p> <p>Control existing infestations of non-native weeds including declared pest plants under the <i>Land Protection (Pest and Stock Route Management) Act 2002</i> (Qld) to ensure that the non-native weeds cover less than 10% of the offset area (e.g., Parthenium).</p> <p>Buffel Grass is recognised as being a threat to the vegetation communities and habitat in the offset area however is not referred to as a weed as it is not declared in the <i>Land Protection (Pest and Stock Route Management) Act 2002</i> (Qld). Control measures such as grazing and increasing canopy cover of vegetation are included in this plan to decrease the extent of Buffel Grass over time. Control of Buffel Grass is best managed via grazing during the dry season and increasing tree canopy cover.</p> <p>Spot spraying of patches of Parthenium is permitted.</p>	Throughout the offset area	Weed control will be undertaken as early as practicable within the natural regeneration process throughout the offset areas and then periodically as required to treat the weeds at the optimum time in their life cycles to control and minimise the spread of the existing weed species.	<p>Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder.</p> <p>Trigger for remedial action and reassessment of the management actions detailed: pest plants are present/cover more than 10% of the offset area</p>	<p>Quarterly inspections will be conducted by the Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder to observe and record the presence of weeds and success of previously applied weed control measures. The inspection will include before and after photos of the weed control area. The field data sheets provided in Appendix A may assist with documenting weed presence and control measures.</p> <p>Quarterly inspections will be conducted by the Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder to record the minimum grass cover in the offset area. The following grass cover is to be present at the end of the dry season as a minimum:</p> <ul style="list-style-type: none"> Brigalow communities 60% groundcover or 	<p>Upon being notified or becoming aware of pest plants being present in greater than 10% of the offset area, the Pastoral Manager is to implement pest control measures within one month. These measures may include, and are not limited to:</p> <ul style="list-style-type: none"> foliar spraying; basal bark spraying; stem injection; cut stump; cut and swab; stem scraper; and wick applicators. <p>The Offset Area Report will document the weed presence, weed control measures and extent of grass cover during the reporting period and the correlating responsive actions.</p> <p>Residual Risk: Low</p>

Management action	How the action will be carried out	Where the action will be carried out	When the action will be carried out	Who will be carrying out the action	Progress/ measurable outcomes	Comments/ corrective actions
					<p>1500kg/ha pasture biomass</p> <ul style="list-style-type: none"> Eucalypt Communities 60% groundcover or 850kg/ha pasture biomass. <p><i>Note that groundcover is used to accommodate the change in the structure of the community over time from pasture to a reginal ecosystem</i></p>	



Figure 4: Pasture cover in Brigalow regrowth at 1500kg/ha¹



Figure 5: Pasture cover in eucalypt woodland at 850kg/ha

¹<https://futurebeef.com.au/knowledge-centre/pastures-forage-crops/pasture-photo-standards/>

6. Monitoring requirements

Monitoring of the offset area will occur in accordance with **Table 9**. It is noted that all costs and responsibilities associated with the implementation, and monitoring and reporting of the management plan rests with BMC. Monitoring locations are listed in **Table 10** and shown in **Figure 6**.

6.1 Performance indicators

The management actions in **Table 8** will enhance the habitat quality throughout the offset area. Each scheduled ecological condition assessment will be the tool to compare the habitat quality to previous surveys and assess performance of the offset area.

The results of the monitoring program will inform adaptive management of the offset area so that over time there will be no net loss to the extent and an improvement in condition of the ecological community and habitat. The monitoring will demonstrate an improvement over time of the ecosystem functionality and condition for the Brigalow ecological community and habitat for the Ornamental Snake and Yakka Skink as defined in the relevant Approved Conservation Advices. Noting that external environmental/climatic factors will influence the condition scores at particular points in time, the ecological condition assessment completed in years 2021, 2026 and 2031 will compare the habitat quality to previous surveys and assess performance of the offset area.

Table 9: Schedule of monitoring – offset area, Croydon Station

Monitoring	Attributes monitored	Frequency	Method	Location/s
Surveys undertaken by Ecologists				
Baseline assessment	Refer 'ecological condition' below	Completed in 2016 and is an input into the OAMP	Field observations, vegetation assessment as per the <i>Guide to determining terrestrial habitat quality – a toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy (version 1.1 December 2014)</i> (DEHP, 2014) *	Sites listed at <i>Table 10</i> of the OAMP.
Ecological condition	Recruitment of woody perennial species in EDL	Every five years to, and including, year 2031 (i.e. 2021, 2026 and 2031); reported every 5 years	Field observations, vegetation assessment as per the <i>Guide to determining terrestrial habitat quality – a toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy (version 1.1 December 2014)</i> (DEHP, 2014)*.	Sites listed at <i>Table 10</i> of the OAMP.
	Native plant species richness – trees			
	Native plant species richness – shrubs			
	Native plant species richness - grasses			
	Native plant species richness – forbs			
	Tree canopy height			
	Tree canopy cover			
	Shrub canopy cover		Data for each of the ecological condition attributes monitored will be collected at each site listed in <i>Table 10</i> of the OAMP and reported on and presented in a sequential manner (including previous data collected) to quantify change from the benchmark collected in 2015. This will record the change in each attribute measured and hence the condition of the ecological community and habitat, thus enabling a statistical comparison to previous years' data and the progression of the offset site condition and EPBC Offset Assessment Guide Calculator inputs.	

Monitoring	Attributes monitored	Frequency	Method	Location/s
	Native perennial grass cover			
	Organic litter			
	Large trees			
	Coarse woody debris			
	Non-native plant cover			
Landholder/Pastoral Manager/Authority Holder Records				
<i>Record keeping commences within three months of the Queensland Government approving the voluntary declaration</i>				
Photo points	General vegetation condition	Every April in Year 2, Year 4, and Year 5 (i.e. 2018, 2020 and 2021) and then every five years to (and including) year 2031	Pastoral Manager, Landholder or suitable qualified person appointed by the Landholder will undertake quarterly inspections of the offset area to observe and record grass cover levels, pest plants, accessibility (i.e. condition of fencing), signage, evidence of fire and evidence of pest animal incursion. The inspection records will serve as the primary data source for the Offset Area Report.	Sites listed at <i>Table 10</i> of the OAMP.
Grazing	Stocking rates Grass cover Pugging of the soil by livestock	Monitored monthly during grazing periods and reported in reporting detailed above.	Photo points to be undertaken as per the method described in the <i>Land Manager's Monitoring Guide</i> (DERM, 2010) (or any subsequent published version of this document) provided at Attachment 2 of the OAMP.	Within offset areas
Fire	Occurrence, control measures implemented, timing and result of the control measures	Monitored as required by fire events (at least annually) and activity reported in reporting detailed above.		
Pest plants	Occurrence, control measures implemented, timing and the result of the control measures	Monitored in conjunction with photo point monitoring and reported in reporting detailed above.		
Pest animals	Occurrence, control measures implemented, timing and the result of the control measures	Monitored quarterly and reported in reporting detailed above.		
Access and signage	Condition and functionality of fences and signage	Monitored quarterly and reported in reporting detailed above.		

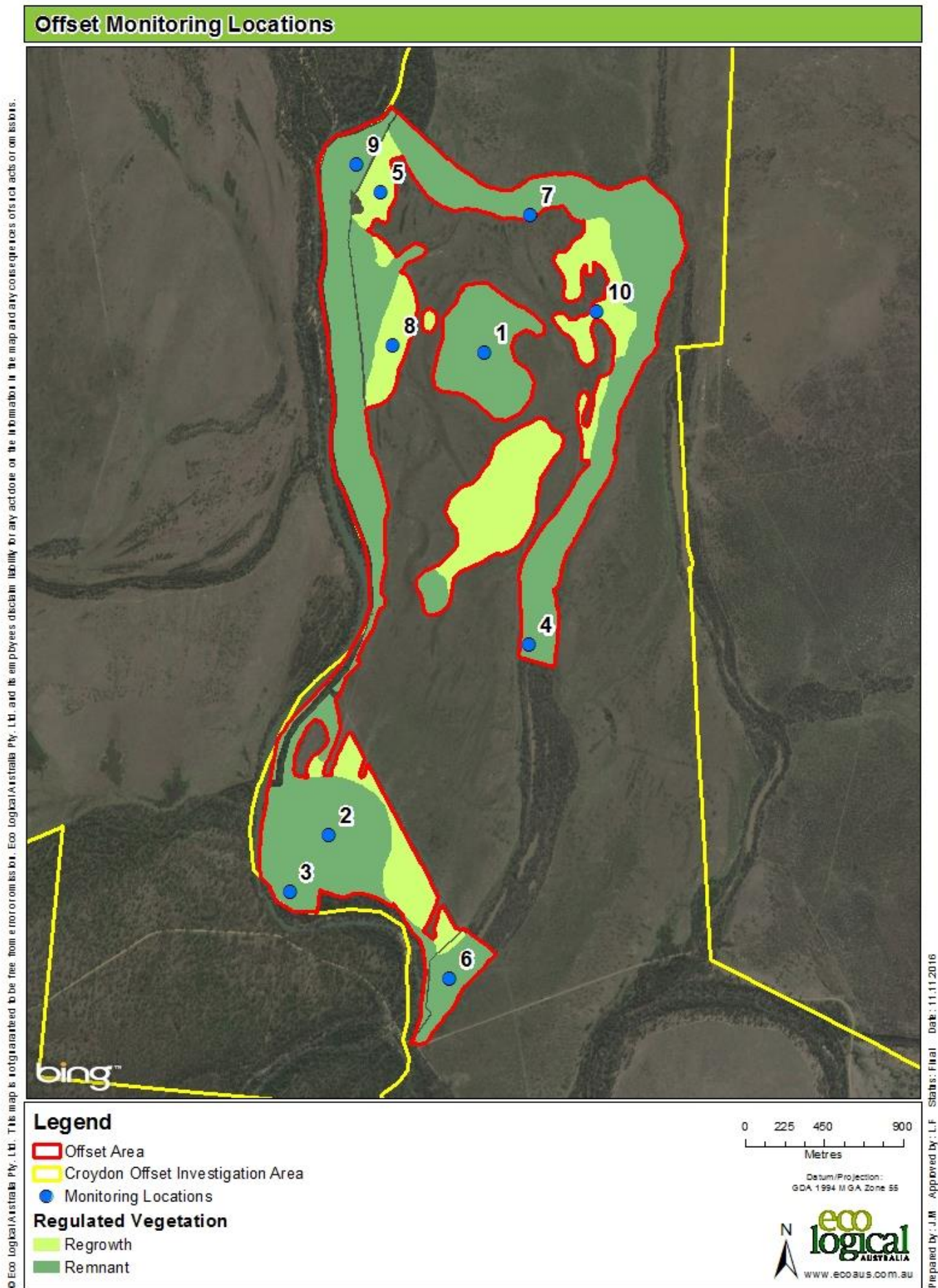
*A methodology for assessing ecological condition published subsequent to the *Guide to determining terrestrial habitat quality – a toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy (version 1.1 December 2014)* (DEHP, 2014) that captures the required scope of information may be used.

Table 10: Monitoring sites

Coordinates system: GDA_1994_MGA_Zone_55

Site number	Regional Ecosystem	Condition	Location - easting	Location - northing
1	11.5.3	Remnant	705708.42	7523475.89
2	11.3.4	Remnant	704709.00	7520768.16
3	11.3.25	Remnant	704474.36	7520453.95
4	11.3.27	Remnant	705895.19	7521804.69
5	11.4.9	Regrowth	705150.69	7524412.11
6	11.3.3	Remnant	705367.84	7519922.25
7	11.3.1	Remnant	705999.27	7524253.02
8	11.3.1	Regrowth	705186.50	7523538.29
9	11.4.9	Remnant	705022.76	7524576.68
10	11.3.3	Remnant	706354.00	7523683.09

Figure 7: Locations of Monitoring Points



7. Reporting

In alignment with the Caval Ridge Offset Monitoring Program, a Before and After Control Intervention (BACI) design is recommended for condition monitoring to enable comparison of changes in vegetation condition against baseline data collected on the offset site.

This will measure changes affected by interventions and the variability due to climatic conditions to prove a useful management measure of the amount and need for intervention measures. Given the length of management, an adaptive management approach will be used to provide a suitable level of management based on the monitoring outcomes. Management activities will be adjusted based on monitoring outcomes of the measured criteria.

BMC will report on the offset area management and submit the reports to the Commonwealth and State administering authorities every 2 years for the first 4 years for the life of this plan and thereafter each 5 years, starting at year 5 (2020), for the life of this plan (i.e. until 2031) (Table 11).

Table 11: Schedule of reporting – offset area, Croydon Station

Report Details	Reporting period	Submission due date
Offset Area Report detailing photo point and management actions	From grant of voluntary declaration to 28 April 2018	30 June 2018
Offset Area Report detailing photo point and management actions	1 May 2018 – 30 April 2020	30 June 2020
Offset Area Report detailing photo point and management actions	1 May 2020 – 30 April 2021	30 June 2021
Ecological condition assessment to accompany the Offset Area Report to cover the preceding 5 years	From grant of voluntary declaration to 30 April 2021	30 June 2021
Ecological condition assessment to accompany the Offset Area Report to cover the preceding 5 years	1 May 2021 – 30 June 2026	30 June 2026
Ecological condition assessment to accompany the Offset Area Report to cover the preceding 5 years	1 May 2026 – 30 June 2031	30 June 2031

8. Consent

Administering authority

SIGNED by the <insert name, position> to indicate approval of the Offset Area Management Plan.

Name:

Signature:

Witness name:

Signature:

Date:

Landholder

The Landholder agrees:

1. A non-compliance with the requirements of this Offset Area Management Plan shall constitute a breach of the terms and conditions of the legally-binding mechanism entered into.
2. To notify the State in writing of an Event, or the likelihood of the occurrence of an Event.
Event means any agreement or understanding entered into, or accepted by and/or circumstance permitted or suffered by the landholder which effects a change of ownership, control or use of the offset area, the exercise of power of sale under any Mortgage, the granting of a Mortgage, the appointment of a receiver, the death of a landholder or any other circumstance which may allow or permit a person, other than the landholder to own, control or use the offset area.
In notifying the State of an Event, the landholder will notify the State of the nature of the change, or potential change of ownership, control or use result from the Event, and the name and address of any person who may own, control or use the offset area as a result of the Event.
3. That if, at the time of execution of this Offset Area Management Plan, there exists a Property Map of Assessable Vegetation (PMAV) over the offset area or a part of it, the landholder hereby agrees, where the management plan area is identified as Category X on the PMAV, to the replacement of the PMAV by the State to reflect the offset area as Category A.
4. To take all necessary steps as may be required to accomplish the obligations contained in this Offset Area Management Plan.

The Landholder acknowledges:

5. That before the State will agree to the release this Offset Area Management Plan the State must be satisfied that the results of the ecological assessments demonstrate achievement of the objectives contained in this Offset Area Management Plan.

The Landholder notes:

6. All reports, notices or requests for amendment in relation to this Offset Area Management Plan must be in writing and delivered to the administering authority at the following address:
<Insert departmental name>
<Insert postal address and telephone number>

SIGNED by *Jennifer Alison Acton* being the current owner of the abovementioned property to indicate that the terms of this Offset Area Management Plan including responsibilities under the Offset Area Management Plan, have been read, understood and accepted.

Name: Jennifer Alison Acton

Signature:

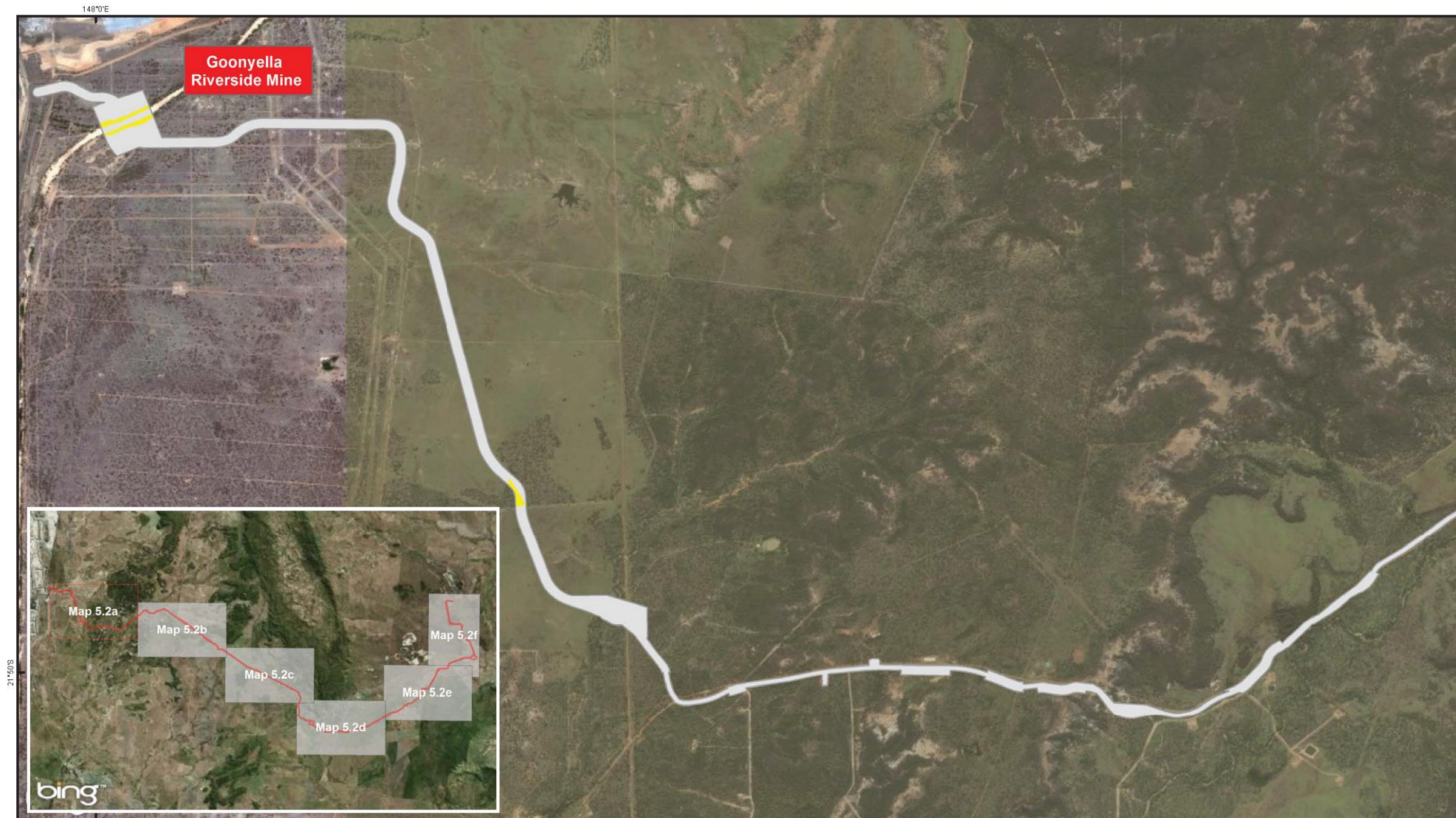
Witness name:

Signature:

Date:

Appendix A: Location of MNES within Dragline Move Project disturbance footprint

Appendix A1: Impact Area Mapping – Ornamental Snake



Notes:
 © Biodiversity Assessment and Management Pty Ltd. While every care is taken to ensure the accuracy of this data, Biodiversity Assessment and Management makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.
 Data Source: Image from ArcGIS Online Bing Maps data (c) 2010 Microsoft Corporation and its data suppliers. Regional Ecosystems V7 and RE Waterways sourced from QLD Government 2012.

Coordinate System: GCS_GDA_1994
 Datum: GDA 1994
 Unit: Degree



1:30,000 at A4
 0 165 330 660 990 1,320
 Meters

LEGEND

- | | |
|---------------------------------|------------------------------|
| Ornamental Snake Habitat | Dragline Corridor Revision C |
| Essential Habitat | Temporary Shutdown Areas |
| Unlikely Habitat | |

Figure: 5.2a
Title: Modelled and ground-truthed Ornamental Snake habitat within the Dragline Route

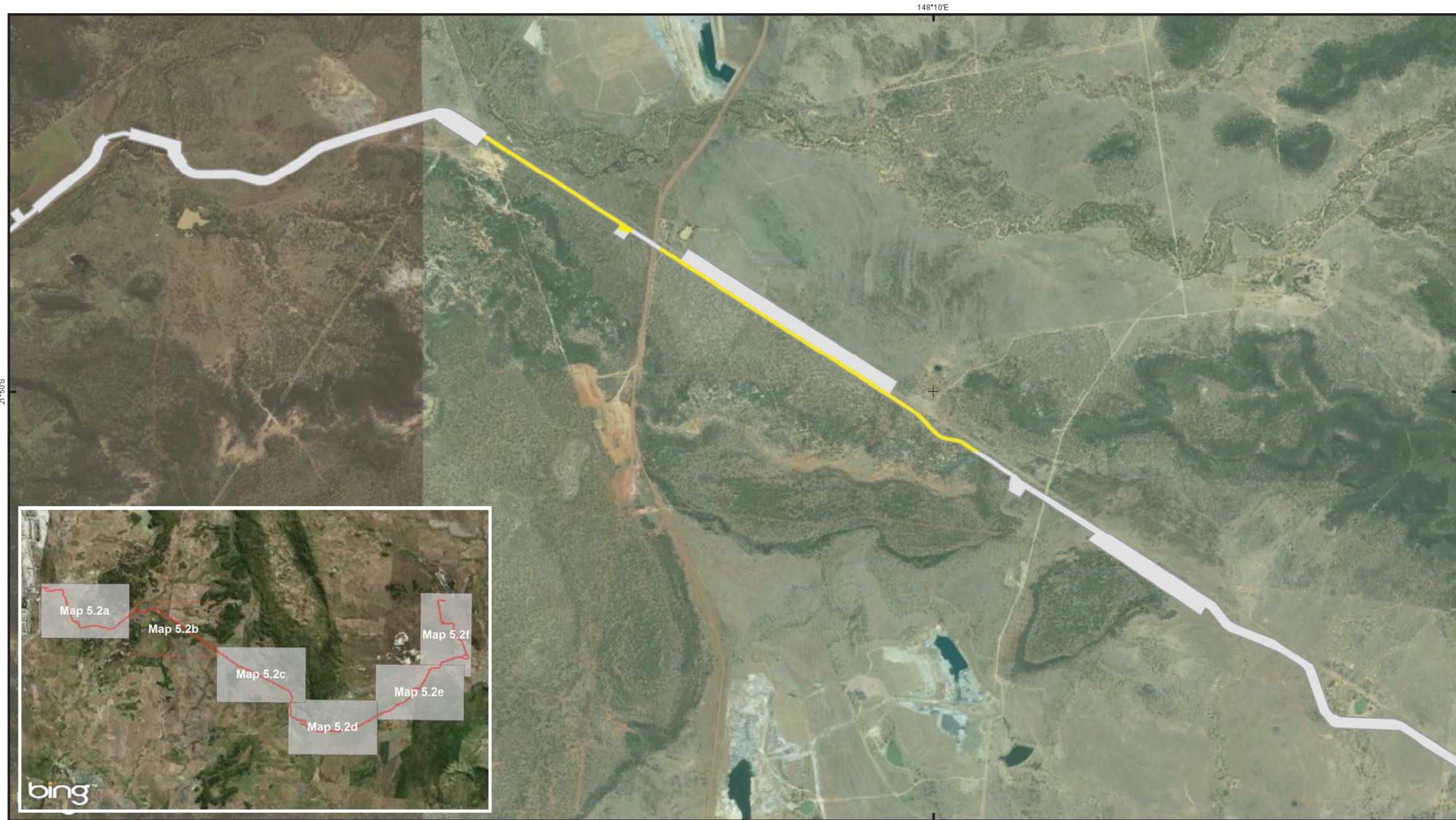
Project: BMC Dragline Move Project
 Terrestrial Ecology MNES Assessment

Client: Advisian



Drawn By: MG Reviewed by: AC Date: 20-Sep-16

Document Location: C:\Users\Owner\Documents\Biodiversity\BAAM\dragline\BAAM_A3_Landscape_OrnamentalSnake_Dragline.mxd Date: 20-Sep-16 11:16:24 PM



Notes:
 © Biodiversity Assessment and Management Pty Ltd. While every care is taken to ensure the accuracy of this data, Biodiversity Assessment and Management makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.
 Data Source: Image from ArcGIS Online Bing Maps data (c) 2010 Microsoft Corporation and its data suppliers. Regional Ecosystems V7 and RE Waterways sourced from QLD Government 2012.

Coordinate System: GCS GDA 1994
 Datum: GDA 1994
 Units: Degree
 1:30,000 at A4
 0 165 330 660 990 1,320 Meters

LEGEND

- Ornamental Snake Habitat
- Essential Habitat
- Unlikely Habitat
- Dragline Corridor Revision C
- Temporary Shutdown Areas

Figure: 5.2b
Title: Modelled and ground-truthed Ornamental Snake habitat within the Dragline Route
Project: BMC Dragline Move Project
 Terrestrial Ecology MNES Assessment
Client: Advisian



Drawn By: MO Reviewed by: AC Date: 20-Sep-16
 Document Location: C:\Users\Owner\Documents\BAAM\dragline\BAAM_A3_Landscape_series_Dragline.mxd Date: 20-Sep-16 11:16:24 PM



Notes:
 © Biodiversity Assessment and Management Pty Ltd. While every care is taken to ensure the accuracy of this data, Biodiversity Assessment and Management makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.
 Data Source: Image from ArcGIS Online Bing Maps data (c) 2010 Microsoft Corporation and its data suppliers. Regional Ecosystems V7 and RE Waterways sourced from QLD Government 2012.

Coordinate System: GCS_GDA_1994
 Datum: GDA_1994
 Units: Degree



1:30,000 at A4
 0 165 330 660 990 1,320
 Meters

LEGEND

- | | |
|---------------------------------|------------------------------|
| Ornamental Snake Habitat | Dragline Corridor Revision C |
| General Habitat | Temporary Shutdown Areas |
| Unlikely Habitat | |

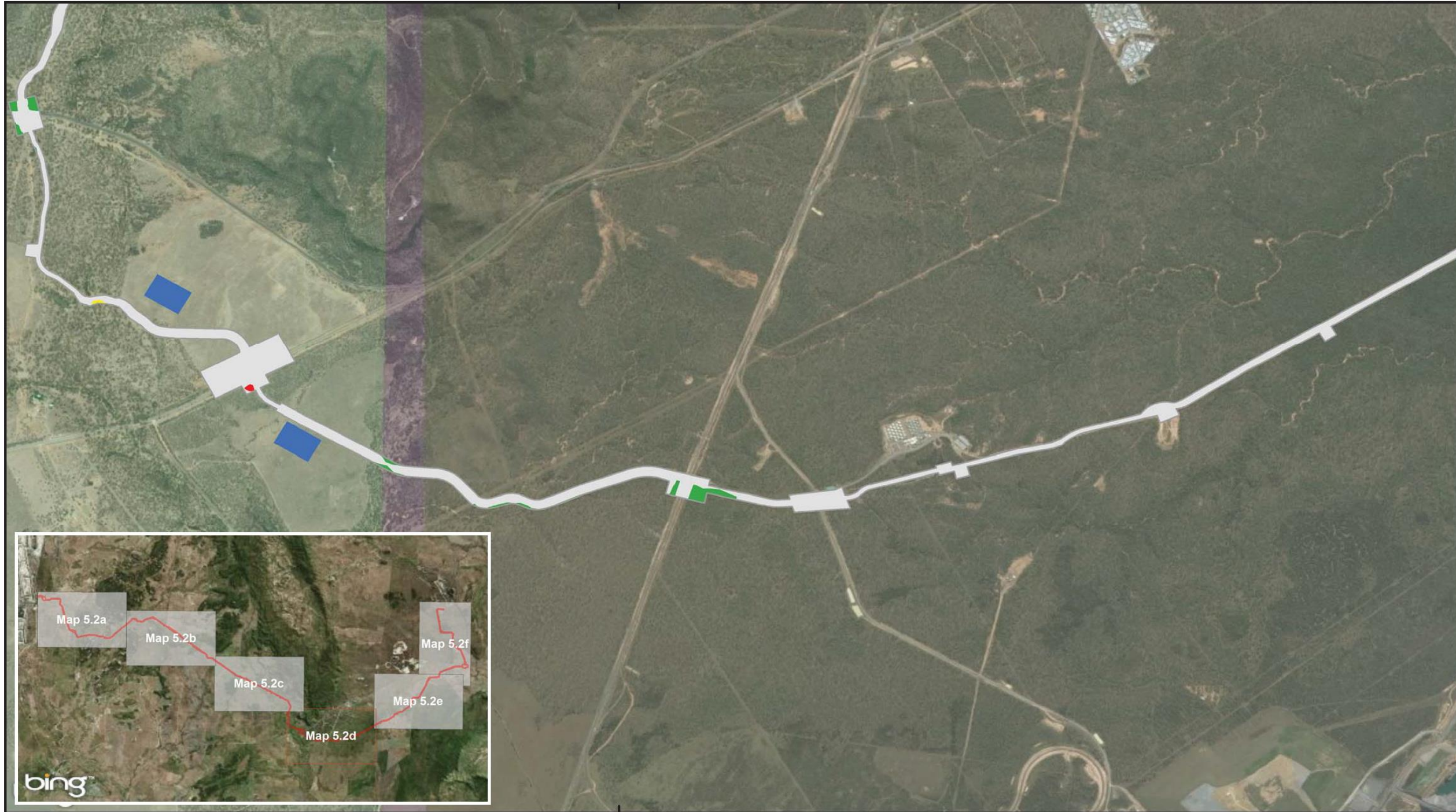
Figure: 5.2c
Title: Modelled and ground-truthed Ornamental Snake habitat within the Dragline Route
Project: BMC Dragline Move Project
 Terrestrial Ecology MNES Assessment
Client: Advisian



Drawn by: MG Reviewed by: AC Date: 20-Sep-16

Document Location: C:\Users\Owner\Documents\Projects\BAAM\dragline\BAAM_A3_Landscape_series_dragline.mxd Date: 20-Sep-16 11:16:24 PM

148°20'E



Notes:
 © Biodiversity Assessment and Management Pty Ltd. While every care is taken to ensure the accuracy of this data, Biodiversity Assessment and Management makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.
 Data Source: Image from ArcGIS Online Bing Maps data (c) 2010 Microsoft Corporation and its data suppliers. Regional Ecosystems V7 and RE Waterways sourced from QLD Government 2012.

Coordinate System: GCS GDA 1994
 Datum: GDA 1994
 Units: Degree



1:30,000 at A4
 0 165 330 660 990 1,320 Meters

LEGEND

- | | |
|---------------------------------|------------------------------|
| Ornamental Snake Habitat | Dragline Corridor Revision C |
| Core Habitat | Temporary Shutdown Areas |
| Essential Habitat | |
| General Habitat | |
| Unlikely Habitat | |

Drawn by: MO Reviewed by: AG Date: 20-Sep-16

Document Location: C:\Users\Owner\Documents\BAAM\dragline\BAAM_A3_Landscape_zones_dragline.mxd Date: 20-Sep-16 11:16:24 PM

Figure: 5.2d
Title: Modelled and ground-truthed Ornamental Snake habitat within the Dragline Route
Project: BMC Dragline Move Project
 Terrestrial Ecology MNES Assessment
Client: Advisian





Notes:
 © Biodiversity Assessment and Management Pty Ltd. While every care is taken to ensure the accuracy of this data, Biodiversity Assessment and Management makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.
 Data Source: Image from ArcGIS Online Bing Maps data (c) 2010 Microsoft Corporation and its data suppliers. Regional Ecosystems V7 and RE Waterways sourced from QLD Government 2012.

Coordinate System: GCS ODA 1994
 Datum: ODA 1994
 Units: Degree



LEGEND

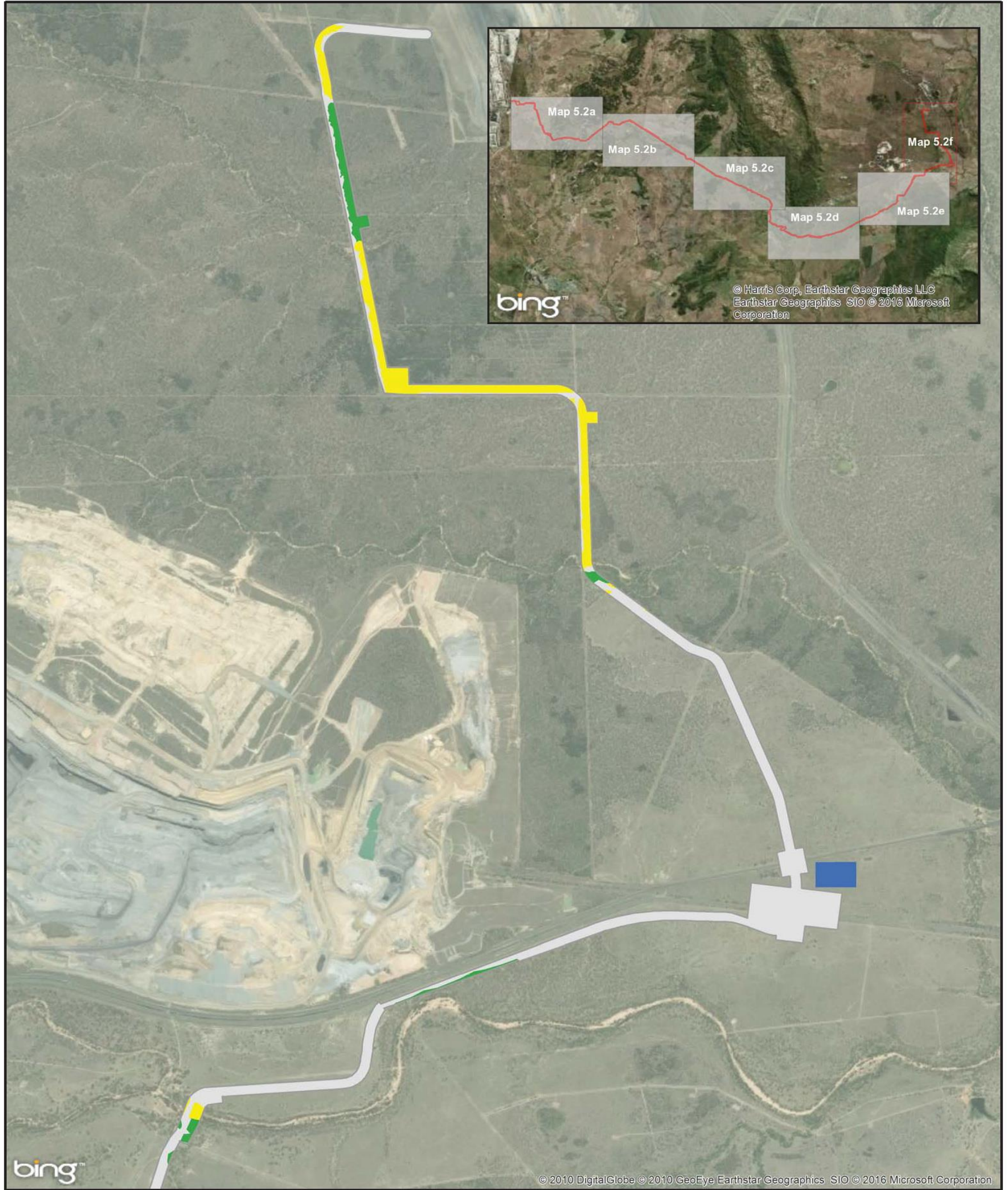
- Ornamental Snake Habitat**
- Essential Habitat
- General Habitat
- Unlikely Habitat
- Dragline Corridor Revision C
- Temporary Shutdown Areas

Drawn by: MG Reviewed by: AC Date: 20-Sep-16

Document Location: C:\Users\Owner\Documents\Projects\BAAM\rag\m\BAAM_A3_Landscape_series_Dragline.mxd Date: 20-Sep-16 11:18:24 PM

Figure: 5.2e
Title: Modelled and ground-truthed Ornamental Snake habitat within the Dragline Route
Project: BMC Dragline Move Project
 Terrestrial Ecology MNES Assessment
Client: Advisian





Notes:

Coordinate System: GCS GDA 1994
 Datum: GDA 1994
 Units: Degree

1:30,000 at A4
 0 0.15 0.3 0.6 0.9 1.2 Kilometers

© Biodiversity Assessment and Management Pty Ltd. While every care is taken to ensure the accuracy of this data, Biodiversity Assessment and Management makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in anyway and for any reason.

Legend

- Ornamental Snake Habitat**
- Essential Habitat
- General Habitat
- Unlikely Habitat
- Dragline Corridor Revision C
- Temporary Shutdown Areas

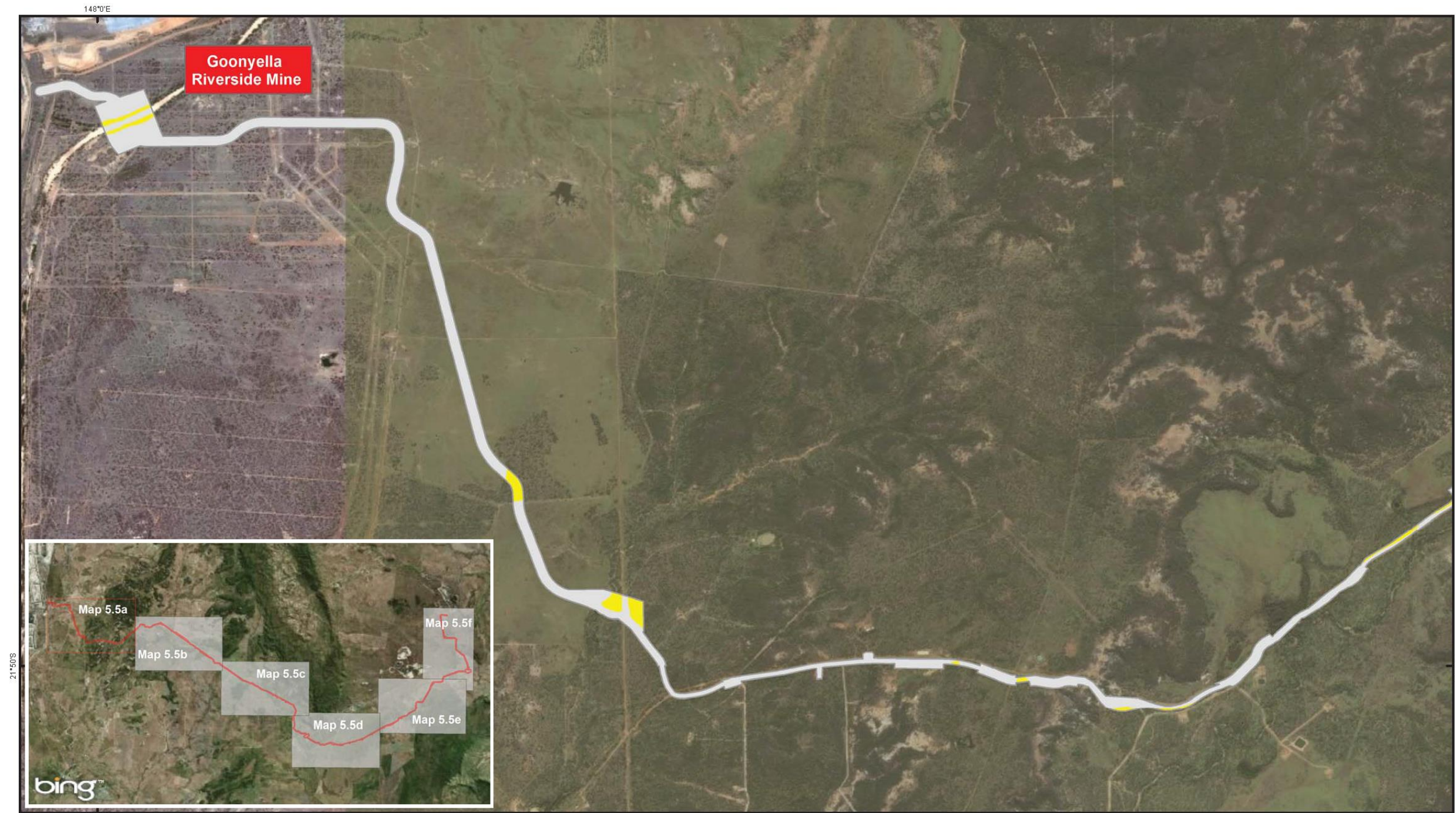
Drawn By: MG Reviewed by: AC Date: 21-Sep-16

Document Location: C:\Users\Owner\Documents\Clients\BAAM\dragline\BAAM_AS_Portrait_dragline.mxd Date: 21-Sep-16 1:00:30 AM

Figure: 5-2f
Title: Modelled and ground-truthed Ornamental Snake habitat within the Dragline Route
Project: BMC Dragline Move Project Terrestrial Ecology MNES Assessment
Client: Client LOGO or name



Appendix A2: Impact Area Mapping – Yakka Skink



Notes:
 © Biodiversity Assessment and Management Pty Ltd. While every care is taken to ensure the accuracy of this data, Biodiversity Assessment and Management makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.
 Data Source: Image from ArcGIS Online Bing Maps data (c) 2010 Microsoft Corporation and its data suppliers. Regional Ecosystems V7 and RE Waterways sourced from QLD Government 2012.

Coordinate System: GCS ODA1994
 Datum: GDA1994
 Units: Degree



LEGEND

- Yakka Skink
- Essential Habitat
- Unlikely Habitat
- Dragline Corridor Revision C
- Temporary Shutdown Areas

Figure: 5.5a
Title: Modelled and ground-truthed Yakka Skink habitat within the Dragline Route
Project: BMC Dragline Move Project
 Terrestrial Ecology MNES Assessment
Client: Advisian



Drawn by: WG Reviewed by: AC Date: 21-Sep-16
 Document Location: C:\Users\johne\Documents\BAM\BAAM\dragline\BAAM_A3_Landscape_zones_Dragline.mxd Date: 21-Sep-16 12:10:23 AM



Notes:
 © Biodiversity Assessment and Management Pty Ltd. While every care is taken to ensure the accuracy of this data, Biodiversity Assessment and Management makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.
 Data Source: Image from Aro@IS Online Bing Maps data (c) 2010 Microsoft Corporation and its data suppliers. Regional Ecosystems V7 and RE Waterways sourced from QLD Government 2012.

Coordinate System: GCS: GDA 1994
 Datum: GDA 1994
 Units: Degree

148°10'E



1:30,000 at A4
 0 165 330 660 990 1,320 Meters

LEGEND

- Essential Habitat
- Temporary Shutdown Areas
- Unlikely Habitat
- Dragline Corridor Revision C

Figure: 5.5b
Title: Modelled and ground-truthed Yakka Skink habitat within the Dragline Route
Project: BMC Dragline Move Project
 Terrestrial Ecology MNES Assessment
Client: Advisian



Drawn By: MG Reviewed by: AC Date: 21-Sep-16

Document Location: C:\Users\Owain\Documents\Projects\BAAM\Dragline\BAAM_A3_Landscape_series_Dragline.mxd Date: 21-Sep-16 12:10:23 AM



Notes:
 © Biodiversity Assessment and Management Pty Ltd. While every care is taken to ensure the accuracy of this data, Biodiversity Assessment and Management makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.
 Data Source: Image from ArcGIS Online Bing Maps data (c) 2010 Microsoft Corporation and its data suppliers; Regional Ecosystems V7 and RE Waterways sourced from QLD Government 2012.

Coordinate System: GCS ODA 1994
 Datum: GDA 1994
 Units: Degree



1:30,000 at A4
 0 165 330 660 990 1,320 Meters

LEGEND

- Yakka Skink
- Essential Habitat
- Unlikely Habitat
- Dragline Corridor Revision C

Drawn By: WG Reviewed by: AC Date: 21-Sep-16

Document Location: C:\Users\Owner\Documents\clients\BAAM\dragline\BAAM_A3_Landscape_series_Dragline.mxd Date: 21-Sep-16 12:10:23 AM

Figure: 5.5c
Title: Modelled and ground-truthed Yakka Skink habitat within the Dragline Route
Project: BMC Dragline Move Project Terrestrial Ecology MNES Assessment
Client: Advisian



148°20'E



Notes:
 © Biodiversity Assessment and Management Pty Ltd. While every care is taken to ensure the accuracy of the data, Biodiversity Assessment and Management makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.
 Data Source: Image from Aerial Bing Maps data (c) 2010 Microsoft Corporation and its data suppliers; Regional Ecosystems V7 and RE Waterways sourced from QLD Government 2012.

Coordinate System: GCS GDA 1994
 Datum: GDA 1994
 Units: Degree



1:30,000 at A4
 0 165 330 660 990 1,320 Meters

LEGEND

- | | |
|-------------------|------------------------------|
| Essential Habitat | Dragline Corridor Revision C |
| General Habitat | Temporary Shutdown Areas |
| Unlikely Habitat | |

Figure: 5.5d
Title: Modelled and ground-truthed Yakka Skink habitat within the Dragline Route
Project: BMC Dragline Move Project
 Terrestrial Ecology MNES Assessment
Client: Advisian



Drawn By: MG Reviewed by: AC Date: 21-Sep-16

Document Location: C:\Users\Diene\Documents\BNC\baam\dragline\BAAM_A3_Landscape_series_dragline.mxd Date: 21-Sep-16 12:10:23 AM



Notes:
 © Biodiversity Assessment and Management Pty Ltd. While every care is taken to ensure the accuracy of this data, Biodiversity Assessment and Management makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.
 Data Source: Image from ArcGIS Online Bing Maps data (c) 2010 Microsoft Corporation and its data suppliers; Regional Ecosystems V7 and RE Waterways sourced from QLD Government 2012.

Coordinate System: GCS GDA 1994
 Datum: GDA 1994
 Units: Degree



1:30,000 at A4
 0 165 330 660 990 1,320 Meters

LEGEND

- Yakka Skink
- Essential Habitat
- Unlikely Habitat
- Dragline Corridor Revision C

Drawn By: MG Reviewed by: AC Date: 21-Sep-16

Document Location: C:\Users\Owner\Documents\Bentley\BAAM\dragline\BAAM_A3_Landscape_series_dragline.mxd Date: 21-Sep-16 12:10:23 AM

Figure: 5.5e
Title: Modelled and ground-truthed Yakka Skink habitat within the Dragline Route
Project: BMC Dragline Move Project
 Terrestrial Ecology MNES Assessment
Client: Advisian





Notes:

Coordinate System: GCS GDA 1994
 Datum: GDA 1994
 Unit: Degree



1:30,000 at A4
 0 0.15 0.3 0.6 0.9 1.2
 Kilometers

© Biodiversity Assessment and Management Pty Ltd. While every care is taken to ensure the accuracy of this data, Biodiversity Assessment and Management makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in anyway and for any reason.

Legend

- Yakka Skink**
- Essential Habitat
- Dragline Corridor Revision C
- Temporary Shutdown Areas
- Unlikely Habitat

Drawn By: MG Reviewed by: AC Date: 21-Sep-16

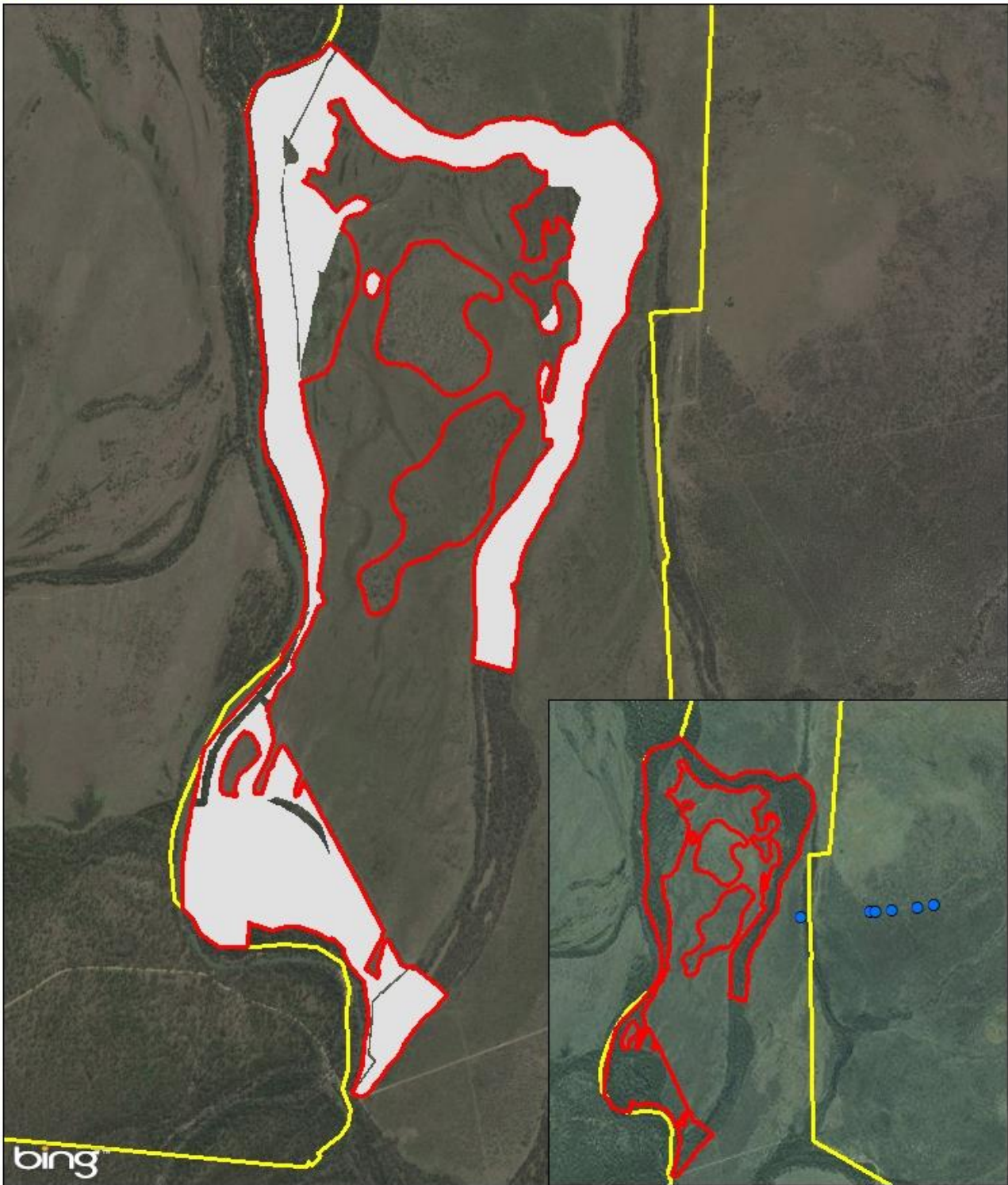
Document Location: C:\Users\Downend\Documents\Clients\BAAM\dragline\BAAM_R3_Portrait_dragline.mxd Date: 21-Sep-16 1:49:00 AM

Figure: 5-5f
Title: Modelled and ground-truthed Yakka Skink habitat within the Dragline Route
Project: BMC Dragline Move Project Terrestrial Ecology MNES Assessment
Client: Client LOGO or name



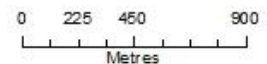
MNES: Ornamental Snake Habitat

© Eco Logical Australia Pty. Ltd. This map is not guaranteed to be free from error or omission. Eco Logical Australia Pty. Ltd. and its employees disclaim liability for any act done or the information in the map and any consequences of its act acts or omissions.



Legend

- Offset Area
- Croydon Offset Investigation Area
- Ornamental Snake Habitat
- Ornamental Snake Records



Datum/Projection:
GDA 1994 MGA Zone 55

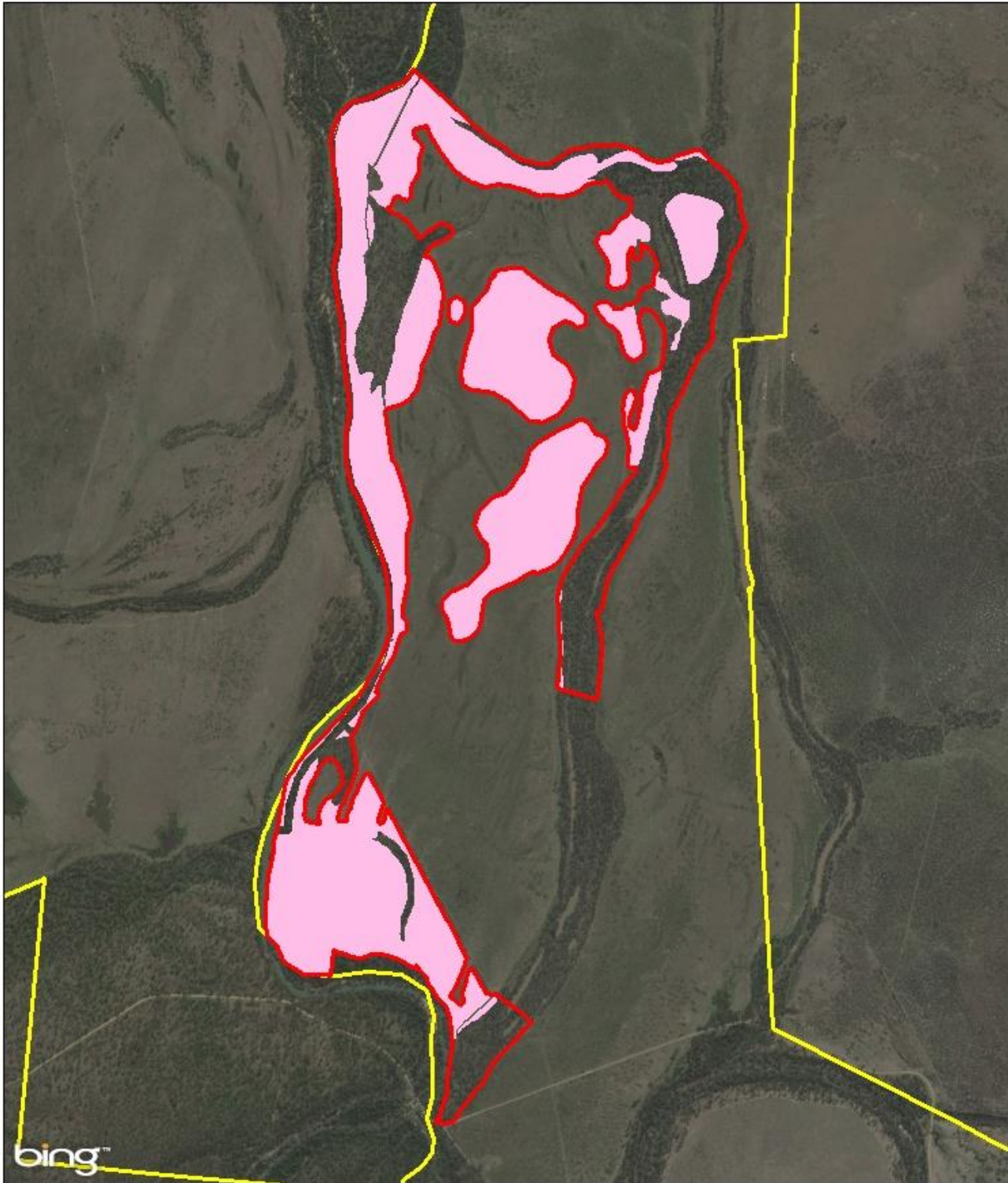


Prepared by: J.M. Approved by: L.F. Status: Final Date: 11.11.2016

Appendix A3B: Offset Area Mapping Yakka Skink

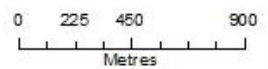
MNES: Yakka Skink Habitat

© Eco logical/Australia Pty. Ltd. This map is not guaranteed to be free from error or omission. Eco logical/Australia Pty. Ltd. and its employees disclaim liability for any actions or the information in the map and any consequences of its use on its basis.



Legend

- Offset Area
- Croydon Offset Investigation Area
- Yakka Skink Habitat



Datum/Projection:
GDA 1994 MGA Zone 55

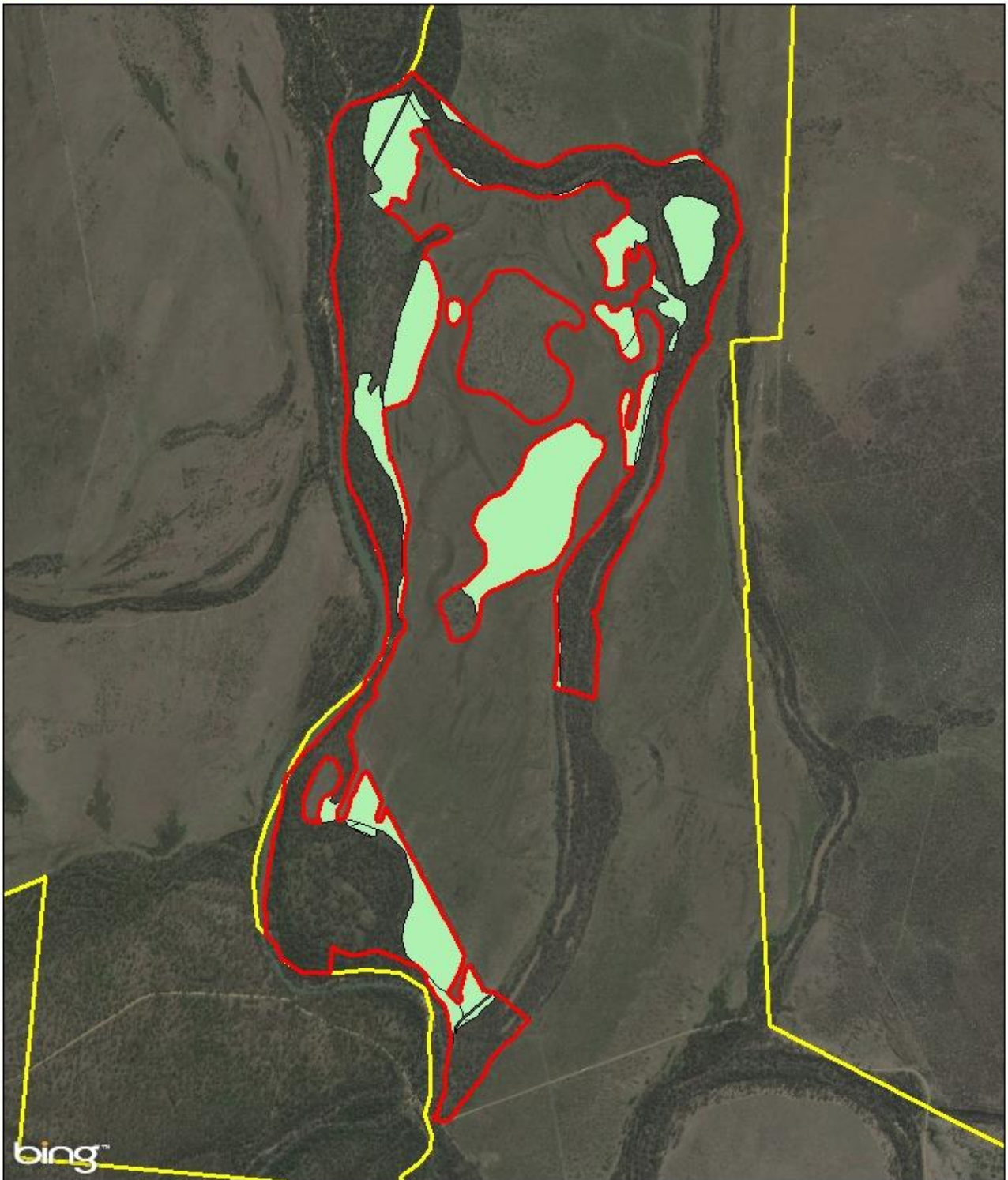


Prepared by: J.M. Approved by: L.F. Status: Final Date: 11.11.2016

Appendix A3C: Offset Area Mapping Yakka Brigalow TEC

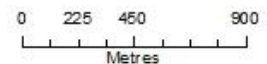
MNES: Brigalow TEC

© Eco logical Australia Pty. Ltd. This map is not guaranteed to be free from error or omission. Eco logical Australia Pty. Ltd. and its employees disclaim liability for any act done or the information in the map and any consequences of its act or omissions.



Legend

- Offset Area
- Croydon Offset Investigation Area
- Brigalow TEC



Datum/Projection:
GDA 1994 MGA Zone 55



Prepared by: J.M. Approved by: L.F. Status: Final Date: 11.11.2016

Attachment 1: Offset Area Ecological Data

Attachment 1A: Supporting Technical Information – Offset Site

1. SURVEY METHODOLOGY

The BMC Dragline move Offset Site is a sub-area of a larger offset investigation area for the BMA Red Hill Project. A full field survey report of the offset area will be prepared for this larger area (circa 4,000ha) in early 2017. This Appendix is a summary of the methodologies and findings in this sub-area for use with the BMC Dragline Project.

The offset field assessments carried out at Croydon by ELA in March/April 2016 consisted of several methodologies including MNES habitat assessment, *BioCondition Assessment*, the *Guide to determining terrestrial habitat quality* and Ornamental Snake surveys.

A summary of these methodologies is provided below.

1.1 MNES habitat assessment

The likelihood of occurrence of threatened flora and fauna along with their habitats were assessed through searches of likely habitat as well as opportunistic searches during foot and vehicular traverses. Offset areas for MNES were assessed with reference to the respective guidelines², the EPBC Act EOP³ and using the EPBC Act Offset Assessment Guide to calculate the offset area required for each MNES.

1.2 BioCondition Assessment

BioCondition is a condition assessment framework for Queensland that provides a measure of how well a terrestrial ecosystem is functioning for biodiversity values.⁴ It is a site-based, quantitative and therefore repeatable assessment procedure that can be used in any vegetative state, and provides a numeric score that can be summarised as a condition rating of 1, 2, 3 or 4, or functional through to dysfunctional condition for biodiversity. In BioCondition, 'condition' refers to the degree to which the attributes of a patch of vegetation differ from the attributes of the same vegetation in its reference state.

In BioCondition, the reference state refers to the natural variability or range in attributes of an ecosystem that is relatively unmodified since European settlement, or 'best on offer'.

² Ornamental Snake, Yakka Skink: see *Survey guidelines for Australia's threatened reptiles – Guidelines for detecting reptiles listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*, Department of Sustainability, Environment, Water, Population and Communities (2011) found at <http://www.environment.gov.au/system/files/resources/eba674a5-b220-4ef1-9f3a-b9ff3f08a959/files/survey-guidelines-reptiles.pdf>.

Squatter Pigeon: see *Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*, Department of the Environment, Water, Heritage and the Arts, 2010, found at <http://www.environment.gov.au/system/files/resources/107052eb-2041-45b9-9296-b5f514493ae0/files/survey-guidelines-birds.pdf>

³ Environment Protection and Biodiversity Conservation Act 1999 *Environmental Offsets Policy*, Department of Sustainability, Environment, Water, Population and Communities, October 2012, found at http://www.environment.gov.au/system/files/resources/12630bb4-2c10-4c8e-815f-2d7862bf87e7/files/offsets-policy_2.pdf

⁴ *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland - Assessment Manual*, Queensland Herbarium, Department of Science, Information Technology and the Arts, version 2.2, February 2015, found at <https://www.qld.gov.au/environment/assets/documents/plants-animals/biodiversity/biocondition-assessment-manual.pdf>

51 BioCondition surveys were undertaken across the Croydon offsets area to assess the existing condition of habitat within these areas. Six of these surveys occurred within the proposed dragline offset area. These surveys collect data on 13 attributes including:

1. Recruitment of woody perennial species in the Ecological Dominant Layer
2. Native plant species richness for trees
3. Native plant species richness for shrubs
4. Native plant species richness for grasses
5. Native plant species richness for forbs
6. Tree canopy height
7. Tree canopy cover
8. Shrub canopy cover
9. Native perennial grass cover
10. Organic litter
11. Large trees
12. Coarse woody debris
13. Non-native plant cover

1.3 Guide to determining terrestrial habitat quality

Habitat quality is assessed through a strategic combination of indicators that measure the overall viability of the site and its capacity to support a prescribed environmental matter. The process for assessing habitat quality is designed in a simple and repeatable way.⁵ The process includes mapping, field measurements and simple calculations to score the indicators. The assessment must measure habitat quality at the impact site and the offset site in order to quantify and compare scores. Each of the three indicators are scored, then summed and translated to a final score out of 10.

The key indicators for determining habitat quality of a land based impact site or an offset site are:

- site condition: a general condition assessment of vegetation compared to a benchmark;
- site context: an analysis of the site in relation to the surrounding environment; and
- species habitat index: the ability of the site to support a species.

The variance in structure, function and quality of habitat on an impact or offset site is accounted for by delineating sites into 'assessment units' based on broad condition state and distinct regional ecosystems. Once the habitat quality of an offset site has been determined it is then assessed based on its ability to improve and provide a conservation outcome for the impacted matter.

1.4 Ornamental Snake surveys

Targeted surveys for Ornamental Snake were undertaken over four days and nights across the larger offset investigation area for the Red Hill project. These surveys consisted of active nocturnal searches as well as snake funnels set up along drift fences.

⁵ *Guide to determining terrestrial habitat quality: A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy, version 1.1, December 2014*, Department of Environment and Heritage Protection, found at <http://www.ehp.qld.gov.au/assets/documents/pollution/management/offsets/habitat-quality-assessment-guide.pdf>

Habitat Values

Habitat values for Ornamental Snake were assessed by the presence of critical habitat factors as listed in the SPRAT and survey guidelines. Critical habitat factors such as gilgai, cracking clay, fallen woody debris and close proximity to water were all factored into the assessment.

Results- Ornamental Snake surveys

Ornamental Snake was confirmed as occurring within the Croydon offset area with 22 individuals recorded. None of these were located within the proposed dragline offsets however there are numerous records in close proximity. No targeted surveys were undertaken in the proposed dragline offset area.

Proposed offsets for the Ornamental Snake consist of the following vegetation and REs:

- 11.3.1 (remnant and non-remnant);
- 11.3.3 (remnant and non-remnant);
- 11.3.4 (remnant);
- 11.3.25 (remnant);
- 11.3.27 (remnant);
- 11.4.9 (remnant and non-remnant); and
- Non-remnant vegetation consisting of gilgai habitat

1.5 Yakka Skink

Targeted surveys and habitat assessments were not undertaken for Yakka Skink during the surveys for the Red Hill project as this was not one of the required MNES. Therefore the offset assessment has been based on RE associations with suitable Yakka Skink habitat such as Eucalypt and Acacia dominated woodlands on substrates consisting of rock, loam, sand or clay (in particular landzones 3, 4, 5, 7 and 10). Where the information was available from other MNES habitat assessments, features such as fallen timber and log/rock piles were considered.

Proposed offsets for the Yakka Skink consist of the following REs:

- 11.3.1 (remnant and non-remnant);
- 11.3.4 (remnant);
- 11.3.25 (remnant);
- 11.4.9 (remnant and non-remnant); and
- 11.5.3 (remnant)

2. START QUALITY SCORE

The start quality of threatened species habitat across the offset site was calculated in accordance with the Queensland Guide to Determine Terrestrial Habitat Quality. This included:

- assessing field collected BioCondition data against the appropriate benchmark values to provide a site condition score as per the prescribed guideline;
- undertaking GIS analysis of patch size, adjacency and connectivity of all identified habitat areas to provide a site context score in accordance with the guideline; and
- assessing field collected habitat assessment data against the following species habitat index attributes to provide a species habitat index score:
 - threats to species;

- quality and availability of food and foraging habitat;
- quality and availability of shelter;
- species mobility capacity; and
- role of site location to species overall population in the state.

The overall habitat quality score, which was used as the start quality was calculated by combining the site condition, site context and species habitat index scores together for each mapped habitat area. Scores were weighted by patch size of mapped habitat areas within the offset area.

3. HABITAT MAPPING

To identify and map out areas of threatened species habitat on the offset site the following approach was undertaken:

- Field observation, BioCondition data and rapid quaternary survey site data was used in combination to Aerial Photographic Interpretation (API) to map and classify vegetation communities across the offset investigation area. Vegetation community classification was based on RE type and condition;
- Threatened species known to be associated with RE types were attributed to mapped RE polygons accordingly; and
- This mapping was validated by targeted habitat assessment data collected across the Croydon offset investigation area for each identified RE. This ensured that the mapped RE supported or had the potential to support (through future management) the necessary habitat features required by the species.

A total of 51 BioCondition sites, 25 Ornamental Snake habitat assessment sites and 125 quaternary sites were recorded across the Red Hill project offset investigation area.

4. LOSS OF HABITAT

The inclusion of degradation processes in assessing risk of loss for both reptile species is of particular relevance due to the fact that both species can persist in relatively cleared environments (as stated in SPRAT profiles). Vegetation clearing in both cases does not necessarily equate to loss of species and is not the definitive way of assessing presence/absence, or in this case retention/loss. Degradation processes such as cattle grazing, fire, pasture improvement can lead to a loss of the critical microhabitat features that the species require to persist such as fallen woody debris, logs, soil cracks and gilgai supporting quality habitat for frog species. Without these features the species would not be able to survive regardless of the presence of a canopy layer. It is therefore pertinent in this case to include degradation processes in assessing risk of loss for these species as this is a key cause in loss in habitat.

5. EXISTING ENVIRONMENT

Acacia harpophylla open forest on alluvial plains

The vegetation community occurs in a large patch in the north-eastern corner and in several smaller patches throughout the offset area. The tall canopy layer is dominated by Brigalow (*Acacia harpophylla*) with Coolibah (*Eucalyptus coolabah*) and Yellow-wood (*Terminalia oblongata*) also present.

The understorey contains both a mid-storey and shrub layer. The mid-storey is dominated by Yellow-wood, Brigalow and Red Bauhinia (*Lysiphyllum carronii*) with Sally Wattle (*Acacia salicina*) and Whitewood

(*Atalaya hemiglauca*) also occurring. The shrub layer consists of a mixture of species including juvenile Brigalow and Yellow-wood, Currant Bush (*Carissa ovata*), Lolly Bush (*Clerodendrum floribundum*), Leichhardt Bean (*Cassia brewsteri*) and Scrub Boonaree (*Alectryon diversifolius*).

The ground layer is dominated by a mixture of native and exotic grasses, including the exotic species Buffel Grass (*Cenchrus ciliaris*) and Sabi Grass (*Urochloa mosambicensis*) and native species, including Brigalow Grass (*Paspalidium caespitosum*), Queensland Bluegrass (*Dichanthium sericeum*) and Native Millet (*Panicum decompositum*).

The vegetation community has a high native species richness with only minor weed incursion in the ground layer. The canopy layer is mature and a high availability of habitat resources such as fallen woody debris and leaf litter are present within the community. Overall, based on site condition assessment this community was determined to be in moderate-high condition.

This community falls within the Broad Vegetation Group (BVG) 25a, is in remnant condition (i.e. >50% canopy cover and 70% height of the undisturbed community) and is analogous with RE11.3.1, which has a Vegetation Management Act 1999 Status (VM class) and Biodiversity Status under the VMA (BD status) of "Endangered".

Acacia harpophylla regrowth on alluvial plains

The vegetation community occurs in two large and several smaller patches, predominantly in the north of the offset area. The low (4 - 6m) canopy layer is dominated by Brigalow and Coolabah, with Red Bauhinia, Sally Wattle and Poplar Box (*Eucalyptus populnea*) also occurring. The mid-storey is dominated by Brigalow and Sally Wattle with Yellow-wood also occurring.

The sparse shrub layer consists of a mixture of species including Brigalow, Red Bauhinia, Desert Lime (*Citrus glauca*), Leichhardt Bean and *Capparis* sp. The ground layer is dominated by exotic grasses such as Buffel and Sabi Grass with some native species such as Brigalow Grass, Fairy Grass (*Sporobolus caroli*) and Forest Bluegrass (*Bothriochloa bladhillii*) occasionally occurring. Scattered native forbs present within the ground layer include Ruby Saltbush (*Enchylaena tomentosa*) and Fine Sida (*Sida filiformis*). A number of exotic forbs including the declared weeds Parthenium (*Parthenium hysterophorus*) and Harrisia Cactus (*Harrisia* sp.) also occur.

The vegetation community is in an immature state and has not reached the canopy height or cover of a remnant community. The community has moderate native species richness and weed incursion within the ground layer ranges from moderate to high. The community does however contain high availability of habitat resources including wood debris and leaf litter. Overall based on site condition assessment, this community was determined to be in moderate condition.

This vegetation community is analogous to RE 11.3.1, however, due to the level of previous disturbance, it is currently of non-remnant status.

Acacia harpophylla with Terminalia oblongata shrubby woodland on clay plains

The vegetation community occurs in three patches located in the north, centre-west and south portions of the offset area. Brigalow dominates the canopy and mid-storey, with Yellow-wood also present in the mid-storey. The sparse shrub layer is dominated by Yellow-wood, Currant Bush and Scrub Boonaree.

The ground layer is dominated by a mix of native and exotic grasses. Exotic grasses include Buffel Grass, Sabi Grass and Guinea Grass occur, as well as the native species Native Millet, Fairy Grass and Brigalow Grass. Scattered forbs including native Sesbania Pea (*Sesbania cannabina*), Budda Pea (*Aeschynomene indica*) and exotic Noogoora Burr (*Xanthium occidentale*) also occur. Various native sedges and cyperus species were noted within low lying areas of the community.

The vegetation community has a canopy height and cover consistent with a remnant community, however, it has a low species richness, particularly tree and shrub species. Habitat resources such as fallen woody debris and organic litter cover are relatively low; however deep gilgai formations and soil cracks are present. Weed incursion is high (average 70% of total ground cover). Overall, this community was determined to be in low-moderate condition.

This community falls within BVG 25a, is in remnant condition (i.e. >50% canopy cover and 70% height of the undisturbed community) and is analogous with RE11.4.9, which has a VM class and BD status of “Endangered”.

***Acacia harpophylla* with *Terminalia oblongata* regrowth on clay plains**

The vegetation occurs primarily in two patches, one in the north-east corner and one in the south of the offset area. A relatively small isolated occurrence of the community is located near the centre of the northern portion of the offset area.

The low (3 – 5 m) canopy and mid-storey layers are dominated by a mixture of Brigalow, Red Bauhinia, Coolabah, Whitewood and Yellow-wood. The shrub layer is dominated by Brigalow, with Stuart’s Desert Rose (*Gossypium stuartianum*) also occurring.

The ground layer is dominated by native grasses including Fairy Grass, Brigalow Grass and *Aristida* sp. Native forbs including Fine Sida, Ruby Saltbush, Nepine (*Capparis lasiantha*) and Pink Tongues (*Rostellularia adscendens*) also commonly occur. Declared weed species including Harrisia Cactus and Parthenium were also occasionally recorded within the community.

The vegetation community lacks the canopy height and cover of a remnant community due to historical land uses involving the clearing of mature vegetation. The immature state of the community means it lacks other remnant community characteristics such as the presence of large mature trees and availability of habitat resources such as fallen woody debris and organic litter. However deep gilgai formations and soil cracks are present. Moderate weed incursion occurs in the ground layer. Overall based on site condition assessment, this community was determined to be in low-moderate condition. The community is associated with RE 11.4.9, however due to the level of previous disturbance it is currently of non-remnant status.

***Eucalyptus tereticornis* woodland on alluvial plains**

The vegetation community occurs on alluvial plains associated with the Connors River, occurring as a large patch in the south and along the northern and western edges of the offset area. The tall canopy (18 – 20 m) and mid-storey layers are dominated by Queensland Bluegum (*Eucalyptus tereticornis*), Coolabah and Moreton Bay Ash (*Corymbia tessellaris*). An emergent layer containing Queensland Bluegum and Moreton Bay Ash is occasionally present.

When present, the sparse shrub layer is dominated by Dysentery Bush (*Grewia latifolia*), Coffee Bush (*Breynia oblongifolia*) and Quinine Bush (*Petalostigma pubescens*). The ground layer comprises a mixture of native forbs and grasses. Native forb species present include Native Basil (*Ocimum spp.*), Native Sensitive Plant (*Neptunia gracilis*) and Wombat Berry (*Eustrephus latifolius*) and native grasses include Spiny-head Mat-rush (*Lomandra longifolia*), Queensland Bluegrass and Forest Bluegrass. Several weed species including Balloon Cotton Vine (*Gomphocarpus physocarpus*), Noogoora Burr, Sabi Grass and Red Natal (*Melinis repens*) are patchily distributed within the ground layer.

The vegetation community has a mature canopy layer, and has moderate native species richness and high availability of habitat resources such as fallen woody debris and leaf litter. Weed incursion is ranges from moderate to high. Overall, based on site condition assessment, this community was determined to be in moderate condition.

This community falls within BVG 16c, is in remnant condition (i.e. >50% canopy cover and 70% height of the undisturbed community) and is analogous with RE11.3.4, which has a VM class and BD status “of concern”.

***Eucalyptus coolabah* woodland on alluvial plains**

The vegetation community occurs in several patches near the boundary of the offset area, particularly in the north-eastern corner and eastern edge where braided portions of Connors River traverse. The canopy layer and mid-storey are dominated by Coolibah, with Queensland Bluegum occurring occasionally in the canopy layer.

A shrub layer is often absent or very sparse. When present, the shrub layer is dominated by species including Sally Wattle and Dysentery Bush. The exotic shrub species Mimosa Bush (*Vachellia farnesiana*) is also common.

The ground layer is primarily dominated by native grasses, including Native Millet, Black Spear Grass (*Heteropogon contortus*) and *Paspalidium spp.* Native forbs including Native Sensitive Plant, Native Basil, Fine Sida and *Vittadinia spp.* are also present. Various native sedges and cyperus species were noted within low lying areas of the community.

The vegetation community has a mature canopy layer and has a moderate native species richness and high availability of habitat resources such as fallen woody debris and leaf litter. Weed incursion is Moderate. Overall, based on site condition assessment, this community was determined to be in moderate condition.

This community falls within BVG 16c, is in remnant condition (i.e. >50% canopy cover and 70% height of the undisturbed community) and is analogous with RE11.3.3, which has a VM class and BD status “of concern”.

***Eucalyptus coolabah* regrowth on alluvial plains**

The vegetation community occurs in two patches in the north of the offset area, adjacent to larger areas of remnant Coolibah woodland. The low (5 -7.5 m) canopy layer is dominated by Coolibah and Sally Wattle. The mid-storey is dominated by Red Bauhinia, with Coolibah, Yellow-wood and Leichardt Bean also occurring. Whitewood and Black Tea-tree (*Melaleuca bracteata*) occur in the mid-storey occasionally.

The sparse shrub layer is dominated by a mixture of species, including Brigalow, Whitewood, Sally Wattle, Currant Bush and Scrub Boonaree. The ground layer is dominated by exotic grasses, including Buffel Grass and Sabi Grass. Native grasses including Forest Bluegrass, Native Millet and Brigalow Grass also occur, along with the native forbs Nepine, Native Basil and Native Sensitive Plant. Noogoora Burr and the declared weed Parthenium were also occasionally recorded within the community.

The vegetation community has a dense canopy cover but lacks the height of a remnant community due to historical land uses involving the clearing of mature vegetation. The immature state of the community means it lacks other remnant community characteristics such as the presence of large mature trees. Weed incursion is high (average 70 % of total ground cover). Overall based on site condition assessment, this community was determined to be in low-moderate condition. The community is associated with RE 11.3.3, however due to the level of previous disturbance it is currently of non-remnant status.

***Eucalyptus tereticornis* +/- *Eucalyptus camaldulensis* woodland fringing drainage lines**

The vegetation community occurs fringes the banks of the Connors River, along the northern and western boundaries of the offset area. The tall (28 – 36 m) canopy layer is dominated by Queensland Bluegum with Weeping Paperbark (*Melaleuca leucadendra*) and Coolibah also occurring. The mid-storey ranges from dense to open and is dominated by a mixture of Coolibah, Sally Wattle, Queensland Bluegum, Sandpaper Fig (*Ficus opposita*) and Red Kamala (*Mallotus philippensis*).

The very sparse shrub layer is dominated by Yellow-wood, Red Kamala, Sandpaper Fig and Red Bauhinia. The ground layer is dominated by native grasses, including Native Millet, Spiny-head Mat-rush and *Paspalidium spp.*, and a variety of native forbs, including *Phyllanthus spp.* Wombat Berry, Native Sensitive Plant, Native Basil, Wandering Jew (*Commelina diffusa*) and Lesser Joyweed (*Alternanthera denticulata*). Weeds including, Noogoora Burr and Eyebane (*Euphorbia prostrata*) were also occasionally recorded within the community.

The vegetation community has an abundance of large trees supporting a mature canopy layer and a high native species richness. The community has a high availability of habitat resources such as fallen woody debris and leaf litter and a moderate to low weed incursion. Overall, based on site condition assessment, this community was determined to be in high condition.

This community falls within BVG 16a, is in remnant condition (i.e. >50% canopy cover and 70% height of the undisturbed community) and is analogous with RE11.3.25, which has a VM class of “least concern” and BD status “of concern”.

Freshwater wetlands

The vegetation community occurs along the eastern boundary of the offset area and is associated with the anabranch, billabongs and depressions that occur on the Connors River floodplain. The canopy is dominated by Queensland Bluegum and Coolabah with Moreton Bay Ash also occurring. The mid-storey is dominated by similar canopy species as well as Sally Wattle. A shrub layer is typically absent.

The ground layer is dominated by native grasses including Forest Bluegrass, Silky Browntop (*Eulalia aurea*) and *Bothriochloa spp.* and sedges such as *Eleocharis spp.* Native forbs such as *Phebalium spp.*, Native Basil and Nardoo (*Marsilea drummondii*) also occur.

The vegetation community has a mature canopy layer, a high native species richness and high availability of habitat resources such as large hollow-bearing trees. Other habitat resources such as fallen woody debris and leaf litter are moderately abundant. Weed incursion is generally very low except for occasional occurrences of exotic forbs. Overall, based on site condition assessment, this community was determined to be in high condition.

This community falls within BVG 34d, is in remnant condition (i.e. >50% canopy cover and 70% height of the undisturbed community) and is analogous with RE11.3.27, which has a VM class of “least concern” and BD status “of concern”.

***Eucalyptus populnea* woodland on sand plains**

The vegetation occurs in two patches in the central northern portion of the offset area and has a canopy layer and mid-storey dominated by Poplar Box. The mid-storey also contains Dallachy's Gum (*Corymbia dallachiana*), Supplejack (*Ventilago viminalis*) and Emu Apple (*Owenia acidula*). A very sparse shrub layer is dominated by Leichhardt Bean, Ironwood (*Acacia excelsa*) and Emu Apple.

The ground layer is dominated by Buffel Grass and Sabi Grass, with the native grasses Forest Bluegrass and Black Spear Grass (*Heteropogon contortus*) occasionally occurring. Native forbs including Fine Sida and *Indigofera linifolia* are present in the ground layer. The declared weed Parthenium is also present within the community.

The vegetation community has a mature canopy layer and moderate canopy cover, however, native species richness is low and weed incursion is high (average 62.5 % of total ground cover). Overall based on site condition assessment, this community was determined to be in moderate condition.

This community falls within BVG 17a, is in remnant condition (i.e. >50% canopy cover and 70% height of the undisturbed community) and is analogous with RE11.5.3, which has a VM class of “least concern” and BD status “no concern at present”.

6. MNES VALUES & OFFSET SUITABILITY

6.1 Brigalow TEC

The proposed offset area provides 113.7 ha of Brigalow dominated vegetation that is consistent with the Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC diagnostic characteristics as outlined in the conservation advice. These areas can be described as woodland and regrowth communities with a canopy layer dominated by Brigalow and analogous to Brigalow listed RE11.3.1 and RE11.4.9.

The woodland communities within the offset area are in remnant condition and for the majority of these areas, currently meets the condition threshold criteria to be classified as the Brigalow TEC. Patches are greater than 0.5 ha, highly connected with surrounding vegetation, exotic perennial grass cover is generally below 50% and structural complexity and species diversity is high. Habitat quality assessments found these communities to be in moderate condition.

The regrowth communities within the offset area vary in age within only a small portion comprising the mature structure and low exotic perennial grass cover to meet the condition threshold criteria to be classified as the Brigalow TEC. Nonetheless, areas not currently meeting the condition thresholds have the potential to be returned to TEC status through active management. Habitat quality assessments found these communities to be in poor to moderate condition.

Suggested attribute values for use in the Commonwealth OAG have been generated and are provided below (see **Table 1** and **Table 2**). These values are based on field data collected at both the impact site and proposed offset area, including observations of threatening processes.

As demonstrated in the calculations below, the proposed offset area directly offsets more than 100% of anticipated significant residual impacts on Brigalow TEC. Notably, the area offsets approximately five times the impacts, providing an additional 100 ha of Brigalow TEC that is above the Offsets Policy requirements. Given this, the offset is considered to provide a substantial net conservation gain by improving both current condition and protected extent of the TEC. The proposed offset area will deliver a conservation outcome that will maintain and improve the viability of the affected MNES.

Table 1. Commonwealth OAG values for Brigalow TEC at the impact site

Attribute	Score	Rationale
Area (ha)	9.7 ha	Significant residual impact identified by BAMB (2016)
Condition	7	Average condition score calculated from field assessment conducted by BAMB (2016)
Total quantum of impact	6.79	As per OAG

Table 2. Commonwealth OAG values for Brigalow TEC within proposed offset area

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Area (ha)	27.1	86.6	Area verified in field assessments conducted by ELA (2016)	Area verified in field assessments conducted by ELA (2016)
Quality				
Start quality	7	6	<p>Site condition is moderate with species diversity, recruitment levels and structural complexity generally resembling an undisturbed community. However, weed incursion varies from low to high, canopy cover has been disturbed and the community lacks large mature trees.</p> <p>Site context is generally high due to high connectivity to surrounding vegetation resulting in a large contiguous vegetation patch. All areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor).</p>	<p>Site condition is poor to moderate due to moderate weed incursion, disturbed canopy layer and the lack of large mature trees. However, species diversity and recruitment levels were recorded at moderate levels.</p> <p>Site context is generally moderate due to reduced connectivity to surrounding vegetation resulting in smaller and isolated vegetation patches. However, all areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor).</p>
Future quality without offset	6	6	<p>Potential for future thinning activities has the potential to reduce structural complexity within the community and increase weed incursion.</p> <p>Continued presence of cattle can also reduce site condition through reducing groundcover and promoting exotic perennial grass growth.</p>	<p>Regrowth communities are generally on a trajectory of improvement. However with the continued presence of cattle grazing, other parameters of site condition can become further degraded. This includes native groundcover complexity, abundance and diversity through increase weed incursion levels.</p> <p>The potential of further clearing can also reduce site context through reduced patch sizes and connectivity.</p>
Future quality with offset	8	7	<p>Protection and management of this area can improve current condition, particularly existing weed incursion and canopy height and cover.</p>	<p>Regrowth communities are generally on a trajectory of improvement. With active management such as reduced cattle grazing, weed management and selective thinning, this improvement can be accelerated.</p> <p>Removal of stock will limit vegetation trampling and in turn allow native shrubs and ground covers to regenerate reducing the abundance of exotic pasture species. This can be further supplemented with weed management. Selective thinning can reduce Brigalow thickets and promote understorey growth and diversity. Protection from clearing will also allow for continued natural regeneration, increase canopy height and cover. Patch size and connectivity will also increase.</p>
Time until ecological benefit	10	20	<p>Remnant areas currently in good condition, with degradation occurring in only a few condition parameters. Estimated time</p>	<p>Estimated time for native species to regenerate, canopy layer to mature and shade out exotic pasture species.</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			is for understorey native species to regenerate and replace exotic pasture species.	
Confidence in quality scores	75%	70%	Removal of cattle and active management exotic weeds are effective measures in improving current degraded condition parameters	Improvement in vegetation structure is reliant on natural regeneration and therefore natural processes. However active management can effectively improve other degraded condition parameters such as weed levels, groundcover complexity, diversity and abundance.
Raw gain	2	1	As per OAG	
Adjusted gain	1.5	0.7	As per OAG	
Risk of Loss				
Risk of loss without offset	15%	90%	Thinning activities are permitted under State legislation within remnant communities, which could impact on a portion of the area without triggering a significant impact under Commonwealth legislation. Thinning activities could reduce structural complexity, promote grazing and increase exotic pasture incursion that would result in a loss of Brigalow TEC status.	As the areas have been historically cleared there is a high chance that the area is periodically cleared for pasture activities. Only a small proportion of regrowth could potentially trigger Commonwealth assessment as the Brigalow TEC.
Risk of loss with offset	5%	5%	The offset area will be legally secured and clearing activities will be prohibited. Stochastic events such as natural fires and flooding will still pose a risk to the offset area. Management actions and remediation activities will be in place to assist in reducing these risks or the severity of outcomes.	
Time over which loss is averted	20	20	Maximum of 20 years.	
Confidence in risk scores	90%	90%	The offset area will be legally secured and clearing activities will be prohibited. This will effectively reduce risk of loss.	
Raw gain	2.71	73.61	As per OAG	
Adjusted gain	2.44	66.25	As per OAG	
Results				
Net present value	4.41	37.01	As per OAG	
% impact offset	67.80%	545.05%	As per OAG	
TOTAL % impact offset	612.85%		Proposed offset area substantially offsets significant residual impacts on Brigalow TEC	

6.2 Ornamental Snake

The proposed offset area provides 254.6 ha of Ornamental Snake habitat that contains the preferred habitat structure, resources and essential microhabitat features that are species requirements outlined in the Commonwealth species profile and threat database. This habitat can be described as woodland and regrowth communities analogous to RE11.3.1 and RE11.4.9 that support gilgai and soil cracks. Woodland and regrowth communities within close proximity to wetlands or large waterway systems (stream order >4) are also areas of identified Ornamental Snake habitat within the offset area, which includes communities analogous to RE11.3.25, RE11.3.3, RE11.3.4 and RE11.3.27.

The woodland communities within the offset area are in remnant condition and contain aquatic habitat suitable to support the species preferred prey of frogs. Habitat on clays plains were found to contain a variety of shallow to deep gilgai that could retain soil moisture as well as large pools of water suitable for use as breeding habitat for frog species. Based on the presence and condition of aquatic habitat, foraging resources were verified during field surveys to be abundant within remnant habitat areas. In addition, remnant habitat areas were found to contain an abundance of coarse woody debris, deep leaf litter and/or soil cracks that could provide sufficient shelter habitat for the species. Habitat quality assessments found these remnant areas to be in moderate to high condition.

The regrowth communities within the offset area were also found to contain suitable aquatic habitat and therefore foraging resources for Ornamental Snake. The abundance of shelter habitat was not as high as remnant habitat areas; however deep soils cracks were present throughout regrowth areas. Habitat quality assessments found regrowth habitat to be in poor to moderate.

The proposed offset area occurs in the lower catchment of the Connors River, which consists of a series of braided channels, lagoon wetland systems and floodplains, all land form types where the species is often found in greatest numbers. Species presence has been confirmed within the area and species abundance was found to be high during fauna surveys within suitable habitat areas, which includes areas of regrowth habitat. This recorded presence is now the most eastern known population for the species. The proposed offset area and surrounding suitable habitat is therefore considered important in maintaining the population of Ornamental Snake in the region.

Suggested attribute values for use in the Commonwealth OAG have been generated and are provided below (see **Table 3** and **Table 4**). These values are based on field data collected at both the impact site and proposed offset area, including observations of threatening processes.

As demonstrated in the calculations below, the proposed offset area directly offsets more than 100% of anticipated significant residual impacts on Ornamental Snake. Notably, the area offsets approximately one and a half times the impacts, providing an additional 55 ha of Ornamental Snake habitat that is above the Offsets Policy requirements. Given this, the offset is considered to provide a substantial net conservation gain by improving both current condition and protected extent of Ornamental Snake habitat. The proposed offset area will deliver a conservation outcome that will maintain and improve the viability of the affected MNES.

Table 3. Commonwealth OAG values for Ornamental Snake at the impact site

Attribute	Score	Rationale
Area (ha)	52.33 ha	Significant residual impact identified by BAMM (2016)
Condition	7	Average condition score calculated from field assessment conducted by BAMM (2016)
Total quantum of impact	36.63	As per OAG

Table 4. Commonwealth OAG values for Ornamental Snake within proposed offset area

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Area (ha)	213.5	41.1	Area verified in field assessments conducted by ELA (2016)	Area verified in field assessments conducted by ELA (2016)
Quality				
Start quality	7	5	<p>Site condition is moderate with recruitment levels and structural complexity generally resembling an undisturbed community. However, weed incursion and therefore species diversity varies from low to high, canopy and shrub cover has been disturbed and in some areas there is a lack of large mature trees.</p> <p>Site context is ranges from moderate to high due to varying levels of connectivity to surrounding vegetation. Some areas form large contiguous vegetation patches, whilst other a more fragmented and isolated. All areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor). Habitat quality for Ornamental Snake is high due to moderate existing threats and the abundance of foraging and sheltering resources. These areas within the offset area are likely to play an important role in the maintenance of the species in the region.</p>	<p>Site condition is poor to moderate due to high weed incursion, disturbed canopy layer and the lack of large mature trees. However, species diversity and recruitment levels were recorded at moderate levels.</p> <p>Site context is generally moderate due to reduced connectivity to surrounding vegetation resulting in smaller and isolated vegetation patches. However, all areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor). Habitat quality for Ornamental Snake is moderate due to the presence of existing threats and reduced sheltering resources such as fallen woody debris. However, foraging resources are still moderate to abundant.</p>
Future quality without offset	6	3	<p>Potential for future thinning activities has the potential to reduce structural complexity within the ground layer and associated sheltering resources.</p> <p>Continued presence of cattle can also compact soils and reduce soil cracks that provide shelter habitat for the species. Grazing can also lead to erosion and sedimentation of wetlands, waterways and gilgai areas impacting negatively on frog populations, which are a key prey item for the Ornamental Snake.</p>	<p>Continued presence of cattle can also compact soils and reduce soil cracks that provide shelter habitat for the species. Grazing can also lead to erosion and sedimentation of wetlands, waterways and gilgai areas impacting negatively on frog populations, which are a key prey item for the Ornamental Snake.</p> <p>The potential of further clearing can also reduce habitat extent and connectivity, impacting on the species ability to disperse.</p>
Future quality with offset	8	7	<p>Protection and management of this area can improve current condition, particularly existing weed and pest species incursion. It can also further enhance habitat quality by</p>	<p>Regrowth communities are generally on a trajectory of improvement. With active management such as reduced cattle grazing and pest management, this improvement can be accelerated.</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
			ensuring continued natural succession and development of mature features such as logs and dense leaf litter.	Removal of stock will decrease soil compaction, limit understorey trampling and improve water quality of frog habitat. This will in turn improve the quality and abundance of foraging and sheltering resources. Control of pest species will also reduce potential threats to Ornamental Snake. Protection from clearing will increase connectivity and patch size, which in turn would increase the area's ability to sustain viable populations.
Time until ecological benefit	20	20	Estimated time for weed and pest reduction, further development of features such as logs and for increase in Ornamental Snake abundance and breeding success (due to better quality habitat and more prey items).	Estimated time for canopy layer to mature and provide leaf litter and fallen woody debris for sheltering habitat. This timeframe also accommodates for an increase in Ornamental Snake abundance and breeding success (due to better quality habitat and more prey items).
Confidence in quality scores	70%	70%	Improvement in quality and abundance of sheltering habitat is reliant on natural succession. However active management can effectively improve other degraded condition parameters such as weed levels and pest species presence.	
Raw gain	2	4	As per OAG	
Adjusted gain	1.4	2.8	As per OAG	
Risk of Loss				
Risk of loss without offset	15%	90%	Continuation of cattle grazing or thinning with the potential to intensify cattle grazing in areas of Ornamental Snake habitat could degrade essential habitat features that are critical to supporting the species. This includes soil cracks, fallen woody debris and quality prey habitat. The loss of these habitat requirements would result in the loss of suitable habitat.	As the areas have been historically cleared there is a high chance that the area is periodically cleared for pasture activities. Only a small proportion of regrowth could potentially trigger Commonwealth assessment as the Brigalow TEC. However, the majority of Ornamental Snake habitat is at risk of being cleared or grazed to the extent that essential habitat features for the species are lost.
Risk of loss with offset	5%	5%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be managed. Stochastic events such as natural fires and flooding will still pose a risk to the offset area. Management actions and remediation activities will be in place to assist in reducing these risks or the severity of outcomes.	
Time over which loss is averted	20	20	Maximum of 20 years.	
Confidence in risk scores	90%	90%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be undertaken for fire management purposes. This will effectively reduce risk of loss.	

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Raw gain	19.22	34.94	As per OAG	
Adjusted gain	18.46	31.44	As per OAG	
Results				
Net present value	39.18	22.25	As per OAG	
% impact offset	106.96%	60.75%	As per OAG	
TOTAL % impact offset	167.71%		Proposed offset area offsets significant residual impacts on Ornamental Snake	

6.3 Yakka Skink

The proposed offset area provides 245.8 ha of Yakka Skink habitat that is dominated by preferred vegetation type, substrate and essential microhabitat features that are species requirements outlined in the Commonwealth species profile and threat database. This habitat can be described as woodland and regrowth communities analogous to RE11.3.1, RE11.4.9, RE11.5.3, RE11.3.25 and RE11.3.4.

The woodland communities within the offset area are in remnant condition and occur on the soil substrates that are preferential for the species. In some portions, this habitat is also dominated by a canopy often associated with the species including Brigalow and Poplar Box. Both structural complexity and floristic diversity within remnant habitat was found to be moderate to high, providing an array of habitat niches for the species food source such as invertebrates. Based on this habitat condition, foraging resources were verified during field surveys to be abundant within remnant habitat areas. In addition, remnant habitat areas were found to contain an abundance of coarse woody debris, deep leaf litter in some areas, large logs, which provide sufficient shelter habitat for the species. Habitat quality assessments found these remnant areas to be in moderate condition.

The regrowth communities within the offset area were also found to occur on preferential soil substrates and contain associated canopy species. However, due to the degraded condition of these habitat types, both foraging and sheltering resources were found to be limited. Habitat quality assessments found regrowth habitat to be in poor to moderate.

Similar to the impact area, the offset area occurs in northern areas of the Brigalow Belt where populations of Yakka Skink are scattered and fragmented. Targeted searches for the species were not undertaken during field assessments; however previous records of the species occur within 106 km of the offset area. This is similar to the impact area where closest records of the species to the impact site are 190 km away.

Suggested attribute values for use in the Commonwealth OAG have been generated and are provided below (see **Table 7** and **Table 8**). These values are based on field data collected at both the impact site and proposed offset area, including observations of threatening processes.

As demonstrated in the calculations below, the proposed offset area directly offsets more than 100% of anticipated significant residual impacts on Yakka Skink. Notably, the area provides an additional 35 ha of Yakka Skink habitat that is above the Offsets Policy requirements. The proposed offset area will deliver a conservation outcome that will maintain and improve the viability of the affected MNES.

Table 7. Commonwealth OAG values for Yakka Skink at the impact site

Attribute	Score	Rationale
Area (ha)	99.35 ha	Significant residual impact identified by BAMB (2016)
Condition	7	Average condition score calculated from field assessment conducted by BAMB (2016)
Total quantum of impact	69.55	As per OAG

Table 8. Commonwealth OAG values for Yakka Skink within proposed offset area

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Area (ha)	159.2	86.6	Area verified in field assessments conducted by ELA (2016)	Area verified in field assessments conducted by ELA (2016)
Quality				
Start quality	7	5	<p>Site condition is moderate with recruitment levels and structural complexity generally resembling an undisturbed community. However, weed incursion and therefore species diversity varies from low to high, canopy and shrub cover has been disturbed and in some areas there is a lack of large mature trees.</p> <p>Site context is ranges from low to high due to varying levels of connectivity to surrounding vegetation. Some areas form large contiguous vegetation patches, whilst other a more fragmented and isolated. All areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor).</p> <p>Habitat quality for Yakka Skink is moderate due to limited existing threats and the moderate abundance of foraging and sheltering resources.</p>	<p>Site condition is poor to moderate due to high weed incursion, disturbed canopy layer and the lack of large mature trees. However, species diversity and recruitment levels were recorded at moderate levels.</p> <p>Site context is generally moderate due to reduced connectivity to surrounding vegetation resulting in smaller and isolated vegetation patches. However, all areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor).</p> <p>Habitat quality for Yakka Skink is low to moderate due to the presence of existing threats and reduced foraging habitat and very limited sheltering habitat.</p>
Future quality without offset	6	3	<p>Potential for future thinning activities has the potential to reduce structural complexity within the ground layer and associated sheltering resources.</p> <p>Continued presence of cattle and pest species such as feral pigs can destroy the species' burrow systems.</p>	<p>Continued presence of cattle and pest species such as feral pigs can destroy the species' burrow systems.</p> <p>The potential of further clearing can remove shelter sites and reduce habitat extent and connectivity.</p>
Future quality with offset	8	7	<p>Protection and management of this area can improve current condition, particularly pest species incursion. It can also further enhance habitat quality by ensuring continued natural succession and development of mature features such as logs and dense leaf litter.</p>	<p>Regrowth communities are generally on a trajectory of improvement. With active management such as reduced cattle grazing and pest management, this improvement can be accelerated.</p> <p>Removal of stock will improve ground layer structure and complexity. Control of pest species will also reduce potential threats to Yakka Skink.</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
				Protection from clearing will increase connectivity and patch size, which in turn would increase the area's ability to sustain viable populations.
Time until ecological benefit	20	20	Estimated time for pest reduction and further development of features such as logs.	Estimated time for pest reduction and canopy layer to mature and provide leaf litter and fallen woody debris for sheltering habitat.
Confidence in quality scores	70%	70%	Improvement in quality and abundance of sheltering habitat is reliant on natural succession. However active management can effectively improve other degraded condition parameters such as pest species presence.	
Raw gain	2	4	As per OAG	
Adjusted gain	1.4	2.8	As per OAG	
Risk of Loss				
Risk of loss without offset	15%	90%	Continuation of cattle grazing or thinning with the potential to intensify cattle grazing in areas of Yakka Skink habitat could degrade essential habitat features that are critical to supporting the species. This includes fallen woody debris, logs and burrowing systems. The loss of these habitat requirements would result in the loss of suitable habitat.	As the areas have been historically cleared there is a high chance that the area is periodically cleared for pasture activities. Only a small proportion of regrowth could potentially trigger Commonwealth assessment as the Brigalow TEC. However, the majority of Yakka Skink habitat is at risk of being cleared.
Risk of loss with offset	5%	5%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be managed. Stochastic events such as natural fires and flooding will still pose a risk to the offset area. Management actions and remediation activities will be in place to assist in reducing these risks or the severity of outcomes.	
Time over which loss is averted	20	20	Maximum of 20 years.	
Confidence in risk scores	90%	90%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be undertaken for fire management purposes. This will effectively reduce risk of loss.	
Raw gain	15.92	73.61	As per OAG	
Adjusted gain	14.33	66.25	As per OAG	
Results				
Net present value	29.22	46.89	As per OAG	
% impact offset	42.01%	67.42%	As per OAG	
TOTAL % impact offset	109.43%		Proposed offset area offsets significant residual impacts on Yakka Skink	

6.4 Squatter Pigeon

The proposed offset area provides 306.1 ha of Squatter Pigeon habitat that contains the preferred habitat structure, substrate and essential water resources that are species requirements outlined in the Commonwealth species profile and threat database. This habitat can be described as woodland and regrowth communities on alluvial or sand plains, which includes habitat analogous to RE11.3.1, RE11.3.25, RE11.3.4, RE11.3.3, RE11.3.27 and RE11.5.3.

The woodland communities within the offset area are in remnant condition and generally comprise the sandy or loamy, well-draining substrate that is required for the species to nest and forage. Portions of the remnant habitat also contain the preferred patchy native ground coverage (< 30% cover), which the species utilise to forage and dust-bathe. The mature canopy layer provides substantial sheltering habitat for the species. Based on the presence and condition of known habitat preferences for the species, both nesting and foraging habitat is abundant across the offset area. Habitat quality assessments found these remnant areas to be in moderate to high condition.

The regrowth communities within the offset area were also found to comprise the sandy or loamy, well-draining substrate but with often with high exotic ground coverage. The abundance of shelter habitat is lower than remnant habitat areas due to the lack of a mature canopy. Habitat quality assessments found regrowth habitat to be in poor to moderate condition.

The proposed offset area occurs in the lower catchment of the Connors River, which consists of a series of braided channels, lagoon wetland systems and floodplains. It provides the critical water resources necessary for the daily requirements of the species and within close proximity (<1 km) of suitable habitat. The offset area therefore provides potential breeding habitat for Squatter Pigeon. Whilst species presence was not confirmed during surveys, previous records of the species occur within 35 km of the offset area. The species has also been recorded 40 km downstream along the Connors River in adjacent regrowth habitat. The proposed offset area and surrounding suitable habitat is therefore considered important in maintaining the population of Squatter Pigeon in the region.

Suggested attribute values for use in the Commonwealth OAG have been generated and are provided below (see **Table 5** and **Table 6**). These values are based on field data collected at both the impact site and proposed offset area, including observations of threatening processes.

As demonstrated in the calculations below, the proposed offset area directly offsets more than 100% of anticipated significant residual impacts on Squatter Pigeon. Notably, the area offsets approximately one and a half times the impacts, providing an additional 100 ha of Squatter Pigeon habitat that is above the Offsets Policy requirements. Given this, the offset is considered to provide a substantial net conservation gain by improving both current condition and protected extent of Squatter Pigeon habitat. The proposed offset area will deliver a conservation outcome that will maintain and improve the viability of the affected MNES.

Table 5. Commonwealth OAG values for Squatter Pigeon at the impact site

Attribute	Score	Rationale
Area (ha)	89.2 ha	Significant residual impact identified by BAMM (2016)
Condition	7	Average condition score calculated from field assessment conducted by BAMM (2016)
Total quantum of impact	62.44	As per OAG

Table 6. Commonwealth OAG values for Squatter Pigeon within proposed offset area

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
Area (ha)	237.1	69	Area verified in field assessments conducted by ELA (2016)	Area verified in field assessments conducted by ELA (2016)
Quality				
Start quality	7	6	<p>Site condition is moderate with recruitment levels and structural complexity generally resembling an undisturbed community. However, weed incursion and therefore species diversity varies from low to high, canopy and shrub cover has been disturbed and in some areas there is a lack of large mature trees. Site context is ranges from moderate to high due to varying levels of connectivity to surrounding vegetation. Some areas form large contiguous vegetation patches, whilst other a more fragmented and isolated. All areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor).</p> <p>Habitat quality for Squatter Pigeon is moderate to high due to moderate levels of existing threats and the abundance of sheltering resources. Foraging habitat condition is variable, but critical water resources are present. These areas within the offset area are likely to play an important role in the maintenance of the species in the region.</p>	<p>Site condition is poor to moderate due to high weed incursion, disturbed canopy layer and the lack of large mature trees. However, species diversity and recruitment levels were recorded at moderate levels.</p> <p>Site context is generally moderate due to reduced connectivity to surrounding vegetation resulting in smaller and isolated vegetation patches. However, all areas are situated within a mapped ecological corridor (Isaac-Connors State Regional Corridor). Habitat quality for Squatter Pigeon is moderate due to reduced foraging and sheltering habitat condition as a result of the lack of a mature canopy and high exotic grass cover.</p>
Future quality without offset	6	4	<p>Potential for future thinning activities and continued presence of cattle can promote exotic grass cover, reducing availability of foraging resources (native grasses) and foraging habitat condition (patchy groundcover).</p>	<p>The potential of further clearing can reduce habitat patch size and availability of foraging and nesting resources.</p>
Future quality with offset	8	7	<p>Protection and management of this area can improve current condition, particularly existing weed and pest incursion.</p>	<p>Regrowth communities are generally on a trajectory of improvement. With active management such as reduced</p>

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
				cattle grazing and pest management, this improvement can be accelerated. Removal of stock will assist in improving native ground coverage. Control of pest species will also reduce potential threats to Squatter Pigeon. Protection from clearing will increase sheltering habitat.
Time until ecological benefit	20	20	Estimated time for weed and pest reduction and restoration of a more dominant native ground layer.	Estimated time for canopy layer to mature and provide sheltering habitat. This timeframe also accommodates for weed and pest reduction.
Confidence in quality scores	70%	70%	Reduction of weed coverage within the offset area will require ongoing and active management due to its location in lower catchment areas. However, this management approach can effectively improve degraded condition parameters.	
Raw gain	2	3	As per OAG	
Adjusted gain	1.4	2.1	As per OAG	
Risk of Loss				
Risk of loss without offset	15%	90%	Continuation of cattle grazing or thinning could degrade habitat adjacent to essential water resources, resulting in the loss of suitable habitat including potential breeding habitat critical to supporting the species.	As the areas have been historically cleared there is a high chance that the area is periodically cleared for pasture activities. Regrowth areas are not currently protected from ongoing clearing activities.
Risk of loss with offset	5%	5%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be managed. Stochastic events such as natural fires and flooding will still pose a risk to the offset area. Management actions and remediation activities will be in place to assist in reducing these risks or the severity of outcomes.	
Time over which loss is averted	20	20	Maximum of 20 years.	
Confidence in risk scores	90%	90%	The offset area will be legally secured, clearing activities will be prohibited and grazing will be undertaken for fire management purposes. This will effectively reduce risk of loss.	
Raw gain	23.71	58.65	As per OAG	
Adjusted gain	21.34	52.79	As per OAG	
Results				
Net present value	43.51	36.89	As per OAG	
% impact offset	69.69%	59.09%	As per OAG	

Attribute	Score		Rationale	
	Remnant	Regrowth	Remnant	Regrowth
TOTAL % impact offset	128.78%		Proposed offset area offsets significant residual impacts on Squatter Pigeon	

7. MSES VALUES & OFFSET SUITABILITY

7.1 Regulated Vegetation - Endangered

The proposed offset area provides 113.7 ha of 'endangered' regulated vegetation, which comprises 27.1 ha in remnant condition and 86.6 ha in regrowth condition. Vegetation is analogous to RE11.3.1 and RE11.4.8, which falls under BVG 25a. Overall habitat quality scores for regrowth and remnant areas are six and seven out of ten, respectively.

Significant residual impacts on endangered regulated vegetation are anticipated to be 2.03 ha. As per the Queensland Government Land-based Offset Multiplier Calculator a multiplier of 3.67 or 7.5 ha of regrowth vegetation is required to sufficiently offset impacts. The extent of regrowth areas fulfils this requirement. Predicted habitat quality gain of regrowth areas is two, which equates to an increased overall habitat quality score of eight out of ten after 20 years.

Remnant areas within the offset area have not been used to offset significant residual impacts due to the current high habitat quality score and therefore the requirement to achieve a score of nine out of ten within 20 years.

7.2 Regulated Vegetation – Of Concern

The proposed offset area provides 162.2 ha of 'of concern' regulated vegetation, which comprises 153 ha in remnant condition and 9.2 ha in regrowth condition. Vegetation is analogous to RE11.3.3 and RE11.3.4, which falls under BVG 16c. Overall habitat quality scores for regrowth and remnant areas is six out of ten.

Significant residual impacts on of concern regulated vegetation are anticipated to be 5.07 ha. As per the Queensland Government Land-based Offset Multiplier Calculator a multiplier of 3.67 or 18.6 ha of regrowth vegetation is required to sufficiently offset impacts. For remnant communities a multiplier of 4 or 20.28 ha is required. The extent of regrowth areas alone do not fulfil this requirement. An additional 10.3 ha of remnant vegetation will be utilised to offset anticipated impacts. Predicted habitat quality gain of regrowth areas is two, which equates to an increased overall habitat quality score of eight out of ten after 20 years.

7.3 Regulated Vegetation – Watercourse

The proposed offset area provides 162.2 ha of regulated 'watercourse' vegetation analogous to RE11.3.1, RE11.3.3 and RE11.3.4, which falls under BVG 25a and 16c, respectively. All vegetation is associated with the Connors River and mapped tributaries.

Regulated watercourse vegetation from BVG 25a comprises 13.6 ha in remnant condition and 59.8 ha in regrowth condition. Overall habitat quality scores for regrowth and remnant areas are six and seven out of ten, respectively. Regulated watercourse vegetation from BVG 16c comprises 76.5 ha in remnant condition and 9.2 ha in regrowth condition. Overall habitat quality scores for regrowth and remnant areas is six out of ten.

Significant residual impacts on regulated watercourse vegetation are anticipated to be 0.56 ha (BVG 25a) and 1.1 ha (BVG 16c). As per the Queensland Government Land-based Offset Multiplier Calculator a multiplier of 3.67 or 2.1 ha (BVG 25a) and 4 ha (BVG 16c) of regrowth vegetation is required to sufficiently offset impacts. The extent of regrowth areas fulfils this requirement. Predicted habitat quality gain of regrowth areas is two, which equates to an increased overall habitat quality score of eight out of ten after 20 years.

Remnant areas of regulated watercourse vegetation from BVG 25a within the offset area have not been used to offset significant residual impacts due to the current high habitat quality score and therefore the requirement to achieve a score of nine out of ten within 20 years. Remnant areas of regulated watercourse

vegetation from BVG 16c within the offset area have not been used to offset significant residual impacts as additional contribution is not required.

8. CURRENT THREATS

Value	Threat
Brigalow TEC	<ul style="list-style-type: none"> • Clearing of regrowth areas <15 years of age • Thinning of remnant communities to increase cattle grazing resulting in reduced ground layer diversity and structure, and an increase in exotic perennial grass cover
Ornamental Snake	<ul style="list-style-type: none"> • Clearing of regrowth habitat • Ongoing cattle grazing compacting soils, reducing soil cracks and degrading aquatic habitat • Thinning of remnant communities resulting in reduced ground layer structure • Ongoing pest incursion and predation on Ornamental Snake
Squatter Pigeon	<ul style="list-style-type: none"> • Clearing of regrowth habitat • Thinning of remnant communities & increase cattle grazing resulting in an increase in exotic perennial grass cover • Ongoing pest incursion and predation on Squatter Pigeon
Yakka Skink	<ul style="list-style-type: none"> • Clearing of shelter habitat within regrowth areas • Thinning of remnant communities resulting in reduced ground layer structure • Ongoing pest incursion (feral pigs) destroying potential burrowing systems
MSES	<ul style="list-style-type: none"> • Clearing of regrowth areas • Thinning in remnant communities • Degradation of understorey from weed incursion and cattle grazing

Attachment 1B: Detailed Field Data and Assessment Units

Assessment Unit 1

BioCondition Scoring Sheet	Max Score	CB22 Site 1	CB30 Site 2	CB36 Site 3
Field based attributes				
Recruitment of woody perennial species	5	3	5	3
Native plant species richness				
<i>Trees</i>	5	5	5	5
<i>Shrubs</i>	5	5	5	5
<i>Grasses</i>	5	5	5	2.5
<i>Forbs</i>	5	5	5	5
Tree Canopy Height	5	5	5	5
Tree Canopy Cover	5	3	3	3
Shrub canopy cover	5	3	5	5
Native perennial grass cover	5	5	5	5
Organic litter cover	5	5	5	3
Large trees	15	5	5	5
Coarse woody debris	5	2	5	2
Weed cover	10	10	10	5
Total Field based attributes	80	61	68	53.5
GIS based attributes				
Fragmented - Patch size (input score manually)	10	10	10	10
Fragmented - Connectivity (l, m, h, or vh)	5	4	4	4
Fragmented - Context (input score manually)	5	4	2	4
Fragmented - Corridors	6	6	6	6
Total GIS attributes	26	24	22	24
Total BioCondition Score	106	85	90	77.5
Average Total BioCondition Score			84.17	



Assessment Unit 2

BioCondition Scoring Sheet

	Max Score	CB21 Site 1	CB17 Site 2	CB24 Site 3	CB37 Site 4	CB38 Site 5
Field based attributes						
Recruitment of woody perennial species	5	5	5	5	5	5
Native plant species richness						
<i>Trees</i>	5	5	5	5	5	5
<i>Shrubs</i>	5	2.5	2.5	2.5	5	0
<i>Grasses</i>	5	5	5	5	5	5
<i>Forbs</i>	5	5	5	5	2.5	5
Tree Canopy Height	5	3	3	3	3	3
Tree Canopy Cover	5	5	2	2	2	2
Shrub canopy cover	5	5	3	5	5	3
Native perennial grass cover	5	5	3	5	5	5
Organic litter cover	5	5	5	3	5	3
Large trees	15	0	0	0	0	0
Coarse woody debris	5	0	0	0	0	0
Weed cover	10	5	3	3	0	5
Total Field based attributes	80	50.5	41.5	43.5	42.5	41
GIS based attributes						
Fragmented - Patch size (input score manually)	10	10	7	10	7	10
Fragmented - Connectivity (l, m, h, or vh)	5	2	2	2	4	2
Fragmented - Context (input score manually)	5	4	4	4	4	4
Fragmented - Corridors	6	6	6	6	6	6
Total GIS attributes	26	22	19	22	21	22
Total BioCondition Score	106	72.5	60.5	65.5	63.5	63
Average Total BioCondition Score				65.00		



Assessment Unit 3

BioCondition Scoring Sheet

CB34
Max Score Site 1

Field based attributes

Recruitment of woody perennial species	5	5
Native plant species richness		
<i>Trees</i>	5	2.5
<i>Shrubs</i>	5	2.5
<i>Grasses</i>	5	2.5
<i>Forbs</i>	5	2.5
Tree Canopy Height	5	5
Tree Canopy Cover	5	5
Shrub canopy cover	5	3
Native perennial grass cover	5	3
Organic litter cover	5	5
Large trees	15	0
Coarse woody debris	5	0
Weed cover	10	0
Total Field based attributes	80	36
GIS based attributes		
Fragmented - Patch size (input score manually)	10	10
Fragmented - Connectivity (l, m, h, or vh)	5	4
Fragmented - Context (input score manually)	5	2
Fragmented - Corridors	6	6
Total GIS attributes	26	22
Total BioCondition Score	106	58
Average Total BioCondition Score		58.00



Assessment Unit 4

BioCondition Scoring Sheet

CB32
Max Score Site 1

Field based attributes

Recruitment of woody perennial species	5	5
Native plant species richness		
<i>Trees</i>	5	5
<i>Shrubs</i>	5	0
<i>Grasses</i>	5	2.5
<i>Forbs</i>	5	2.5
Tree Canopy Height	5	3
Tree Canopy Cover	5	2
Shrub canopy cover	5	3
Native perennial grass cover	5	5
Organic litter cover	5	3
Large trees	15	0
Coarse woody debris	5	2
Weed cover	10	3
Total Field based attributes	80	36
GIS based attributes		
Fragmented - Patch size (input score manually)	10	10
Fragmented - Connectivity (l, m, h, or vh)	5	2
Fragmented - Context (input score manually)	5	2
Fragmented - Corridors	6	6
Total GIS attributes	26	20
Total BioCondition Score	106	56
Average Total BioCondition Score		56.00



Assessment Unit 5

BioCondition Scoring Sheet

	Max Score	CB40 Site 2	CB41 Site 3
Field based attributes			
Recruitment of woody perennial species	5	3	5
Native plant species richness			
<i>Trees</i>	5	5	5
<i>Shrubs</i>	5	5	5
<i>Grasses</i>	5	2.5	2.5
<i>Forbs</i>	5	2.5	2.5
Tree Canopy Height	5	5	5
Tree Canopy Cover	5	3	3
Shrub canopy cover	5	0	0
Native perennial grass cover	5	3	5
Organic litter cover	5	5	5
Large trees	15	5	5
Coarse woody debris	5	5	5
Weed cover	10	0	5
Total Field based attributes	80	44	53
GIS based attributes			
Fragmented - Patch size (input score manually)	10	7	10
Fragmented - Connectivity (l, m, h, or vh)	5	0	5
Fragmented - Context (input score manually)	5	2	4
Fragmented - Corridors	6	6	6
Total GIS attributes	26	15	25
Total BioCondition Score	106	59	78
Average Total BioCondition Score		68.50	



Assessment Unit 6

BioCondition Scoring Sheet

	Max Score	CB6 Site 1	CB49 Site 4
Field based attributes			
Recruitment of woody perennial species	5	0	5
Native plant species richness			
<i>Trees</i>	5	5	2.5
<i>Shrubs</i>	5	0	2.5
<i>Grasses</i>	5	2.5	2.5
<i>Forbs</i>	5	2.5	5
Tree Canopy Height	5	5	5
Tree Canopy Cover	5	5	5
Shrub canopy cover	5	3	3
Native perennial grass cover	5	3	3
Organic litter cover	5	3	5
Large trees	15	10	10
Coarse woody debris	5	0	2
Weed cover	10	3	5
Total Field based attributes	80	42	55.5
GIS based attributes			
Fragmented - Patch size (input score manually)	10	7	10
Fragmented - Connectivity (l, m, h, or vh)	5	4	2
Fragmented - Context (input score manually)	5	2	2
Fragmented - Corridors	6	6	6
Total GIS attributes	26	19	20
Total BioCondition Score	106	61	75.5
Average Total BioCondition Score		68.25	



Assessment Unit 7

BioCondition Scoring Sheet

	CB25	CB27	CB28	CB29	
	Site 1	Site 2	Site 3	Site 4	
Field based attributes					
Recruitment of woody perennial species	5	3	5	5	5
Native plant species richness					
<i>Trees</i>	5	5	5	5	5
<i>Shrubs</i>	5	2.5	2.5	2.5	0
<i>Grasses</i>	5	2.5	2.5	2.5	0
<i>Forbs</i>	5	2.5	2.5	2.5	0
Tree Canopy Height	5	3	3	3	3
Tree Canopy Cover	5	5	5	5	5
Shrub canopy cover	5	5	3	3	5
Native perennial grass cover	5	5	3	5	1
Organic litter cover	5	5	5	5	5
Large trees	15	0	0	0	0
Coarse woody debris	5	2	0	2	2
Weed cover	10	0	0	0	0
Total Field based attributes	80	40.5	36.5	40.5	31
GIS based attributes					
Fragmented - Patch size (input score manually)	10	10	10	10	10
Fragmented - Connectivity (l, m, h, or vh)	5	2	2	2	2
Fragmented - Context (input score manually)	5	4	4	4	4
Fragmented - Corridors	6	6	6	6	6
Total GIS attributes	26	22	22	22	22
Total BioCondition Score	106	62.5	58.5	62.5	53
Average Total BioCondition Score			59.13		



Assessment Unit 8

BioCondition Scoring Sheet

Field based attributes

Recruitment of woody perennial species	5	3	5	5
Native plant species richness				
<i>Trees</i>	5	5	5	5
<i>Shrubs</i>	5	5	5	5
<i>Grasses</i>	5	2.5	2.5	2.5
<i>Forbs</i>	5	2.5	2.5	5
Tree Canopy Height	5	5	5	5
Tree Canopy Cover	5	3	3	5
Shrub canopy cover	5	5	3	5
Native perennial grass cover	5	5	5	5
Organic litter cover	5	5	5	5
Large trees	15	15	15	5
Coarse woody debris	5	2	5	5
Weed cover	10	5	5	10
Total Field based attributes	80	63	66	67.5
GIS based attributes				
Fragmented - Patch size (input score manually)	10	10	10	5
Fragmented - Connectivity (l, m, h, or vh)	5	5	5	5
Fragmented - Context (input score manually)	5	4	4	2
Fragmented - Corridors	6	6	6	6
Total GIS attributes	26	25	25	18
Total BioCondition Score	106	88	91	85.5
Average Total BioCondition Score			88.17	

	CB16 Site 1	CB23 Site 2	CB31 Site 3
--	----------------	----------------	----------------



Assessment Unit 9

BioCondition Scoring Sheet

	Max Score	CB7 Site 1	CB44 Site 2
Field based attributes			
Recruitment of woody perennial species	5	5	3
Native plant species richness			
<i>Trees</i>	5	5	5
<i>Shrubs</i>	5	0	0
<i>Grasses</i>	5	5	5
<i>Forbs</i>	5	5	5
Tree Canopy Height	5	5	5
Tree Canopy Cover	5	5	5
Shrub canopy cover	5	5	5
Native perennial grass cover	5	5	3
Organic litter cover	5	3	3
Large trees	15	15	15
Coarse woody debris	5	5	0
Weed cover	10	10	10
Total Field based attributes	80	73	64
GIS based attributes			
Fragmented - Patch size (input score manually)	10	7	5
Fragmented - Connectivity (l, m, h, or vh)	5	5	2
Fragmented - Context (input score manually)	5	4	4
Fragmented - Corridors	6	6	6
Total GIS attributes	26	22	17
Total BioCondition Score	106	95	81
Average Total BioCondition Score		88.00	



Assessment Unit 10

BioCondition Scoring Sheet

Field based attributes

Recruitment of woody perennial species	5	5	3
Native plant species richness			
<i>Trees</i>	5	2.5	2.5
<i>Shrubs</i>	5	5	2.5
<i>Grasses</i>	5	2.5	5
<i>Forbs</i>	5	2.5	0
Tree Canopy Height	5	5	5
Tree Canopy Cover	5	2	5
Shrub canopy cover	5	5	5
Native perennial grass cover	5	5	5
Organic litter cover	5	5	5
Large trees	15	5	10
Coarse woody debris	5	5	5
Weed cover	10	0	0
Total Field based attributes	80	49.5	53
GIS based attributes			
Fragmented - Patch size (input score manually)	10	5	5
Fragmented - Connectivity (l, m, h, or vh)	5	0	2
Fragmented - Context (input score manually)	5	2	2
Fragmented - Corridors	6	6	6
Total GIS attributes	26	13	15
Total BioCondition Score	106	62.5	68
Average Total BioCondition Score		65.25	

	CB33	CB35
Max Score	Site 1	Site 2



Fauna Scores

	Remnant							Mature regrowth							Regrowth					
	Threats to species	Quality & availability of foraging habitat	Quality & availability of shelter	Species mobility capacity	Role of site	Total score		Threats to species	Quality & availability of foraging habitat	Quality & availability of shelter	Species mobility capacity	Role of site	Total score		Threats to species	Quality & availability of foraging habitat	Quality & availability of shelter	Species mobility capacity	Role of site	Total score
Ornamental Snake							Ornamental Snake							Ornamental Snake						
11.3.1	15	5	10	10	4	44	11.3.1	7	5	5	7	4	28	11.3.1	7	5	5	7	4	28
11.4.9	7	10	10	10	4	41	11.4.9	-	-	-	-	-	-	11.4.9	7	5	5	7	4	28
11.3.3	7	10	5	10	4	36	11.3.3	7	5	1	7	4	24	11.3.3	-	-	-	-	-	-
11.3.4	15	10	5	10	4	44	11.3.4	-	-	-	-	-	-	11.3.4	-	-	-	-	-	-
11.3.27	7	10	5	10	4	36	11.3.27	-	-	-	-	-	-	11.3.27	-	-	-	-	-	-
11.3.25	15	10	5	10	4	44	11.3.25	-	-	-	-	-	-	11.3.25	-	-	-	-	-	-
Squatter Pigeon							Squatter Pigeon							Squatter Pigeon						
11.3.3	7	5	10	10	4	36	11.3.3	7	5	1	10	4	27	11.3.3	-	-	-	-	-	-
11.3.27	7	5	10	10	4	36	11.3.27	-	-	-	-	-	-	11.3.27	-	-	-	-	-	-
11.3.25	7	10	10	10	4	41	11.3.25	-	-	-	-	-	-	11.3.25	-	-	-	-	-	-
11.3.1	15	1	10	10	4	40	11.3.1	7	1	5	10	4	27	11.3.1	7	1	1	10	4	23
11.3.4	7	5	10	10	4	36	11.3.4	-	-	-	-	-	-	11.3.4	-	-	-	-	-	-
11.5.3	7	10	10	10	4	41	11.5.3	-	-	-	-	-	-	11.5.3	-	-	-	-	-	-
Yakka Skink							Yakka Skink							Yakka Skink						
11.3.1	15	5	1	10	1	32	11.3.1	7	5	1	10	1	24	11.3.1	7	1	1	10	1	20
11.4.9	15	5	1	10	1	32	11.4.9	-	-	-	-	-	-	11.4.9	7	1	1	10	1	20
11.3.25	15	10	10	10	1	46	11.3.25	-	-	-	-	-	-	11.3.25	-	-	-	-	-	-
11.3.4	15	10	5	10	1	41	11.3.4	-	-	-	-	-	-	11.3.4	-	-	-	-	-	-
11.5.3	7	5	5	10	1	28	11.5.3	-	-	-	-	-	-	11.5.3	-	-	-	-	-	-

MNES Offset Area Scores

	AU 1			AU 2			AU 3			AU 4		
	11.3.1 rem			11.3.1 regrowth			11.4.9 remnant			11.4.9 regrowth		
Brigalow TEC	Area	Score	Weighted Score	Area	Score	Weighted Score	Area	Score	Weighted Score	Area	Score	Weighted Score
	13.6	7.94339623	3.971698113	59.8	6.1320755	4.231132075	13.5	5.471698	2.735849057	26.8	5.283019	1.637735849
Ornamental Snake	11.3.1 rem			11.3.1 regrowth			11.4.9 remnant			11.4.9 regrowth		
	Area	Score	Weighted Score	Area	Score	Weighted Score	Area	Score	Weighted Score	Area	Score	Weighted Score
	13.1	8.21794872	0.493076923	7.9	5.9615385	1.132692308	13.5	6.346154	0.380769231	26.8	5.384615	3.5
Yakka Skink	11.3.1 rem			11.3.1 regrowth			11.4.9 remnant			11.4.9 regrowth		
	Area	Score	Weighted Score	Area	Score	Weighted Score	Area	Score	Weighted Score	Area	Score	Weighted Score
	13.6	7.44871795	0.670384615	59.8	5.5769231	3.848076923	13.5	5.769231	0.461538462	26.8	4.871795	1.51025641
Squatter Pigeon	11.3.1 rem			11.3.1 regrowth								
	Area	Score	Weighted Score	Area	Score	Weighted Score						
	13.6	7.96153846	0.477692308	59.8	5.7692308	5.019230769						
	AU 5			AU 6			AU 7			AU 8		
Brigalow TEC												
Ornamental Snake	11.3.4 rem			11.3.3 rem			11.3.3 mature regrowth			11.3.25 rem		
	Area	Score	Weighted Score	Area	Score	Weighted Score	Area	Score	Weighted Score	Area	Score	Weighted Score
	75.3	7.21153846	2.524038462	76.4	6.6826923	2.405769231	6.4	5.328846	0.852615385	21.5	8.472436	0.84724359
Yakka Skink	11.3.4 rem									11.3.25 rem		
	Area	Score	Weighted Score							Area	Score	Weighted Score
	75.3	7.01923077	3.299038462							21.5	8.600641	1.204089744
Squatter Pigeon	11.3.4 rem			11.3.3 rem			11.3.3 mature regrowth			11.3.25 rem		
	Area	Score	Weighted Score	Area	Score	Weighted Score	Area	Score	Weighted Score	Area	Score	Weighted Score
	75.3	6.69871795	2.143589744	77.7	6.6826923	2.205288462	9.2	5.521154	0.71775	21.5	8.280128	0.745211538
	AU 9			AU 10								
Brigalow TEC												
Ornamental Snake	11.3.27 rem											
	Area	Score	Weighted Score									
	13.7	7.94871795	0.476923077									
Yakka Skink				11.5.3 rem								
				Area	Score	Weighted Score						
				35.3	5.9775641	1.315064103						
Squatter Pigeon	11.3.27 rem			11.5.3 rem								
	Area	Score	Weighted Score	Area	Score	Weighted Score						
	13.7	7.94871795	0.476923077	35.3	6.8108974	1.021634615						

MSES Offset Area Scores

	AU 1			AU 2		
Endangered 25a	11.3.1 remnant Area	Weighted Score	Weighted Score	11.3.1 regrowth Area	Weighted Score	Weighted Score
	13.6	7.940566	3.970283019	59.8	6.132075	4.231132075
Watercourse 16c Of Concern 16c						
Watercourse 25a	11.3.1 remnant Area	Weighted Score	Weighted Score	11.3.1 regrowth Area	Weighted Score	Weighted Score
	13.6	7.940566	-	59.8	6.132075	-
	AU 3			AU 4		
Endangered 25a	11.4.9 remnant Area	Weighted Score	Weighted Score	11.4.9 regrowth Area	Weighted Score	Weighted Score
	13.5	5.471698	2.735849057	26.8	5.283019	1.637735849
Watercourse 16c Of Concern 16c						
Watercourse 25a						
	AU 5			AU 6		
Endangered 25a						
Watercourse 16c Of Concern 16c	11.3.4 rem Area	Weighted Score	Weighted Score	11.3.3 rem Area	Weighted Score	Weighted Score
	75.3	6.462264	3.166509434	77.7	6.438679	3.283726415
Watercourse 25a						
	AU 7					
Endangered 25a						
Watercourse 16c Of Concern 16c	11.3.3 mature regrowth Area	Weighted Score	Weighted Score			
	9.2	5.578302	-			
Watercourse 25a						

Impact Site Scores

MNES value	Significant Residual Impact (ha)	Condition score
Ornamental Snake habitat	83.19	7
Yakka Skink habitat	99.35	7
Brigalow TEC	9.7	7
MSES value		
Endangered regulated vegetation (BVG 25a)	2.03	7
Of Concern regulated vegetation (BVG 17a)	2.16	7
Of Concern regulated vegetation (BVG 16c)	5.07	7
Watercourse regulated vegetation (BVG 25a)	0.56	7
Watercourse regulated vegetation (BVG 16c)	1.1	7
Watercourse regulated vegetation (BVG 17a)	4.83	7
Squatter Pigeon habitat	14.01	7

Impact vs Offset Summary

Offset value	Significant Residual Impact (ha) Condition score		Offset (ha) Condition			Calculation score Total			Meets requirements	Surplus (ha)
	Impact (ha)	Condition score	(ha)	Condition	Regrowth	Remnant	Regrowth	Remnant		
MNES values										
Ornamental Snake habitat	52.33	7	254.6	5	7	60.75%	106.96%	167.71%	✓	~55
Yakka Skink habitat	99.35	7	245.8	5	7	67.42%	42.01%	109.43%	✓	~35
Brigalow TEC	9.7	7	113.7	6	7	545.05%	67.80%	612.85%	✓	~100
Squatter Pigeon habitat	89.2	7	306.1	6	7	59.09%	69.69%	128.78%	✓	~100
MSES value										
Endangered regulated vegetation (BVG 25a)	2.03	7	113.7	6	7	x3.67	Not suitable	7.4501	✓	79.1499
Of Concern regulated vegetation (BVG 16c)	5.07	7	162.2	6	6	x3.67	x4	19.455	✓	142.72
Watercourse regulated vegetation (BVG 25a)	0.56	7	73.4	6	8	x3.67	Not suitable	2.0552	✓	57.7448
Watercourse regulated vegetation (BVG 16c)	1.1	7	162.2	6	6	x3.67	x4	4.037	✓	158.16

Fact sheet
DECLARED CLASS 2 PEST PLANT

Parthenium weed

Parthenium hysterophorus



Parthenium costs the beef industry a total of \$16.5 million per year and cropping industries several million dollars per year.

Declaration details

In Queensland, Parthenium is a Class 2 declared plant.

Under the *Land Protection (Pest and Stock Route Management) Act 2002*, Class 2 declaration requires landholders to control pests on the land and waters under their control. A local government may serve a notice upon a landholder requiring control of declared pests.



PP2 June 2011

Description and general information

Size

Parthenium weed is an annual herb with a deep tap root and an erect stem that becomes woody with age. As it matures, the plant develops many branches in its top half and may eventually reach a height of two metres.

Leaves

Its leaves are pale green, deeply lobed and covered with fine soft hairs.

Flowers

Small creamy white flowers occur on the tips of the numerous stems. Each flower contains four to five black seeds that are wedge-shaped, two millimetres long with two thin, white scales.

Lifecycle

Parthenium weed normally germinates in spring and early summer, produces flowers and seed throughout its life and dies around late autumn. However, with suitable conditions (rain, available moisture, mild temperatures), parthenium weed can grow and produce flowers at any time of the year. In summer, plants can flower and set seed within four weeks of germination, particularly if stressed.

Potential damage

Parthenium weed is a vigorous species that colonises weak pastures with sparse ground cover. It will readily colonise disturbed, bare areas along roadsides and heavily stocked areas around yards and watering points. Parthenium weed can also colonise brigalow, gidgee and softwood scrub soils. Its presence reduces the reliability of improved pasture establishment and reduces pasture production potential.

Parthenium weed is also a health problem as contact with the plant or the pollen can cause serious allergic reactions such as dermatitis and hay fever.

Habitat and distribution

Parthenium weed is capable of growing in most soil types but becomes most dominant in alkaline, clay loam soils.

The plant is well established in Central Queensland and present in isolated infestations west to Longreach and in northern and southern Queensland.

Infestations have also been found in northern and central parts of New South Wales and it is capable of growing in most states of Australia.

Control

Prevention and weed seed spread

As with most weeds, prevention is much cheaper and easier than cure. Pastures maintained in good condition, with high levels of grass crown cover, will

limit parthenium weed colonisation. Drought, and the subsequent reduced pasture cover, creates the ideal window of opportunity for parthenium weed colonisation when good conditions return.

Parthenium seeds can spread via water, vehicles, machinery, stock, feral and native animals and in feed and seed. Drought conditions aid the spread of seed with increased movements of stock fodder and transports.

Vehicles and implements passing through parthenium weed infested areas should be washed down with water. Wash down facilities are located in Alpha, Biloela, Charters Towers, Emerald, Gracemere, Injune, Monto, Moura, Rolleston, Springsure and Taroom. Particular care should be taken with earthmoving machinery and harvesting equipment. The wash down procedure should be confined to one area, so that plants that establish from dislodged seed can be destroyed before they set seed.

Extreme caution should be taken when moving cattle from infested to clean areas. Avoid movement during wet periods as cattle readily transport seed in muddy soil. On arrival, cattle should be held in yards or small paddocks until seed has dropped from their coats and tails prior to their release into large paddocks. Infestations around yards can be easily spotted and controlled whereas infestations can develop unnoticed in large paddocks.

Particular care should be taken when purchasing seed, hay and other fodder materials. Always keep a close watch on areas where hay has been fed out for the emergence of parthenium or other weeds.

Property hygiene is important. Owners of clean properties should ensure that visitors from infested areas do not drive through their properties. If your property has parthenium weed on it, ensure that it is not spread beyond the boundary or further within the property.

Pasture management

Grazing management is the most useful method of controlling large-scale parthenium weed infestations. Maintain pastures in good condition with high levels of ground and grass crown cover. This may require rehabilitation of poor pastures, followed by a sound grazing maintenance program.

Sown pasture establishment—Poor establishment of sown pastures can allow parthenium weed colonisation. pasture agronomist Aerial seeding prior to scrub pulling is normally beneficial.

Overgrazing—High grazing pressure caused by drought or high stock numbers decreases the vigour and competitiveness of pastures and allows the entry and spread of parthenium weed. Maintenance of correct stock numbers is most important in controlling parthenium weed. pasture agronomist

Pastures spelling—In situations of serious infestation, pasture spelling is essential for rehabilitation. Total spelling is much more effective than simply reducing the

2 Parthenium weed *Parthenium hysterophorus*

stocking rate. However, overgrazing of the remainder of the property must be avoided.

The most appropriate time for pasture spelling is the spring–summer growing period, with the first 6–8 weeks being particularly important. If the condition of perennial grasses (native or sown) is low, spelling for the entire growing season may be required or introduced grasses may need to be re-sown. Herbicide treatment can hasten the rehabilitation process by removing a generation of parthenium seedlings and allowing grass seedlings to establish without competition. In the presence of parthenium weed, grass establishment is poor.

Grazing during winter should not increase the parthenium weed risk. Most tropical grasses are dormant and can tolerate moderate grazing during this period. However, parthenium weed may germinate and grow at this time.

Fencing—One of the main problems in controlling parthenium weed is the large paddock size and the variability of country within paddocks. The resulting uneven grazing pressures encourage parthenium weed to colonise the heavily grazed country. Ideally, similar land types should be fenced as single units. Fencing can be used to great effect to break up large paddocks, allowing more flexible management such as pasture spelling or herbicide application, options not available previously.

Burning—Burning is not promoted as a control strategy for parthenium weed. However, research suggests that burning for pasture management (e.g. woody weed control) should not result in an increased infestation if the pasture is allowed to recover prior to the resumption of grazing. Stocking of recently burnt areas known or suspected to contain parthenium decreases pasture competition and favours parthenium, ultimately creating a more serious infestation.

Herbicide control

Non-crop areas—Parthenium weed should be sprayed early before it can set seed. A close watch should be kept on treated areas for at least two years.

Small and/or isolated infestations should be treated immediately. Herbicide control will involve a knockdown herbicide to kill plants that are present and a residual herbicide to control future germinations. Repeated spraying may be required even within the one growing season to prevent further seed production.

Extensive infestations will require herbicide treatment in conjunction with pasture management. Timing of spraying is critical so that parthenium weed is removed when plants are small and before seeding has occurred. Grasses should be actively growing and seeding so that they can recolonise the infested area.

Table 1 shows the herbicides registered for parthenium weed control and application rates. Before using any herbicide always read the label carefully. All herbicides must be applied strictly in accordance with the directions on the label.

Cropping areas—Controlling parthenium weed in cropland requires selective herbicide use and/or crop rotations. For further information on parthenium weed control in crops consult your local biosecurity officer.

Biological control

The combined effects of biological control agents reduced the density and vigour of parthenium weed and increased grass production.

There are currently a number of insect species and two rust pathogens that have been introduced to control parthenium weed—a selection of these are outlined below.

Epiblema strenuana is a moth introduced from Mexico established in all parthenium weed areas. The moth's larvae feed inside the stem, forming galls that stunt the plant's growth, reduce competitiveness and seed production.

Listronotus setosipennis is a stem-boring weevil from Argentina but is of limited success in reducing parthenium weed infestations.

Zygogramma bicolorata is a defoliating beetle from Mexico which is highly effective where present. It emerges in late spring and is active until autumn.

Smicronyx lutulentus (Mexico) lays eggs in the flower buds where the larvae feed on the seed heads.

Conotrachelus albocinereus (stem-galling weevil from Argentina) produces small galls and is still becoming established in Queensland.

Bucculatrix parthenica (leaf mining moth from Mexico) larvae feed on leaves, leaving clear windows in the leaf.

Carmestia ithacae is a stem boring moth from Mexico which is becoming established at favourable sites in the northern Central Highlands.

Puccinia abrupta is a winter rust from Mexico that infects and damages leaves and stems. It is currently established over a wide area from Clermont south. It requires a night temperature of less than 16 degrees and 5–6 hours of leaf wetness (dew). Sporadic outbreaks occur where weather conditions are suitable.

Puccinia melampodii is a summer rust from Mexico that weakens the plant by damaging the leaves over the summer growing season. It is currently established and spreading at a number of sites from north of Charters Towers to Injune in the south.

Manual control

Hand pulling of small areas is not recommended. There is a health hazard from allergic reactions and a danger that mature seeds will drop off and increase the area of infestation.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

Table 1 Herbicides registered for parthenium weed.

Herbicide	Rate	Situation	Comments
2,4-D amine 500 g/L	0.4 L/100 L	Land—industrial, pastures; rights-of-way	Spot spray
atrazine 500 g/L max 3 kg/ha/yr	3.6–6 L/ha	Fields and fallow	Boom spray
	6 L/ha	Land—industrial, commercial, non-agricultural, roadside, right-of-way	Boom spray
atrazine 900 g/kg max 3 kg/ha/yr	2–3.3 kg/ha	Fields and fallow	Boom spray
	3.3 kg/ha	Land—non-agricultural, commercial, industrial	Boom spray
2,4-D + picloram (Tordon 75-D)	125 ml/100 L	Land—commercial, industrial, pastures, right-of-way	Spot spray
	3 L/ha	Land—commercial, industrial, pastures, right-of-way	Boom spray
2,4-D ester ¹	.025 L/10 L	Land—non-agricultural, pastures	Rosette stage
glyphosate (450 g/L)	0.8–1.2 L/ha	Fields and fallow	Spot spray
metsulfuron methyl	5–7 g/ha	Fields and fallow	Seedlings only
	5 g/100 L	Land—commercial, industrial, pastures, rights-of-way	Spot spray
hexazinone	3.5 L/ha or 7 L/10 L/20 m ²	Land—commercial, industrial, pastures, rights-of-way	Boom spray or spot spray
	dicamba (200 g/L)	0.7–2.8 L/ha or 0.1–0.19 L/100L	Grass pastures
(500 g/L)	0.28–1.1 L/ha or 0.40–0.76 L/100L	Grass pastures	Boom spray or spot spray
(700 g/kg)	200–800 g/ha or 30–60 g/100 L	Grass pastures	Boom spray or spot spray

¹Use restricted in some areas of Central Queensland

Notes The registered rates are for non-crop uses. Consult label for in-crop recommendations. For power hand spray or knapsack use, spray plants to the point of runoff.

Fact sheets are available from Department of Employment, Economic Development and Innovation (DEEDI) service centres and our Customer Service Centre (telephone 13 25 23). Check our website at www.biosecurity.qld.gov.au to ensure you have the latest version of this fact sheet. The control methods referred to in this fact sheet should be used in accordance with the restrictions (federal and state legislation, and local government laws) directly or indirectly related to each control method. These restrictions may prevent the use of one or more of the methods referred to, depending on individual circumstances. While every care is taken to ensure the accuracy of this information, DEEDI does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.

© The State of Queensland, Department of Employment, Economic Development and Innovation, 2011.

CS0564

4 Parthenium weed *Parthenium hysterophorus*

Harrisia cactus

Moonlight cactus

Harrisia martinii, *Harrisia tortuosa* and *Harrisia pomanensis*



Harrisia cactus can form dense infestations that will reduce pastures to a level unsuitable for stock. Harrisia cactus will choke out other pasture species when left unchecked.

The spines are a problem for stock management, interfering with mustering and stock movement.

Harrisia cactus produces large quantities of seed that is highly viable and easily spread by birds and other animals. As well as reproducing from seed, harrisia cactus has long trailing branches that bend and take root wherever they touch the ground. Any broken-off portions of the plant will take root and grow.

Control of this plant is difficult as it has a deep underground tuberous root system.

Declaration details

Harrisia cactus (*Harrisia martinii*, *Harrisia tortuosa* and *Harrisia pomanensis*) are Class 2 declared pest plants under the *Land Protection (Pest and Stock Route Management) Act 2002*. All other harrisia species are Class 1 declared pest plants.

Declaration requires landholders to control declared pests on the land and waters under their control. A local government may serve a notice upon a landholder requiring control of declared pests.

Great state. Great opportunity.



It is an offence to introduce, keep or supply Class 1 or 2 pests without a permit issued by Biosecurity Queensland. Penalties apply.

Description and general information

Dense infestations of harrisia cactus choke out pasture. The sharp spines, even in light infestations, make pasture unfavourable to stock and interfere with operations such as mustering.

The plant fruits prolifically and seeds are spread widely by birds and animals. *Harrisia cactus* can also reproduce by stem sections taking root. A deep underground tuberous root system allows the plant to survive even if the above-ground parts are killed.

Harrisia cactus is a perennial. The spiny fleshy stems are jointed and form tangled mats about half a metre high. Many branches often lie flat and take root where they touch the ground. Each section is ribbed lengthwise with six ribs; each rib has low, thick, triangular humps at regular intervals. These humps have cushions of grey felty hairs, three to five short spines lying flat, and one to three erect, stiff, very sharp spines 2.5–3 cm long.

The large flowers open at night. Flowers are pink and funnel-shaped with a tinge of white. These grow singly near the ends of the stems on a scaly but spineless slender grey-green tube 12–15 cm long.

Round, red fruits 4–5 cm across have scattered bumps with hairs and spines. Numerous small black seeds are embedded in the white, juicy pulp of the fruit, which splits open when ripe.

Harrisia cactus roots are of two types. Shallow feeding roots up to 3 cm thick and 30 cm to 2 m long grow mostly horizontally off a crown, up to 15 cm below ground level. Swollen tuberous storage roots descend to a depth of 15–60 cm.

Life cycle

Harrisia cactus bears a bright red fruit containing 400–1000 small black seeds. Fruit and seed are readily eaten by birds and to a lesser extent by feral pigs. Plants are easily established from seed dropped by these animals. Seeds germinate soon after rain.

Seedlings quickly produce a swollen tuberous food storage root that develops as the plant grows. Branches take root where they touch the ground and new plants will grow from broken branches and sections of underground tubers.

Counts of tubers in dense cactus infestations have shown over 125 000 per hectare. Each plant houses many dormant underground buds that are all capable of reshooting when the tip growth dies; any small portion of the tuberous root left in the soil will grow.

Habitat and distribution

Harrisia cactus is a native of Argentina and Paraguay, South America. It was introduced to Australia as a pot plant in the 1890s. In 1935 it was first recognised as a serious pest in the Collinsville district and by the 1950s was rapidly spreading south.

Harrisia cactus is mainly a pest of brigalow and associated softwood country. However, infestations are now appearing in box and ironbark stands and also in pine forests. The cactus is shade tolerant and reaches its maximum development in the shade and shelter of brigalow scrub, though established infestations can persist once scrub is pulled.

Harrisia cactus is found in the Collinsville, Nebo, Moranbah, Dingo, Blackwater and Goondiwindi districts, with minor infestations occurring at Millmerran, Greenmount, Gatton, Ipswich, Rockhampton, Rannes, Mount Morgan, Alpha and Mitchell.

Control

Mechanical control

Dig out plants completely and burn. Ensure that all tubers that can grow are removed and destroyed.

Ploughing is not considered an effective means of control unless followed by annual cropping.

Biological control

Two introduced insects have become established in the field:

- a stem-boring longicorn beetle, *Alcidion cereicola*
- a mealy bug, *Hypogeococcus festerianus*.

The stem-boring beetle only attacks older woody stems. In the Collinsville area, large beetle colonies developed and contributed to the collapse of dense areas of cactus. Populations of *Alcidion cereicola* have declined with the reduction in the cactus in recent years.

The most successful biological control agent is the mealy bug *Hypogeococcus festerianus* which is now present in harrisia cactus in Collinsville, Dingo, Moranbah, Blackwater, Nebo, Charters Towers and Goondiwindi districts, with small colonies established at Alpha, Capella, Rannes, Gatton, Greenmount, Millmerran and Rockhampton.

How mealy bug works

The mealy bug aggregates and feeds in the tips of stems and buds, where it limits growth and causes distortion. This results in the knotting of the stem. The plant's response is to utilise energy reserves within the tuber system to produce new growth. Eventually the plant dies, as it is unable to support the continuous high energy demands.

2 *Harrisia cactus* *Harrisia martinii*, *Harrisia tortuosa* and *Harrisia pomanensis*

Dry weather reduces the effectiveness of the mealy bug. When dry, the plant's tuber system becomes dormant. Consequently, mealy bug damage does not result in new growth and the energy reserves within the plant are not affected. Instead the bug may damage all vegetative parts and eventually die out. The tuber will remain dormant until adequate moisture returns, when it will reshoot.

How to spread the bug

Mealy bug disperses naturally via wind, although landholder assistance is necessary for its continuous spread, particularly between patches. The bug is manually spread by cutting infected stems and placing them into healthy plants. The best pieces for starting new colonies are large knobs of twisted and distorted cactus that contain many mealy bugs well protected inside knots. Stem tips covered by white, woolly masses of bug are also good. To collect the bug, cut infected stems approximately 15 cm from the distorted knob and place segments in green, plump sections of the healthy plant. Avoid placing mealy bug in stressed or dried out stems. Small cactus plants require at least one large knot, with larger plants requiring three knots per plant. Where possible, landholders should infest every cactus clump as this ensures a rapid reduction in growth and fruiting potential. When cactus infestations are light, chemical control may be a preferable option.

Cut pieces can be transported in boxes or open vehicles. They are not delicate, but are best kept in the shade. Avoid keeping them in large heaps, in direct sunlight, under tarpaulins or in closed containers for long periods. Such conditions will promote rotting of the stems, leading to poor results or failures. Ideally, stems should be put out within three days and a maximum of five days.

When to infest

Best results come by infesting new areas during spring and early summer, from September to December. Maximum growth and spreading occurs in the summer months of December to February. During the drier and colder months of April to August the mealy bug does not die, but little growth and multiplication occurs. Introduction of mealy bug during autumn and winter will not be lost, but little effect is seen until the following summer.

How soon to expect results

Mealy bugs are generally more active and effective on harrisia cactus growing underneath shrubs and trees, so results will be seen more quickly in these areas than in cactus growing in the open. Best results are obtained when infesting plants that have actively growing new shoots.

During wet summers in northern and central Queensland, the growing points of stems will begin to curl after about six weeks.

By the end of the first summer, damage (severe twisting) will be widespread in infested plants. If the initial infestation was sufficiently heavy, no fruit or growth will

occur during the second year, and the cactus will begin to die during the third year. Seedlings and regrowth shoots will continue to be present but by the end of the fourth year there should be very little cactus left.

In the southern portion of the state, where temperatures are lower, the mealy bug still provides control but the process takes longer. However, the mealy bug will do better on cactus in the open, rather than in the shade, as temperatures are higher in the open.

Where to obtain mealy bugs

If you cannot obtain mealy bugs from your own property or neighbour, contact the vegetation management, weed control, or environmental officer at your local government.

Foliar application of registered herbicides provides effective control, but can be costly over large areas. Before using any herbicide always read the label carefully. All herbicides must be applied strictly in accordance with the directions on the label.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

Map 1. Distribution of harrisia cactus in Queensland

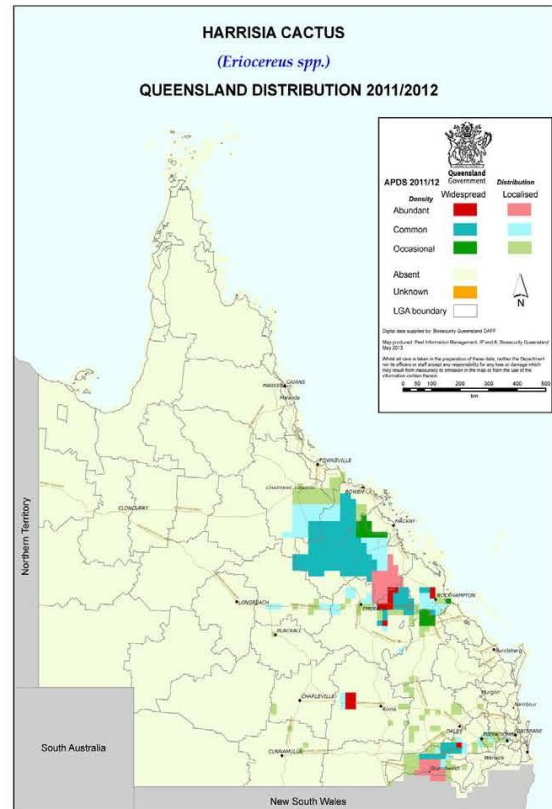


Table 1 Herbicides registered for the control of harrisia cactus

Situation	Herbicide active ingredient	Rate	Comments
Land – non-agricultural land Land – rights of way	dichlorprop as K salt (600 g/L)	1 L/60 L water	Good soil moisture essential. Spray plant when actively growing to run-off point. A follow-up treatment may be necessary.
Land – commercial/industrial/public Land – rights of way, pastures Pastures – native	metsulfuron-methyl (600 g/kg) (e.g. Brush-Off®)	20 g/100 L water + surfactant	Spray plant when actively growing to run-off point. A follow-up treatment may be necessary
Agricultural land – non-crop Forests – timber production Land – commercial/industrial/public Land – rights of way, pastures	triclopyr as butotyl (240 g/L) + picloram as ioe (120 g/L) (e.g. Access®)	1 L/60 L diesel	Spray plant when actively growing. Apply as overall spray, wetting all areas of the plant to ground level
Land – around buildings Land – commercial/industrial/public Land – rights of way	triclopyr as butotyl (75 g/L) +metsulfuron-methyl (28 g/L) (e.g. Ultimate®)	0.5 L/100L	
Agricultural land – non-crop Forests – timber production Land – commercial/industrial/public Land – rights of way, pastures	triclopyr as tea (200 g/L) + picloram as tipa (100 g/L) (e.g. Tordon DSH®)	5 L/100 L water 2.5 L/100 L water	Spray plant when actively growing. Treat all stems thoroughly

Read the label carefully before use. Always use the herbicide in accordance with the directions on the label.



This fact sheet is developed with funding support from the Land Protection Fund.

Fact sheets are available from Department of Agriculture, Fisheries and Forestry (DAFF) service centres and our Customer Service Centre (telephone 13 25 23). Check our website at www.biosecurity.qld.gov.au to ensure you have the latest version of this fact sheet. The control methods referred to in this fact sheet should be used in accordance with the restrictions (federal and state legislation, and local government laws) directly or indirectly related to each control method. These restrictions may prevent the use of one or more of the methods referred to, depending on individual circumstances. While every care is taken to ensure the accuracy of this information, DAFF does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.

© The State of Queensland, Department of Agriculture, Fisheries and Forestry, 2013.

Parkinsonia

Jerusalem thorn or jelly bean tree

Parkinsonia aculeata



Parkinsonia is native to tropical America but has spread throughout the world as an ornamental and shade tree. It can form dense impenetrable thorny thickets along river courses, bore drains, floodplains and grasslands. This makes land inaccessible for people and animals, restricts stock access to drinking water, decreases the amount of pasture available and excludes native vegetation.

Because of its invasiveness it has been recognised in Australia as a Weed of National Significance.

Legal requirements

Parkinsonia is a restricted invasive plant under the *Biosecurity Act 2014*. It must not be given away, sold, or released into the environment without a permit. The Act requires everyone to take all reasonable and practical steps to minimise the risks associated with invasive plants and animals under their control. This is called a general biosecurity obligation (GBO). This fact sheet gives examples of how you can meet your GBO.



Queensland
Government

At a local level, each local government must have a biosecurity plan that covers invasive plants and animals in its area. This plan may include actions to be taken on certain species. Some of these actions may be required under local laws. Contact your local government for more information.

Description

A hairless shrub or small tree that rarely grows any more than 10 m high. Parkinsonia has slender green photosynthetic zigzag branches armed with sharp spines.

Its leaves have a short, spine-tipped stalk, with leaf branches 20–40 cm long, flattened with small, oblong leaflets along each edge.

Flowers are yellow, fragrant, five petals, each on a long, slender drooping stalk. Seeds are oval and hard, about 15 mm long, and borne in pencil-like pods 5–10 cm long, constricted between the seeds.

Life cycle

Parkinsonia is fast growing and may flower in early summer of its second or third year of growth. Once established, flowering can occur opportunistically to exploit variable seasonal conditions. Pods mature in late summer, float on water and hence are readily dispersed by flood waters.

Under favourable warm and wet field conditions, most seeds germinate within two years. However, a small proportion of seed may remain dormant for longer periods if it's under heavy pasture cover, buried deeper in the soil profile, when inundated or when insufficient rain has fallen.

Methods of spread

The pods float easily on water so can be carried long distances in floods. Seeds can spread in mud, sticking to vehicles, machinery and on footwear.

Parkinsonia can be spread by livestock, native and feral animals consuming the seed, though this is more in drought times as the pods have low palatability.

Habitat and distribution

As parkinsonia is adapted to an extremely wide range of soil types, there is little doubt that it will continue to spread through watercourses and adjoining areas throughout the sub-humid and semi-arid environments of Queensland.

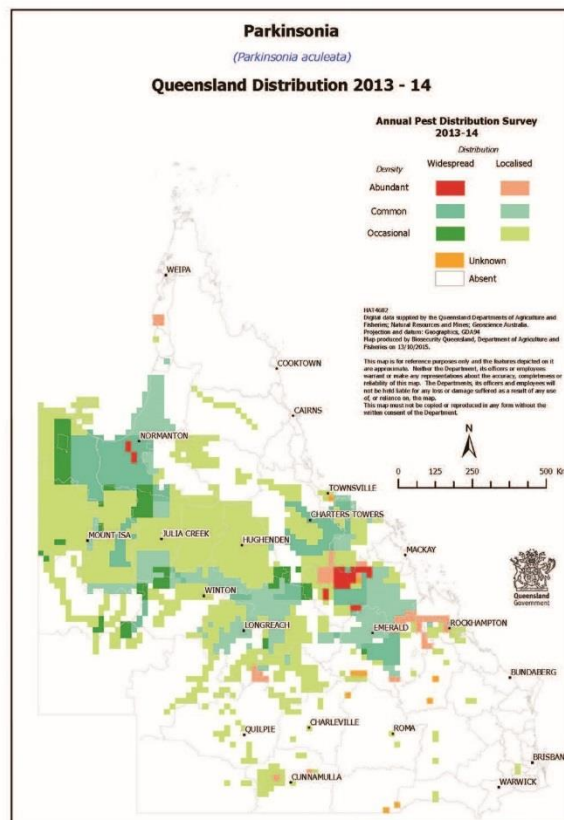
The most vulnerable areas are the lower Gulf of Carpentaria region, Lake Eyre catchment especially the Channel country, Central Queensland including coastal areas and highlands, and Cape York.

Control

Managing parkinsonia

The GBO requires a person to take reasonable and practical steps to minimise the risks posed by parkinsonia. This fact sheet provides information and some options for controlling parkinsonia.

Map 1. Distribution of parkinsonia in Queensland



Mechanical control

Initial clearing by stick raking, blade ploughing or ripping is effective, however:

- it is restricted to reasonably level areas away from watercourses
- clearing will hasten seed germination, necessitating follow-up control either mechanically or chemically.

Establishing improved pasture will aid in managing parkinsonia by competition.

Fire

Fire may be a useful tool for the management of parkinsonia infestations. Kill rates may vary from 30% to 90% with best results obtained from slow moving fires.

Fire will destroy seedlings if sufficient fuel load is present, but mature plants will usually survive.

Biological control

Four species of insects have been introduced into Australia as biological control agents against parkinsonia.

Parkinsonia seed beetles (*Penthobruchus germani* and *Mimosetetes ulkei*)

Both *Penthobruchus germani* and *Mimosetetes ulkei* are seed beetles that attack only parkinsonia and whose larvae destroy mature parkinsonia seeds.

Penthobruchus germani is a small (5–6 mm long) brown beetle from Argentina. It was first released in 1995 and has established much more readily than *Mimosetetes*.

It has established readily at all release sites and spreads rapidly.

Penthobruchus can exert heavy pressure on parkinsonia seeds in some areas. In the field its presence is indicated by white eggs against a darker background of the pods. Round holes in the pods indicate that beetles have emerged.

Mimosestes ulkei is a small (about 5 mm long) two-tone grey beetle from the USA. While it is established at several sites, it does not establish as readily as *Penthobruchus*. It has potential to contribute to the destruction of parkinsonia seeds. In the field, round emergence holes are the only external indication of its presence.

Parkinsonia leaf bug (*Rhinacloa callicrates*)

Rhinacloa callicrates is a small green bug (about 3 mm long) imported from the USA. It feeds on leaves and shoots of parkinsonia resulting in tiny round white spots where it destroys photosynthetic tissue. It is well established throughout Queensland.

Leaf-feeding looper (*Eueupithecia cisplatensis*)

Eueupithecia cisplatensis (UU) is a leaf-feeding looper caterpillar from Argentina who was imported by CSIRO. DAF releases commenced in 2013 and it is now widely established throughout Queensland. The caterpillar stage eats and damages the leaves, affecting flower and seeding production.

Dieback research

Naturally occurring fungal pathogens have been identified as causing dieback within many infestations of parkinsonia across Northern Australia. Studies are continuing regarding the use of these pathogens as biological control tools.

Herbicide control

Herbicides for the control of parkinsonia are listed in Table 1.

Aerial application

Aerial application is undertaken by purpose-built applicators by helicopter. This is useful for dense, strategic infestations although it may be expensive on a broad scale.



Foliar (overall) spray

This is an effective control method for seedlings up to 2 m tall. Spray leaf and stems to point of runoff. A wetting agent must be used.

Basal bark spray

For stems up to 15 cm diameter, carefully spray around the base of the plant to a height of 30 cm above ground level. Larger trees may be controlled by spraying to a greater height, up to 100 cm above ground level.

Plants should be actively growing and preferably flowering. Field experience has shown that good soil moisture is essential for effective control.

Because parkinsonia infested areas are often subject to flooding, care is needed to ensure mud and flood debris does not prevent spray penetration to the bark. The trunk may need to be cleared before spraying. Addition of petrol or A-1 jet fuel will aid penetration.

Cut stump treatment

Cut stump treatment may be performed at any time of the year. Cut stems off horizontally as close to the ground as possible. Immediately (within 15 seconds) swab or spray the cut surface and associated stem with herbicide mixture.

Soil application

Use one dose of herbicide per metre of tree height. Place doses close to tree trunk, either with spot gun on clear bare ground, or underground with ground injector. Rain or sufficient soil moisture is required before herbicide is taken up by the plant.

Do not use near watercourses or within a distance equal to at least twice the height of desirable trees.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland on 13 25 23 or visit www.biosecurity.qld.gov.au.



Parkinsonia *Parkinsonia aculeata* 3

Table 1. Herbicides for the control of parkinsonia

Situation	Herbicide	Rate	Optimum stage and time	Comments
Agricultural non-crop areas on floodplains	Triclopyr 300 g/L + picloram 100 g/L (e.g. Conqueror) or Triclopyr 300 g/L + Picloram 100 g/L + Aminopyralid 8 g/L (e.g. Grazon Extra)	3 L/ha	Seedlings 1–2 m tall, or 12–24 months old	Aerial application (helicopter only) Use specified wetting agent (consult label)
Grazing land	Tebuthiuron 200 g/kg registered for aerial application (e.g. Clearview)	10–15 kg/ha	Any time, but needs moisture to activate herbicide	Aerial application Use the high rate on dense infestations or heavy clay soils (consult label)
Agricultural non-crop areas, commercial and industrial areas, forests, pastures and rights-of-way	Triclopyr 300 g/L + Picloram 100 g/L (e.g. Conqueror) or Triclopyr 300 g/L + Picloram 100 g/L + Aminopyralid 8 g/L (e.g. Grazon Extra)	350 mL/100 L water	Seedlings less than 2 m tall and actively growing	High volume foliar spray Wet plant thoroughly Use wetting agent (consult label)
Agricultural non-crop areas, commercial and industrial areas, fence lines, forestry, pastures and rights-of-way	Triclopyr 240 g/L + Picloram 120 g/L (e.g. Access)	1 L/60 L diesel	See details above Stems up to 5 cm diameter	Basal bark spray Do not treat wet stems Parkinsonia can be treated using the alternative ThinLine method (consult label)
			See details above Plants up to and in excess of basal bark size	Cut stump Cut close to ground level and treat immediately
Around agricultural buildings and in pasture situations	Hexazinone 250 g/L (e.g. Velpar L, Bobcat SL Herbicide)	4 mL per spot 1 spot for each shrub/tree	Any time, but needs moisture to activate herbicide	Soil application (hand application via spotgun) Shrubs/trees up to 5 m high Avoid damage to off target species (consult label)
Grazing land	Tebuthiuron 200 g/kg (e.g. Clearview 200 GR, Scrubmaster)	1 to 1.5 g/m ²	Any time, but needs moisture to activate herbicide	Avoid damage to off target species (consult label)

Read the label carefully before use. Always use the herbicide in accordance with the directions on the label.

This fact sheet is developed with funding support from the Land Protection Fund.

Fact sheets are available from Department of Agriculture and Fisheries (DAF) service centres and our Customer Service Centre (telephone 13 25 23). Check our website at www.biosecurity.qld.gov.au to ensure you have the latest version of this fact sheet. The control methods referred to in this fact sheet should be used in accordance with the restrictions (federal and state legislation, and local government laws) directly or indirectly related to each control method. These restrictions may prevent the use of one or more of the methods referred to, depending on individual circumstances. While every care is taken to ensure the accuracy of this information, DAF does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.

© The State of Queensland, Department of Agriculture and Fisheries, 2016.

07/16



Attachment 1D: Wildlife Online Extract



**Queensland
Government**

Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: Native
Status: Rare and threatened species
Records: Confirmed
Date: Since 1980
Latitude: -22.3841
Longitude: 148.999
Distance: 10
Email: alan.key@earthtrade.com.au
Date submitted: Wednesday 26 Oct 2016 12:28:33
Date extracted: Wednesday 26 Oct 2016 12:30:02

The number of records retrieved = 1

Disclaimer

As the DSITIA is still in a process of collating and vetting data, it is possible the information given is not complete. The information provided should only be used for the project for which it was requested and it should be appropriately acknowledged as being derived from Wildlife Online when it is used.

The State of Queensland does not invite reliance upon, nor accept responsibility for this information. Persons should satisfy themselves through independent means as to the accuracy and completeness of this information.

No statements, representations or warranties are made about the accuracy or completeness of this information. The State of Queensland disclaims all responsibility for this information and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Poaceae	<i>Dichanthium queenslandicum</i>			V	E	1/1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992*. The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ().

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999*. The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).

This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.

This number is output as 999 if it equals or exceeds this value.

Attachment 2: Land Manager's Monitoring Guide

Department of Environment
and Resource Management

Land Manager's Monitoring Guide

Ground cover indicator

Tomorrow's Queensland:
strong, green, smart, healthy and fair



Prepared by:

Environment and Resource Sciences

Department of Environment and Resource Management

© State of Queensland (Department of Environment and Resource Management) 2010

This document has been prepared with all due diligence and care, based on the best available information at the time of publication. The department holds no responsibility for any errors or omissions within this document. Any decisions made by other parties based on this document are solely the responsibility of those parties. Information contained in this document is from a number of sources and, as such, does not necessarily represent government or departmental policy.

If you need to access this document in a language other than English, please call the Translating and Interpreting Service (TIS National) on 131 450 and ask them to telephone Library Services on +61 7 3224 8412.

**This publication is available in alternative formats
(including large print and audiotape) on request.**

Contact (07) 322 48412 or email <library@derm.qld.gov.au>

August 2010

Contents

Contents.....	iii
What is it?	1
Other factors and related indicators.....	1
Why monitor this indicator?	2
Other information sources	20
Books.....	20
CD-ROMs	20
Fact sheets	20
Journal articles.....	21
Websites	21
Glossary.....	21
References	23
Authors.....	24

What is it?

Ground cover is provided by living or dead plants and any of their parts that fall to the surface of the ground.

Cover may also be provided by pebbles and rocks or a crust of cryptogamic materials (plant life without 'true' flowers and seeds, such as mosses, lichens and fungi). Groundcover may be considered as being anything below your eye level that intercepts a vertically falling raindrop.

In most landscapes under natural conditions, there is usually some form of cover on the soil surface. Exceptions include environments that are inhospitable to plant growth including degraded or eroded landscapes, some deserts, and salt pans. In forests, much of the ground cover is provided by fresh or slightly decomposed leaves, bark, fallen logs/limbs, twigs, flowers and fruits (collectively referred to as forest litter). In woodlands and grasslands most of the cover is provided by a variety of herbaceous plants and low growing shrubs. In arid and sub arid Australia, cryptogamic crusts can provide a significant amount of ground cover. These crusts are made up of various cyanobacteria, lichens, mosses and fungi.

Cover is also provided by crops and the stubble that remains after harvest. Weeds have few positive benefits, but the ability of many weed species to rapidly colonise an area can provide effective ground cover. In the urban environment, cover may be provided by landscaped surfaces, gardens and infrastructure such as concrete, bitumen and buildings; however such impermeable surfaces generate high rates of runoff which may lead to off-site erosion problems.

Tree canopies usually provide minimal protection against raindrop impact and tree trunks have no effect on impeding surface flows. For control of erosion, surface cover is essential and bare areas beneath trees are vulnerable.

The amount of ground cover is constantly varying and is dependent on a range of factors including:

- **plant type**—Plants have different growing habits (spreading or erect), life spans (annual or perennial), and decomposition rates. (The stubble of cereal crops can provide protection for up to 12 months while the leaves of some crops such as sunflower, legumes and cotton rapidly break down.)
- **growth rates**—Plant growth is affected by many factors including soil moisture, fertility levels and seasonal conditions.
- **land management**—Grazing, crop and fire management practices have a major impact on ground cover levels.

Ground cover has a number of important functions relating to productivity and environmental health:

- It prevents water erosion by absorbing the impact of falling raindrops that may otherwise cause the soil surface to seal and contribute to excessive runoff.
- It reduces the velocity of runoff and encourages it to spread out rather than to concentrate and develop into an erosive force. Organic matter (including animal dung) and soil can be deposited when overland flow is obstructed by surface cover. Such accumulations are referred to as 'sinks' or 'fertile patches' (Tongway 1994) where the additional water and nutrients provide an improved environment for plants to germinate and grow.
- It prevents erosion from wind by reducing the wind velocity adjacent to the soil surface and provides an effective barrier between the soil and the air above it.
- It moderates the temperature on the soil surface and helps to reduce evaporation rates from the soil surface.
- It is a natural habitat and food source for a wide variety of living organisms and is used to assess and monitor the health of native vegetation.
- It allows for the recycling of nutrients as plant products are allowed to decompose and nutrients are returned to the soil.

Other factors and related indicators

Consideration could be given towards monitoring the following indicators that have an association with ground cover:

- Hillslope erosion
- Gully erosion
- Wind erosion
- Water infiltration
- Pasture composition
- Native species richness

- Soil condition
- Saline land
- Impact of fire
- A range of indicators relating to water quality.

Why monitor this indicator?

The section 'What is it?' indicates the essential role that ground cover plays in ensuring the healthy functioning of a landscape. Land management practices that contribute to low levels of ground cover leave the land vulnerable to land degradation. Monitoring ground cover can:

- help you assess the degree of risk of land degradation occurring
- determine landscapes that are already in a degraded condition.

Graziers make a mental note of the condition of their pastures during their day-to-day activities on the property. However, it becomes difficult to recall how the pastures may have looked in previous seasons unless some observations have been recorded. Our memories can be short, confused or biased; a documented record allows comparison with previous seasons and allows the data to be shared. Grazing lands that have a consistently low level of cover provide a strong indication of excessive stocking rates and degraded land. Figure 1 shows how photographs have been used to compare pasture condition at the same point over a span of three years.

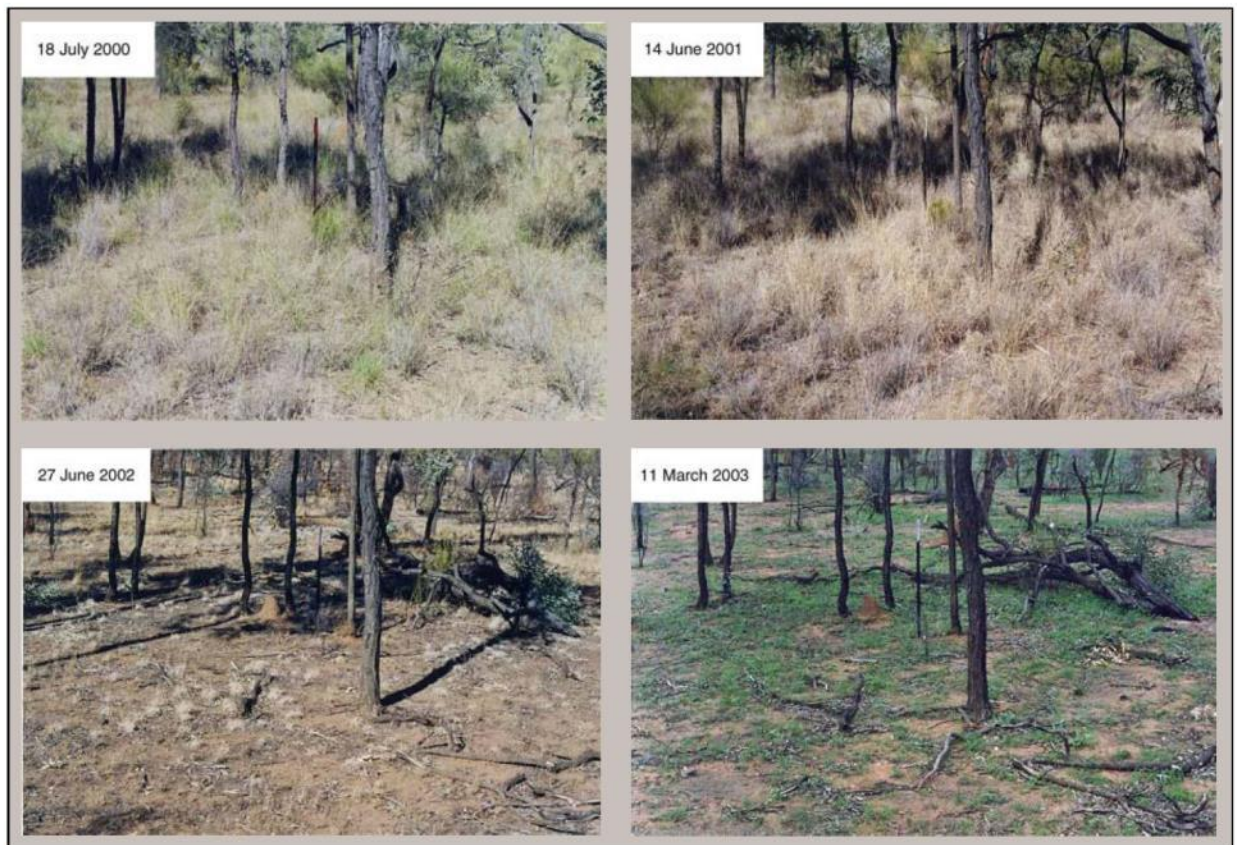


Figure 1: Photographs comparing ground cover at the same point over a three year span

Cover levels in cropping lands may vary dramatically depending on land management practices, the stage of growth of the crop and the crop type. An alternative to regularly monitoring ground cover in paddocks used for cropping is to monitor the adoption of land management practices that affect cover levels, for example, fallow management techniques such as zero tillage and green cane trash blanketing may provide 100% cover throughout the year.

At the catchment scale, an overall indication of ground cover can be used as an assessment of catchment health and the vulnerability of the land to soil erosion and its associated impact on water quality. Techniques such as cross-landscape transects and assessment of satellite imagery can be used. By monitoring on a regular basis, relevant stakeholders can assess change in ground cover levels and associated land management practices over time.

Ground cover measurement is an important component of assessing the health of a landscape from a biodiversity viewpoint. When making observations for biodiversity purposes, we are interested in the different components that make up ground cover, rather than the total amount of cover.

Planning to monitor this indicator

What are your monitoring objectives?

Consider what you are trying to achieve by monitoring ground cover. You may just be interested in the total amount of ground cover, or for an assessment of biodiversity you will need to assess the amount of cover provided by different components such as native plants, weeds, litter and rocks.

If you are confident that your land management practices are consistently providing adequate levels of ground cover, then there may be little point in measuring it. Land managers should be aware of ground cover levels under different land use and management practices because it affects the susceptibility of their property to land degradation. Of special interest is any land with cover levels of less than 40%.

As ground cover may be subject to considerable variation from month to month, there is generally not a great need to monitor it with a high level of precision. A visual assessment of ground cover, as provided in Level 1 of 'How do you measure it?' will provide you with a method of making a rapid assessment of ground cover. Measurements at established sites can be taken to provide a higher level of accuracy, as described in Levels 2a (for overall ground cover) and 2b (for biodiversity assessment) of 'How do you measure it?'.

You also need to consider other indicators that you may wish to measure, for example, if you wanted to monitor plant species as well as cover, you would need to take more measurements if you had an interest in finding rare plants.

How will your data be used?

Primarily your data will be for your own use. However other land managers, catchment groups or your regional body may be interested in your ground cover monitoring. Some regional bodies have set targets of ground cover that they hope land managers in their region will be able to achieve. If you intend to share your data with others, you should check to see if your proposed data collection procedures will be compatible with theirs.

What will you monitor?

Existing standards

Some Queensland Government programs, including the Reef Protection Package and Delbessie Agreement (for renewal of rural land leases) have monitoring requirements tailored for each program, but based on existing monitoring methods. These requirements may be fulfilled in part by the methods in this and other indicator guides, however if your property occurs in selected reef catchments or includes leased land you should refer to the specific guides provided for these individual programs. These include guides for producers that are preparing Environmental Risk Management Plans (ERMPs) under the Reef Protection Package <<http://www.reefwisefarming.qld.gov.au/>> and for land condition assessment under Delbessie land management agreements <http://www.derm.qld.gov.au/land/state/rural_leasehold/land_cond_assessments.html>.

There are no formal standards for monitoring ground cover in Queensland. The use of a quadrat (described in Levels 2a and 2b of 'How do you measure it?') is recommended in order to estimate percentage ground cover. Comparisons can be made with graphical presentations (Figure 2) or photos of a range of different cover levels (Figure 3).

Land Manager's Monitoring guide – Ground cover indicator

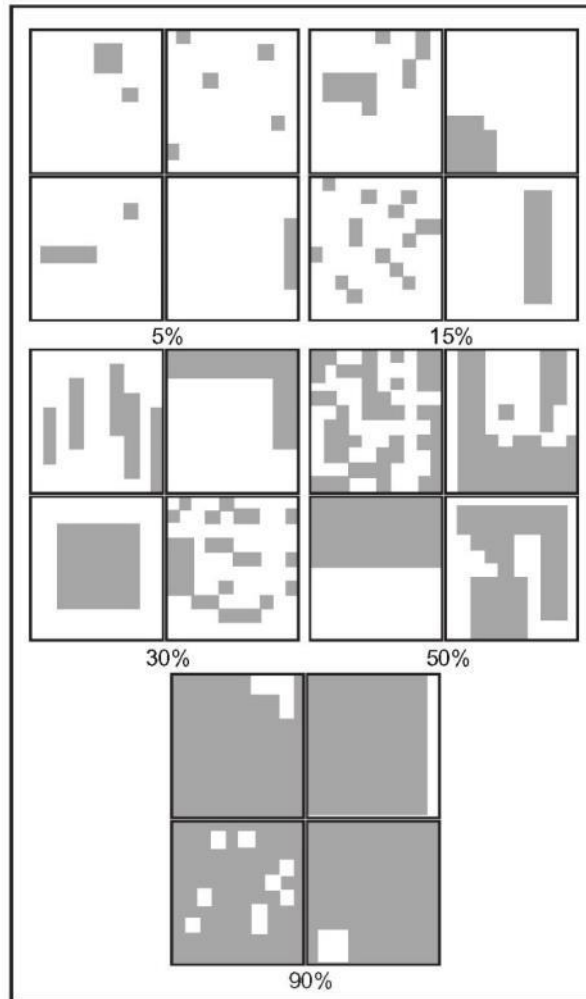


Figure 2: Examples of ground cover patterns as they appear in a quadrat for 5%, 15%, 30%, 50% and 90% cover (Department of Natural Resources 1997)

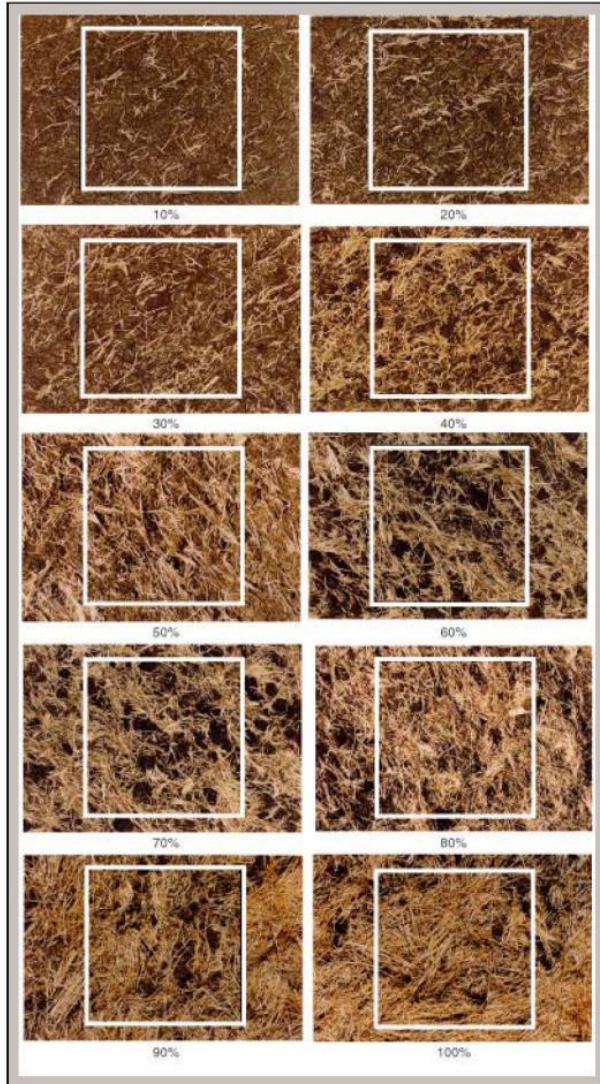


Figure 3: Photographs of wheat stubble cover levels in 10% increments (Molloy 1988)

The spreadsheets provided for Level 2a and 2b allow you to add quadrat measurements in increments of 10%. The spreadsheet will then calculate an average cover level for the site.

An alternative way of grouping cover levels into categories is provided in Grass Check (Department of Natural Resources 1997). These categories are less than 5%, 5–15%, 15–30%, 30–50%, 50–90% and >90%. This categorisation places emphasis on the measurements at the lower end of the scale because surface cover levels are considered to become critical once they drop below 30%.

When monitoring for biodiversity assessment, your data can be compared with benchmark data prepared for the vegetation

zone or regional ecosystem you are monitoring. It is intended that this information will become available on the Queensland Department of Environment and Resource management website.

The CD, 'Pasture photo standards' (Department of Primary Industries 2003) provides colour photos of oblique views of different pasture types (Brigalow belt, Channel country, Central Queensland coast, Cape York Peninsula, Desert uplands, Einasleigh uplands and Wet Tropics, Gulf Plains, Mitchell Grass Downs, Mulga Lands, North West Highlands, Wide Bay and Southeast Queensland, and Southern Brigalow and New England Tablelands). For each pasture type there are photos of six pasture yields from very low to very high. The photos can be used for estimating the amount of fodder available (in kg/ha) to assist in determining future grazing strategies. Because they are oblique views, they are not suitable for directly estimating ground cover as they can tend to result in overestimating the real value. The CD is available from the Queensland Government Bookshop <<https://www.bookshop.qld.gov.au/>> - Search for 'Pasture photo standards'.

Existing monitoring in your area

Before you start monitoring any indicator, it is recommended that you explore who else is monitoring in your area, what they are monitoring and how they are monitoring it. Doing this will not only make sharing your data easier if you choose to do so but will also help you become more familiar with:

- Any area-specific issues that may influence your monitoring
- What strategies and/or methods have proven successful within your area.

Where will you monitor?

You need to determine whether you will monitor ground cover levels on the whole of your property or selected areas that may be of concern, for example, areas that may have cover levels that are less than the critical value of 30–40% (either permanently or occasionally).

If you decide to establish monitoring sites, a decision is needed on whether it is better to take many cover measurements at one site in a paddock or to make a similar number of measurements spread over a number of sites. There are no hard and fast rules as to how many sites you should monitor in a paddock and how many observations you should make. The sites should be accessible and away from fences, tracks, waterways and watering points to ensure that they are representative of a large area of your paddock. Aerial photos or satellite images may be useful in assisting with site selection.

Where different land types occur in the one paddock or where there are areas of special interest (e.g. an area being rehabilitated), it is preferable to have at least one site in each system or zone. The records for each system should be kept separately, since averaging them may lead to a misleading result. For example, if one half of a paddock has 20% cover and the other half 80% cover, the average cover is 50%. This approach does not convey the message that half of this paddock is at high risk from land degradation and may indicate a case for creating an additional paddock so that appropriate management practices can be applied.

To monitor for BioCondition Assessment <<http://www.derm.qld.gov.au/wildlife-ecosystems/biodiversity/biocondition.html>>, ideally all vegetation types and all areas subject to different levels of management on the property should be monitored for ground cover. The combination of a particular vegetation type and management action is called a zone. Considerable thought needs to go into the placement of your monitoring areas within these zones to minimise the number of sites but to still ensure you represent the range of vegetation and management actions on the property.

When and how often will you monitor?

While adequate cover levels are desirable throughout the year, the summer months represent the period of highest erosion risk in Queensland. Figure 4 shows the average monthly erosivity value of the rainfall for Emerald and Pittsworth. Erosivity combines the amount and intensity of rainfall and is highly related to erosion potential.

This period of high erosion risk is a desirable time in which to monitor ground cover. However, in grazing lands there are advantages in monitoring pastures at the end of the growing season, around April. This allows graziers to make decisions on future stocking rates. An added bonus is that temperatures at this time of the year are more comfortable for field monitoring!

Additional monitoring can be undertaken at strategic times such as during a drought, at the end of the dry season or a month after major rainfall.

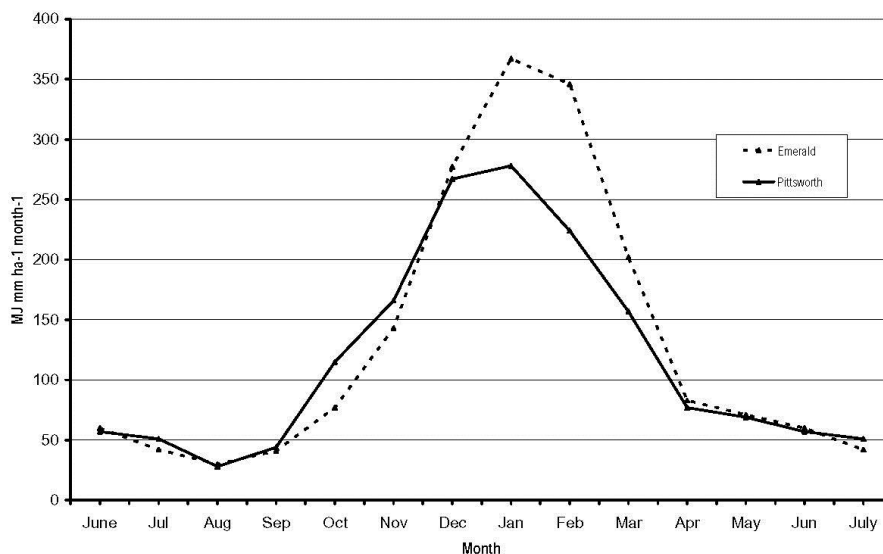


Figure 4: Average monthly rainfall erosivity values for Emerald and Pittsworth

How do you measure it?

For this indicator, two levels for estimating ground cover are described:

- Level 1 involves an overall visual assessment while driving or walking around a paddock. It is appropriate for all forms of land use.
- Level 2 provides a more accurate assessment by estimating ground cover levels using quadrat readings at established monitoring sites:
 - Level 2a describes a system that is most appropriate for grazing lands although it could be used in a cropping situation
 - Level 2b is recommended when monitoring for biodiversity assessment.

A number of methods of measuring ground cover have been published and there are no set rules as to which is the best method to use. However, some Queensland Government programs including the Reef Protection Package and Delbessie Agreement (for renewal of rural land leases) have monitoring requirements which may be fulfilled in part by the methods in this and other indicator guides. If your property occurs in selected reef catchments or includes leased land you should refer to the specific guides provided for these individual programs including those for Environmental Risk Management Plans (ERMPs) <<http://www.reefwise farming.qld.gov.au/>> and for land condition assessment under Delbessie land management agreements <http://www.derm.qld.gov.au/land/state/rural_leasehold/land_cond_assessments.html>.

Since ground cover levels are constantly changing, there may not be a need for you to measure with a high level of precision and the visual assessment described for Level 1 may suffice for most situations. In Levels 2a and 2b, the use of quadrats is described for estimating cover levels where a higher level of precision is required.

Besides using quadrats, it is also possible to measure ground cover using a point observation method rather than a quadrat. In this case, a straight piece of wire or a point on the toe of your boot can be used to record the presence or absence of cover. To avoid confusion, this method has not been described in this indicator. A description of such a method can be found in Francis and Payne (2003).

It is a good idea to have a sign on the post in the photograph to indicate the site details. The date should be noted (cameras often have the facility to do this automatically) as well as the time, photo number and site number. If the photos are printed, appropriate details should be written on the back and they should be filed appropriately. If you are using a digital camera, most suppliers provide software for storing and showing a collection of photographs and adding notes for each picture. As with all computer records, you should make regular backups of your electronic records, such as by burning a CD.

How do you measure it? – Level 1 monitoring

Key aspects of level 1 monitoring

Level 1 monitoring involves a visual assessment of percentage ground cover by making a number of observations as you drive or walk around a paddock. The method does not require the use of quadrats although they could be used initially to assist the observer in gaining skills in estimating cover by making comparisons with the diagrams in Figures 2 and 3.

It is recommended that photographs be taken to provide a permanent record as described in 'Use of photopoints – photographic records'.

In grazing lands, you need to decide if you are going to establish some permanent monitoring sites within each paddock or whether you are going to make an estimate by just walking or driving around the paddock. Permanent monitoring sites are useful when taking photographs so that you can compare identical locations over a period of years.

Paddocks used for cropping will generally have much more uniform ground cover levels than grazing paddocks. It is generally not practical to establish permanent monitoring sites in cropping areas because of their interference with tillage, spraying and harvesting activities. It is usually sufficient to make observations of ground cover in cultivated paddocks by making an overall observation. There is little point in going to a lot of effort to establish a precise level of ground cover for a cultivated paddock since the cover levels can change rapidly as a crop develops.

Skills needed

- Knowledge of the paddock or resource area to allow you to determine suitable monitoring sites
- Ability to estimate ground cover. You can 'calibrate' your eye by using some quadrats and making comparisons with the cover levels provided in Figures 2 and 3

Equipment

- A camera
- If monitoring sites are to be established, two steel pegs are required for each site.

Time taken

- 15 minutes to establish each monitoring site (if required)
- 5 minutes per site, plus travel time in moving from site to site

Setting up

If setting up permanent monitoring sites, consideration needs to be given to the information provided in the selection of monitoring sites in 'Developing your monitoring plan'. It may be appropriate to divide a paddock into two or more zones, keeping separate records for each zone. This would be advisable where there were contrasting cover levels in a paddock resulting from different land types or different grazing pressure associated with the location of a watering point.

Install two steel pegs at the selected sites. The posts should be in a north-south direction at a distance of around 10 metres apart and provided with an identification number. For more information see 'Use of photopoints – photographic records'.

Monitoring procedure

1. Make a visual assessment of the cover at the site. Record the percentage cover using 'Recording sheet' (refer also to 'How to record your results').

2. Where monitoring sites are being used, take a photograph from the photopoint post.

Data quality considerations

As this method is only a visual assessment it is somewhat subjective and there is likely to be some variation in the assessments made by different people. As ground cover levels are constantly changing depending on seasonal conditions and land management practices, a high level of precision is generally not required and this method of assessment should suffice for many situations.

How do you measure it? – Level 2a monitoring

Key aspects of level 2a monitoring

Level 2a monitoring involves setting up a 'monitoring triangle' (see 'Setting up', Figure 8) and taking measurements using a quadrat as you walk around each side of the triangle. It is primarily intended for use in monitoring ground cover in grazing lands.

An advantage of using a monitoring triangle compared to a straight line transect is that you end up at your starting point, rather than having to 'backtrack' to the starting point. A triangle may also provide a better sample of the landscape because of the three different directions of travel.

Skills needed

- Knowledge of the paddock or resource area to allow you to determine suitable monitoring sites
- Ability to estimate ground cover percentage within a quadrat
- Basic maths and ability to use a computer spreadsheet for calculating average percentage cover at a site

Equipment

- Four steel posts for each site. Three are required for the monitoring triangle and another for the photopoint post
- A quadrat for measuring cover (can be made for minimal cost in the property workshop)
- A camera
- GPS unit (optional)

Figure 7 shows two different types of quadrats. Grass Check (Department of Natural Resources 1997) makes the following recommendations for their use:

- 50 cm by 50 cm quadrat for areas with more than 500 mm rainfall, or areas with good Mitchell or buffel grass cover
- 100 cm by 50 cm quadrat for other pasture areas.

To facilitate the estimation of percentage cover, the sides of the quadrat can be painted in alternate colours to divide it into 10 cm lengths. An open end allows the quadrat to be used where there are obstructions such as trees or shrubs.

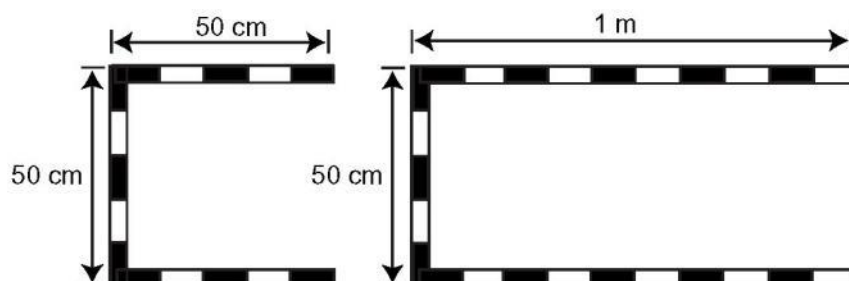


Figure 7: Two types of quadrats used for measuring ground cover

Time taken

- 45 minutes to locate and establish a monitoring site
- 30 minutes to take the recordings and the photograph per site

Setting up

You need to decide how many monitoring sites you will establish in a paddock and where you will locate them. The section 'Where will you monitor?' has advice on selecting suitable monitoring sites.

The monitoring triangle as indicated in Figure 8 is marked out as follows:

1. At the northern end of the triangle, drive in two posts or place markers, 10 m apart in a north-south direction. The northernmost marker is the photopoint post and the other is referred to as point 1.
2. From point 1, measure or step out a triangle with each side 100 m long and place markers for points 2 and 3. The easiest way to do this is to go south 87 m, then 50 m left and right from that point.
3. If the site is covered with trees and shrubs, mark the sides of the triangle with a marker every 50 m or put coloured markers on some trees.
4. The location of each site should be numbered and marked on a property plan. GPS recordings may also be taken.

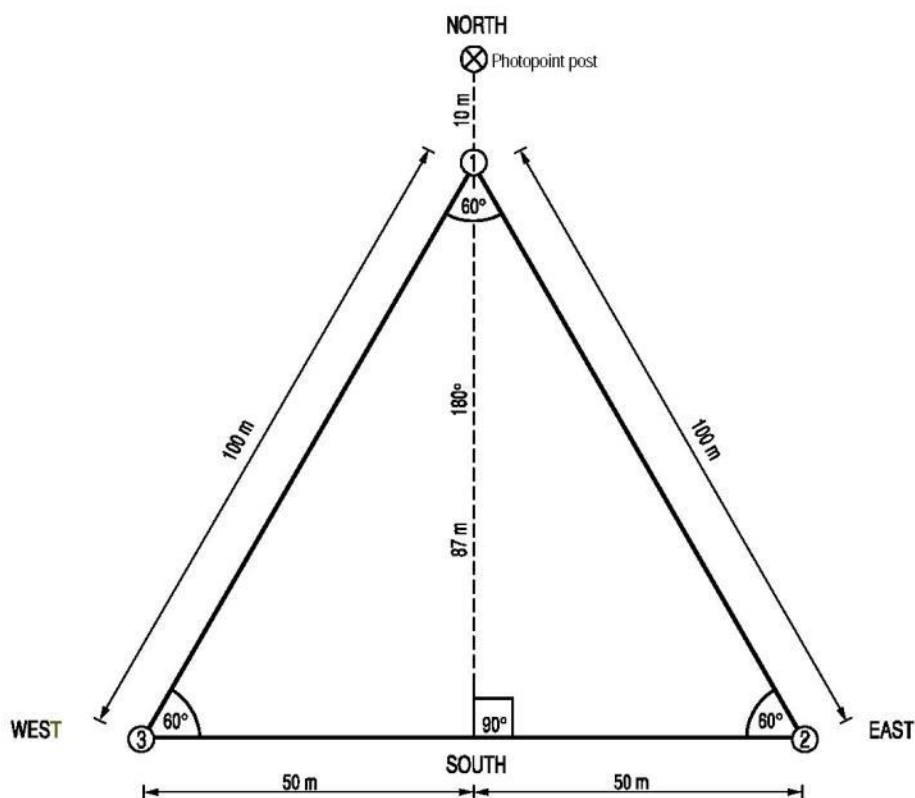


Figure 8: Approximate dimensions for a monitoring triangle

Note that a high level of precision is not required when marking out the triangle. It would be acceptable to use 100 paces instead of 100 metres. It would also be appropriate to reduce or enlarge the size of the triangle (e.g. a triangle with 50 metre sides would be acceptable in small paddocks).

If using steel posts they should be made safe and visible to motor bike and horse riders; for example, attach a piece of PVC pipe over the top or paint the posts white and place a protective cap over them. On open areas such as Mitchell

grass downs, it may be necessary to place some old tyres around the posts to alleviate the effects of stock gathering to rub on the posts and increasing stock pressure in the area.

Monitoring procedure

1. In order to take 50 recordings around the triangle, you would need to make 17 observations on two sides and 16 on the third side. This would mean taking observations at regular spacings of every 6 or 7 paces depending on your length of stride.
2. At each observation point, place the quadrat in front of the leading foot and estimate the ground cover percentage by comparing with Figure 2 or Figure 3. The measurement includes cover occupied by grass, herbage, leaves, litter and manure. Cover provided by low shrubs of less than 1 metre is included but not higher shrub or tree canopy. Tip: Consider cover as being anything below your eye level that intercepts a raindrop that is falling vertically, or mentally 'move' all of the cover to one corner of the quadrat and estimate the cover that way.
3. Record your estimated percentage using the 'Level 2a Recording sheet' (refer also to 'How to record your results').
4. Continue walking around the transect until you have a total of 50 estimates.
5. Take your landscape and trayback photographs at the photosite point. Record any relevant notes that relate to the photo.

Data quality considerations

This technique is based on the method described in Grass Check (Department of Natural Resources 1997). However, the recommended number of observations along the three sides of the triangle has been reduced from 100 to 50. There is a trade-off between the number of observations you make at a single monitoring site and the number of sites you have in a paddock. There is little point in making a large number of observations at one site if that site is not representative of the whole paddock.

How do you measure it? – Level 2b monitoring

Key aspects of level 2b monitoring

Level 2B monitoring is consistent with the BioCondition Assessment Framework developed by the Queensland Department of Environment and Resource Management <<http://www.derm.qld.gov.au/wildlife-ecosystems/biodiversity/biocondition.html>>. The framework provides a means of assessing biodiversity at a patch, property or paddock scale that is compared to benchmarks for a particular vegetation type. A total of ten site-based attributes and three landscape-based attributes are assessed. For BioCondition Assessment, the following components of ground cover are measured: organic litter, native perennial and annual grasses, native non-grasses (herbs, forbs and others), introduced plants (weeds), rock cover, fallen logs and bare ground.

Skills needed

- Knowledge of local vegetation types and associated land management practices to allow you to determine suitable monitoring sites
- Ability to estimate ground cover percentage within a quadrat
- Basic maths and ability to use a computer spreadsheet for calculating average percentage cover at a site

Equipment

- Two steel posts for permanently marking the transect
- A 1 m by 1 m quadrat (can be made for minimal cost in the property workshop). To facilitate the estimation of percentage cover, the sides of the quadrat can be painted in alternate colours to divide it into 10 cm lengths. An open end allows the quadrat to be used where there are obstructions such as trees or shrubs.
- A camera
- GPS unit (optional)

Figure 9 shows an example of a quadrat recommended for use in monitoring for biodiversity.

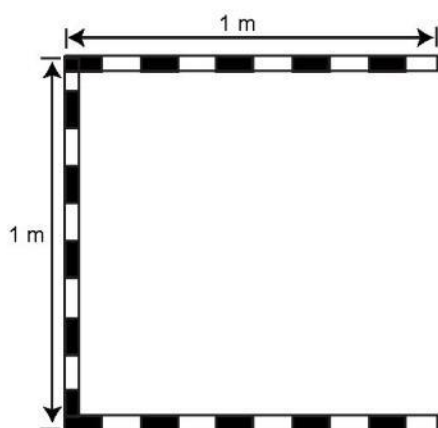


Figure 9: Quadrat recommended for use in measuring ground cover for BioCondition assessment

Time taken

- 30 minutes to locate and establish a monitoring site as illustrated in Figure 10.
- 15 minutes to take and record the ground cover observations and to take a photograph at each site

Setting up

To monitor for BioCondition Assessment, ideally all vegetation types and all areas subject to different levels of management on the property should be monitored for ground cover. The combination of a particular vegetation type and management action is called a zone. Some thought needs to go into the placement of your monitoring areas within these zones to minimise the number of sites but still ensure you represent the range of vegetation and management actions on the property.

Figure 10 shows the layout for a monitoring site used to assess the ground cover component for BioCondition Assessment. Ideally the transect should be across the slope and the photopoint should be the most northerly post.

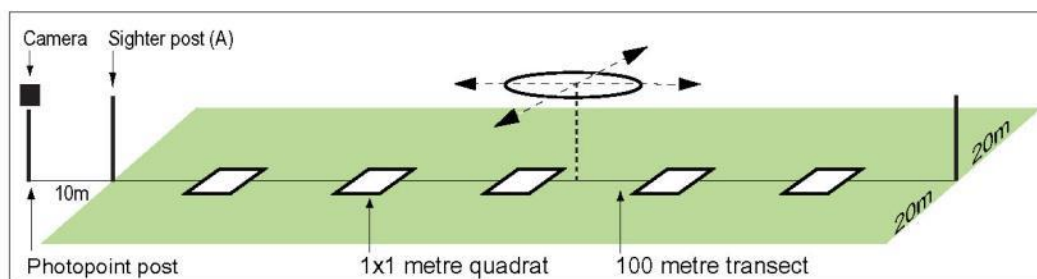


Figure 10: Standard monitoring site for BioCondition Assessment

The two end points of the transect should be permanently marked with, for example, steel posts. If using posts they should be made safe and visible to motor bike and horse riders (e.g. by attaching a piece of PVC pipe over the top or painting the posts white and placing a protective cap over them). On open areas such as Mitchell grass downs, it may be necessary to place some old tyres around the posts to alleviate the effects of stock gathering to rub on the posts and increasing stock pressure in the area. The location of each site should be numbered and marked on a property plan and/or GPS recordings should also be taken and entered into your GIS.

Monitoring procedure

1. Commencing at one end of the 100 m transect, walk a distance of 10 metres and place the quadrat in front of your leading foot and estimate the ground cover within the quadrat. You need to make separate ground cover assessments

for the following components:

- native perennial grasses
- native annual grasses
- native herbs and forbs (non-grass)
- native shrubs (less than 1 metre height)
- weeds
- litter
- rock
- bare
- fallen logs
- cryptograms.

Tip: Consider cover as being anything below your eye level that intercepts a raindrop that is falling vertically or mentally 'move' all of the cover to one corner of the quadrat and estimate the cover that way. Cover provided by low shrubs of less than 1 metre is included but not higher shrubs or tree canopies.

2. Record your estimated percentage cover within the quadrat on the relevant level 2b recording sheet. (refer also to 'How to record your results').
3. Continue walking along the transect making estimates with the quadrat every 20 metres until you have a total of five estimates
4. Take your landscape and trayback photographs at the photopoint. For biodiversity monitoring, you should also take four additional landscape photographs from the centre point of the transect, one each facing the four points of the compass (north, south, east and west). Make any relevant notes against your photographs.

How to record your results

The information you collect while monitoring is referred to as data. Data is distinct pieces of information (e.g. numbers, text or images) that can be stored electronically, on paper or as samples. An organised collection of data with a common theme is called a dataset. For example, a collection of data about a particular geographic area for a particular time period would form a dataset.

When you are working in the field, the simplest way to record your data is to have a field recording sheet with you. A field recording sheet will help ensure that your data is recorded in a way that is easy to enter into a spreadsheet and also acts as a checklist to ensure that you don't miss recording any important information.

'Recording sheets' for each of the different methods of measuring cover (Levels 1, 2a and 2b) are provided with this indicator material. Examples of completed recording sheets are also provided. Blank data sheets can be printed off for use in the field. Your data can be entered into the electronic version of the field recording sheet if you want to use the automatic totalling and averaging functions. You can also enter the summary data on to the data recording sheet for the long-term collation of your data and creation of charts.

Metadata

There are two aspects to recording information: the information (data) you collect each time you monitor and the metadata associated with your monitoring data. Metadata is pieces of information that describe data or is 'data about data'. It describes the 'who, what, when, where, why and how' about a data set. Metadata is critical to preserving the usefulness of data over time.

It is important to record the information shown in Table 1 below. This table is available in the spreadsheets that can be downloaded for each of the indicator levels in 'How do you measure it?'

Table 1: Typical data sheet for recording metadata that describes the dataset

Key element	Metadata
Short description of the contents of the dataset	
Name of the land manager or business responsible for the dataset	
Brief assessment of reliability of the information in the dataset	
Brief history of the source and processing steps used to produce the dataset	
Maintenance and update frequency of the dataset	
Location or area the data relates to	

What does your data mean?

Percentage ground cover can be highly variable and strongly influenced by the weather, seasonal growth patterns, land type and land use and management practices. Figure 11 provides an example of how the average cover levels may vary in a paddock (similar graphs can be produced from the spreadsheets provided in 'How to record your results' of this indicator. The annual rainfall has been added to the graph. Keep in mind that rainfall occurs sporadically and it is quite possible that a high proportion of the rainfall may have occurred in one or two months at the beginning, middle or end of the recording period.

A minimum level of 30–40% cover is required in order to ensure a reasonable level of protection from erosion and to perform the other ecological functions of ground cover as described in 'What is it?'. Higher levels of cover will increase the benefits that cover provides. In grazing lands the 30% to 40% cover level should exist at the beginning of the summer storm season. To achieve this, a surface cover level of around 70% is desirable at the end of the summer growing season.

Figure 11 shows the relationship between annual soil erosion and ground cover over 14 years at Greenmount on the Darling Downs. Figure 12 shows the relationship between ground cover and runoff as well as soil loss derived from 7 years of measurements on pasture land in Central Queensland.

Minimising soil erosion and runoff has important implications for water quality since runoff will usually contain sediment, nutrients and any agricultural chemicals that may have been applied to the soil (Finlayson and Silburn 1996).

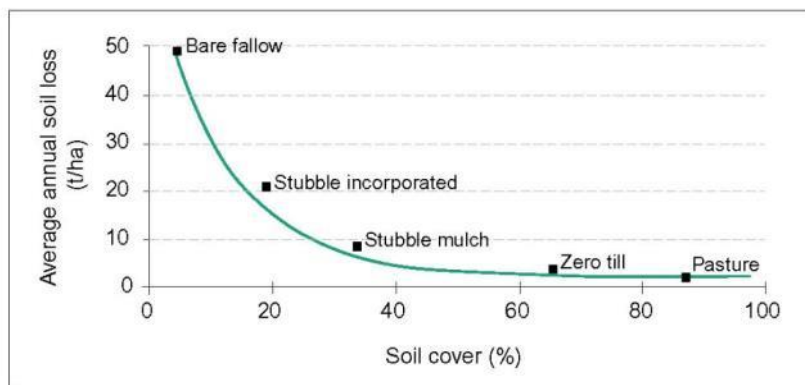


Figure 11: Annual average soil loss (1978–92) vs. cover for contour bay catchments on the eastern Darling Downs (Freebairn 2004)

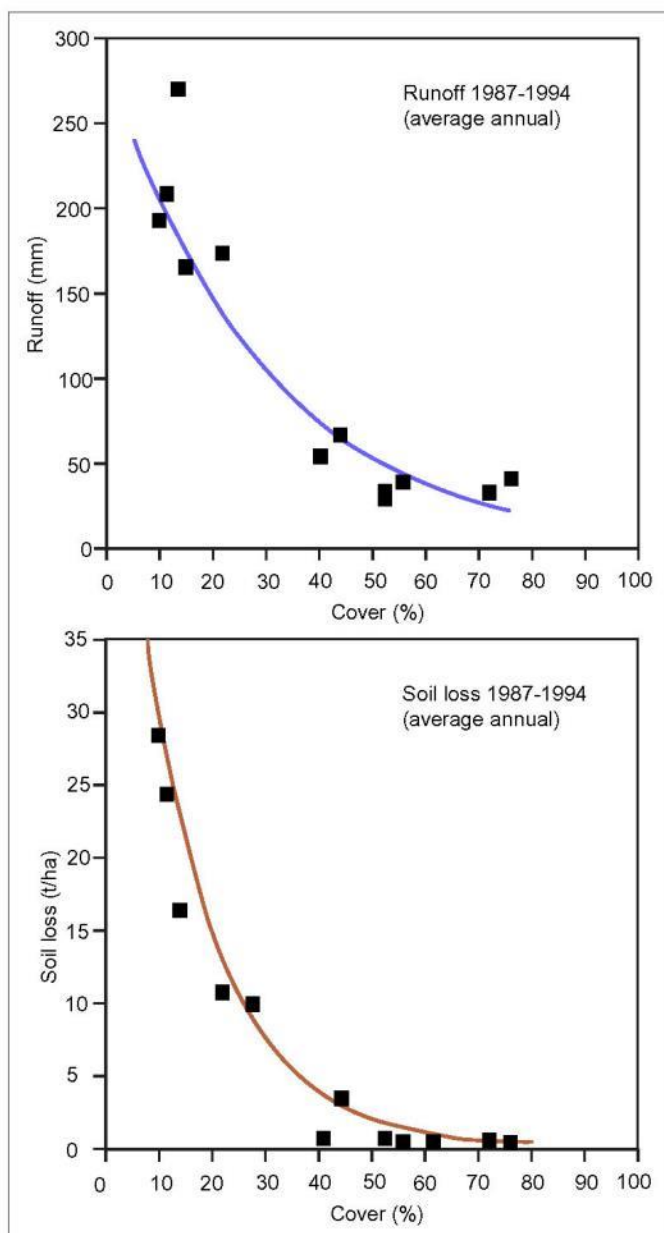


Figure 12: Average annual runoff and soil loss (1987–94) vs. ground cover for native pasture in Central Queensland (Mark Silburn, Queensland Department of Natural Resources and Water, pers. comm. 2005)

When monitoring for biodiversity values in the ground cover, your data would need to be compared with benchmark data prepared for the vegetation zone or regional ecosystem type you are monitoring. It is intended that this information will become available soon on the Queensland Department of Environment and Resource Management website. However, in general, to maintain ecological processes important for biodiversity, good ground cover (>50%) comprising litter, fallen logs and native plant species is the key. Litter and fallen logs provide habitat for ground-dwelling vertebrate and invertebrate fauna, as well as influencing soil microclimate, structure and composition.

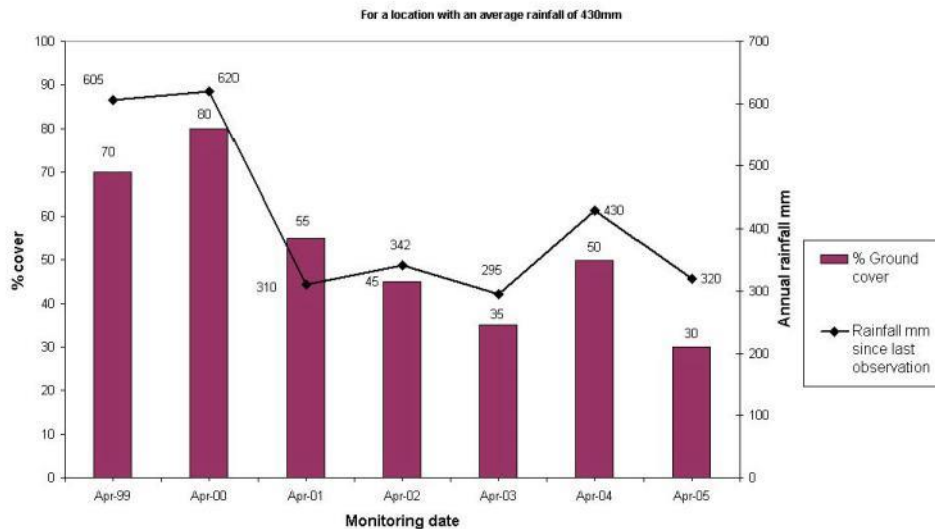


Figure 13: Rainfall and changes in pasture ground cover from 1999 to 2005

What are some management options?

These management options are only generalisations and should be interpreted with caution. It is important to remember that each situation is unique and so the most appropriate management option will also vary.

Grazing lands

Pastures need to be managed so that adequate levels of cover are maintained on the soil surface. Excessive grazing pressure, especially during periods of drought, leads to bare, vulnerable soil surfaces. The period of greatest risk is in late spring and early summer when cover levels are often low and rainfall intensities can be high. High grazing pressure also has an impact on both biodiversity and productivity because it can lead to pressure on the most palatable species, remove litter and lead to the introduction of weeds.

The data you collect and the charts you prepare, combined with your production records, can help you identify which paddocks or parts of a paddock are most productive and the conditions under which they maintain good cover. Your monitoring will also highlight the areas that lose cover quickly and require careful management.

Stocking rates should be based on the amount of grass in the paddock and the condition of the pasture, taking into account likely rainfall patterns for the next spring and summer. Seasonal forecasts including the Southern Oscillation Index (SOI) are a useful aid to management decisions at certain times of the year. A strongly negative SOI, especially in spring, can herald an El Niño and significant chance of drought; a positive SOI indicates a chance of wetter than normal conditions.

AussieGRASS (Australian Grassland and Rangeland Assessment by Spatial Simulation) is a simulation model developed to predict and to monitor historical grass production and land cover across Queensland and all Australian regions <<http://www.longpaddock.qld.gov.au/rainfallandpasturegrowth/index.php>>. At property or regional scale, maps from AussieGRASS output give the user a free monthly updated view of the current, historical and 3-month projected outlook of rainfall, pasture growth and grassfire risk. By taking account of livestock grazing by region, the pasture growth maps provide another valuable tool for producers to help base their decisions of stock and pasture management upon. These may include sites for stock agistment, buying and selling of produce and livestock decisions or status of pasture growth regionally or State wide.

As you increase your understanding of the responsiveness of your paddocks, you can begin to incorporate your results into your property management plan or farm management system by identifying different areas of your property according to their risk of developing low ground cover.

Strategies that can be used to respond to a poor seasonal outlook include heavy culling and sale, early weaning, agisting,

custom feedlotting and supplementary feeding. Regular planning includes stocking up with hay and supplements when prices are attractive. Some of these stockpiles can be used each winter to enhance normal management and replaced to ensure the reserves are always of good quality. Overdependence on supplementary feeding is an indication of excessive grazing pressure.

When assessing stocking rates the effects of native animals such as kangaroos and pests such as rabbits need to be considered.

Opportunistic spelling should be part of a grazing strategy. A total spell in a good summer season may be required to allow desirable grasses to recover from past overgrazing. Grazing pressure can also be managed by the location of watering points. They need to be located to minimise stock concentration in areas vulnerable to erosion.

Fire is a key tool for managing pastures and woody weeds but it needs to be managed carefully. Burnt pastures need to be spelled to allow around 20 cm regrowth before grazing. Your fire regime should be tailored to the land type, needs of the pasture species and any nature conservation considerations such as ground feeding or nesting birds. Burning too frequently may prevent pasture species from seeding or regenerating after drought or heavy grazing. No fire will allow regeneration of native trees and shrubs and woody weed species in cleared or naturally open country. A permit is necessary before burning and the conditions of the Vegetation Management Act need to be complied with.

The Queensland Department of Employment, Economic Development and Innovation provides a range of guides on management of specific types of pastures <http://www.dpi.qld.gov.au/27_7791.htm>. For more details check the reference Partridge (1992).

Graziers may wish to use the Stocktake package <www.dpi.qld.gov.au/stocktake>. It is a paddock-scale land condition monitoring method used as part of a grazing land management package recommended by the Queensland Department of Employment, Economic Development and Innovation. It has been developed to provide grazing land managers with a practical, systematic way to:

- Assess land condition and long-term carrying capacity
- Calculate seasonal forage budgets
- Integrate this information into a sustainable long-term production system.

Cropping lands

Crops need to be managed so that cover levels of at least 30–40% are provided throughout the year but especially during the summer months when there is a greater chance of high-intensity rainfall. After harvest, crop stubbles (referred to as ‘trash’ in the sugar cane industry) need to be retained on the soil surface, rather than being burnt or buried by tillage implements. Table 2 shows the amount of wheat or barley stubble cover removed by various tillage operations. The use of herbicides and specialised machinery has allowed the practices of reduced or zero tillage which result in maximum levels of ground cover retention.

Table 2: Estimated reduction in wheat or barley stubble cover from different farming operations (Department of Primary Industries and Fisheries brochure ‘Measuring stubble cover – Photostandards for winter cereals’)

Implement	Residue buried by each tillage operation	
	Fresh stubble	Old (brittle) stubble
Disc plough	60–80%	80–90%
Chisel plough	30–40%	40–60%
Blade plough	20–30%	30–50%
Boomspray	Negligible	Negligible

The term ‘opportunity cropping’ refers to the practice of planting a crop when sufficient soil water is available rather than according to a fixed rotation. It allows landholders to maximise surface cover levels.

Some non-cereal row crops such as sunflower, grain legumes and cotton provide inadequate levels of surface cover. Row spacings also affect the amount of cover provided by a crop.

Minimum tillage practices also apply to horticultural cropping. Cover crops can be grown during a fallow period to provide

Cater, D 2002, *The amount of stubble needed to reduce wind erosion*, Farmnote No 67/2002, Western Australia Department of Agriculture. <http://www.agric.wa.gov.au/objtwr/imported_assets/content/lwe/land/erosion/fn067_2002.pdf>

Journal articles

Molloy, JM and Moran, CJ 1991, Compiling a field manual from overhead photographs for estimating crop residue cover, *British Soil Use and Management Journal* 7, 177–83.

Websites

Landscape function analysis: A systems approach to assessing rangeland condition, CSIRO Sustainable Ecosystems web site <<http://www.csiro.au/services/EcosystemFunctionAnalysis.html>>

Stocktake – Grazing land management package, Queensland Department of Primary Industries and Fisheries <http://www.dpi.qld.gov.au/27_11643.htm>

Queensland Department of Environment and Resource Management fact sheets <http://www.derm.qld.gov.au/services_resources/item_list.php?category_id=123>

BioCondition Assessment Framework, Queensland Department of Environment and Resource Management <<http://www.derm.qld.gov.au/wildlife-ecosystems/biodiversity/biocondition.html>>.

Glossary

Fallen logs

Fallen logs refer to coarse woody debris or dead timber on the ground greater than 10 cm diameter and greater than 0.5 m in length.

Grazing pressure

This term refers to the amount of feed available compared to the rate of removal by grazing animals. The ideal stocking rate is flexible, so as to maintain a moderate grazing pressure most of the year and to match stock numbers to available feed. When assessing stocking rates, the effects of native animals such as kangaroos and pests such as rabbits need to be considered.

Ground cover

Ground cover is provided by plants (living or dead) and any parts of the plant that fall to the surface of the ground. Cover may also be provided by pebbles and rocks and 'crusts' formed by fungi, mosses, etc. In the urban environment, infrastructure such as concrete, bitumen and buildings may provide cover but their impermeability leads to high rates of runoff with consequent water loss and adverse effects downstream.

Herbaceous plants

Plants with soft, rather than woody stem tissues.

Infiltration

The movement of water from the soil surface into the soil profile. Surface cover assists infiltration by minimising raindrop impact and by retarding the flow of runoff across the soil surface. Soil characteristics affecting infiltration rates include surface seals, hard-setting layers, surface and subsurface compaction and impermeable subsoils. Infiltration rates are usually higher within plant tussocks compared to the area between tussocks because of the presence of plant roots and higher levels of biological life in this zone.

Litter

The ground cover provided in forests, woodlands and pastures by fresh or slightly decomposed leaves, bark, twigs, flowers and fruits. Litter is defined in BioCondition as including both fine and coarse organic material such as fallen leaves, twigs and branches less than 10 cm diameter.

Minimum tillage

A conservation tillage system in which the crop is grown with the fewest possible tillage operations. Herbicides and/or grazing may be used for fallow weed control.

Opportunity cropping

The practice of planting a crop whenever soil moisture reserves are considered sufficient, rather than according to a rigid rotational pattern. This leads to an increase in cropping frequency (e.g. two crops in three years) and greater levels of surface cover.

BioCondition Assessment Framework

The BioCondition Assessment Framework developed by the Queensland Department of Environment and Resource Management provides a means of assessing ecosystem condition for biodiversity at a patch, property or paddock scale that is compared to benchmarks for the particular vegetation type. It uses data from ten attributes to compile a dataset for conducting a BioCondition Assessment.

Rainfall erosivity

A measure of the capacity of the rainfall in a given location to cause erosion. It takes into account the combined effects of rainfall quantity and its kinetic energy (intensity). In most areas of Queensland, rainfall erosivity peaks in January–February and reaches a low point in August–September.

Raindrop impact

The result of the violent break-up and dispersion of raindrops when they hit the ground surface. If the surface is not protected, soil particles may be dislodged and scattered a considerable distance, due to the energy of the raindrop's impact. Dislodged particles are easily transported away by overland flow.

Stubble

The straw residue that remains after a grain crop has been harvested. It includes standing straw and that discharged by a harvester.

Stubble burning

A management practice in which the stubble from a crop is burnt after the harvest or prior to the sowing of the next crop. Stubble burning exposes the soil to erosion and destroys a potential source of soil organic matter.

Stubble incorporation

A management practice where stubble is incorporated into the surface soil by tillage, thereby promoting stubble breakdown and reducing the amount of protection that surface stubble can provide against erosion.

Stubble mulching

A conservation farming practice where stubble is retained on the surface of the soil by using suitable farm machinery such as chisel or blade ploughs. Implements such as disc ploughs are not suitable for stubble mulching since they incorporate an excessive amount of stubble into the soil.

Trash

Trash is the stubble remaining after the harvest of a sugarcane crop. The term 'green cane trash blanket' refers to a protective blanket of cane trash over the soil surface.

Zero tillage (or no tillage)

A minimum tillage practice in which the crop is sown directly into a soil not tilled since the harvest of the previous crop. Weed control is achieved by the use of herbicides and the retained stubble provides erosion control.

References

- Department of Natural Resources 1997, *Grass check*, Publication DNRQ97002, Queensland Department of Natural Resources.
- Department of Primary Industries 2003, *Pasture photo standards CD*, Queensland Department of Primary Industries.
- Finlayson, B and Silburn, M 1996, 'Soil, nutrient and pesticide movements from different land use practices and subsequent transport by rivers and streams', in HM Hunter, AG Eyles and GE Rayment (eds), *Downstream effects of land use*, pp. 129–40, Department of Natural Resources, Queensland.
- Francis, A and Payne, R 2003, *Field method for measuring soil surface cover*, Primary Industries and Resources SA fact sheet No. 8/01.
- Freebairn, D 2004, Some observations on the role of soil conservation structures and conservation, *Journal of the Australian Association of Natural Resource Management* 7(1), 8–13.
- Molloy, J 1988, *Field manual for measuring stubble cover*, Queensland Department of Primary Industries.
- Partridge, I 1992, *Managing native pastures – a grazier's guide*, Information Series QI92009, Queensland Department of Primary Industries.
- Tongway, D 1994, *Rangeland soil condition assessment manual*, CSIRO Division of Wildlife and Ecology, Canberra.

The Land Manager's Monitoring Guide

Indicator: Ground cover

Metadata recording sheet

Key element	Metadata
Short description of the contents of the dataset.	<i>e.g. Ground cover at "specified property"</i>
Name of the land manager or business responsible for the dataset.	
Brief assessment of reliability of the information in the dataset.	<i>Record which method you have decided to use, e.g. Level 1, 2a or 2b monitoring plus brief description of the method</i>
Brief history of the source and processing steps used to produce the dataset.	<i>Record which method you have decided to use, e.g. Level 1, 2a or 2b monitoring plus brief description of the method</i>
Maintenance and update frequency of the dataset.	
What location or area does the data relate to.	<i>Provide property or other location details and/or GPS Eastings and Northings</i>

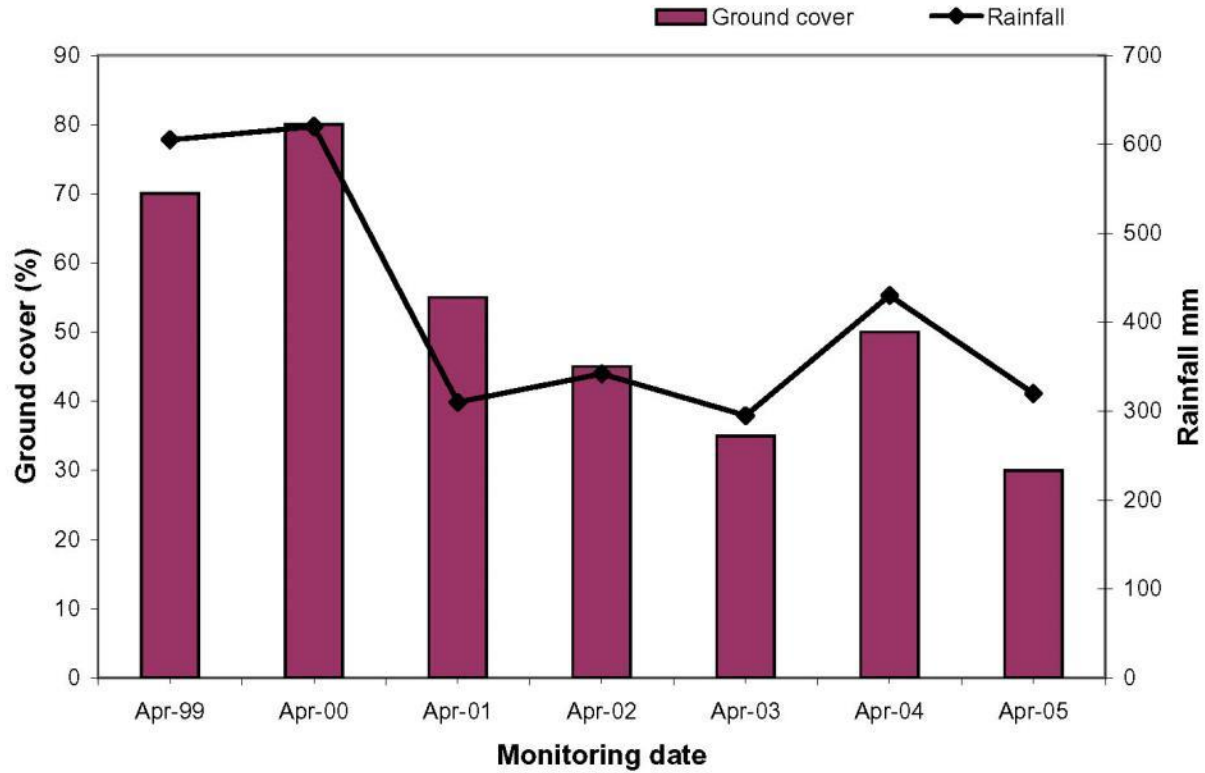
The Land Manager's Monitoring Guide

Indicator: Ground cover

Level 1 example field recording sheet - visual observations

Date	30/2/05					Recorder	Jane W	
Paddock name	Observation					Average cover (%)	Comments	
	1	2	3	4	5			
Tank paddock	40	60	40	35	35	42		
Creek paddock	45	30	55	65	45	48		
Carinya paddock	35	40	55	25	35	38		
Home paddock	60	40	45	55	65	53		
Far paddock	40	35	45	60	55	47		

Rainfall and changes in pasture cover from 1999 to 2005



For a location with an average rainfall of 430mm

The Land Manager's Monitoring Guide

Indicator: Ground cover

While every care is taken to ensure the accuracy of this information, the Department of Environment and Resource Management does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.

© The State of Queensland (Department of Environment and Resource Management) 2010