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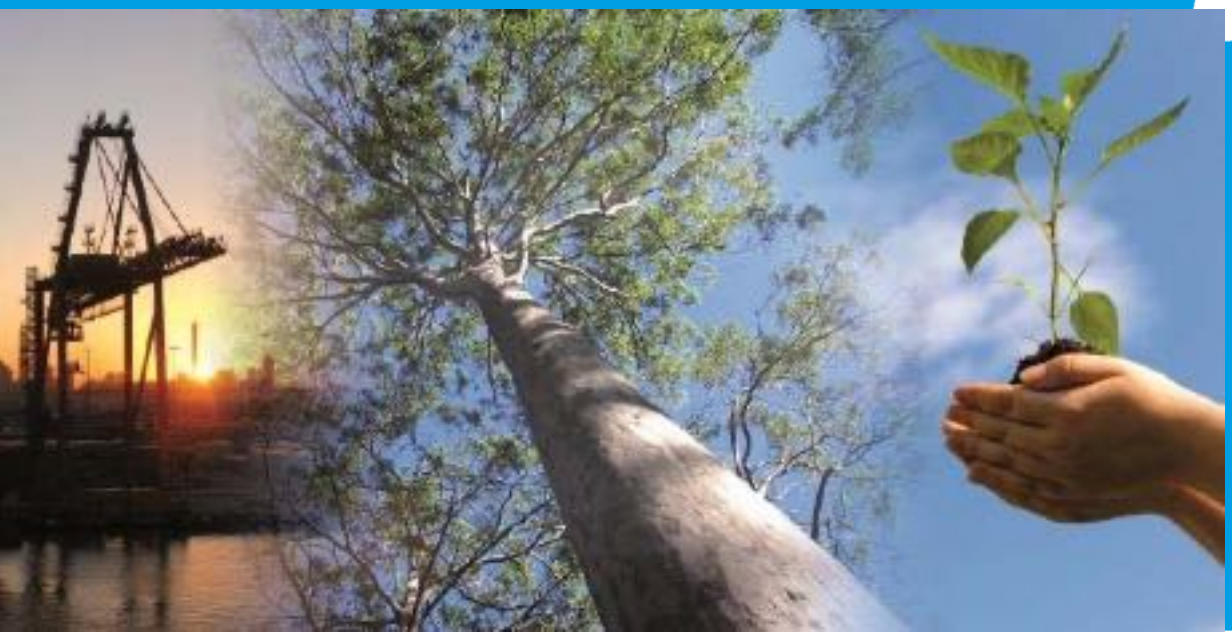
Offset Delivery Plan

Baralaba North Continued Operations Project (BNCOP)
EPBC Approval 2013/7036



[redacted] Offset Delivery Plan
Baralaba North Continued Operations Project (BNCOP) EPBC Approval 2013/7036

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1 EXECUTIVE SUMMARY

1.1 Executive Summary

[redacted] proposes to expand the Baralaba North Mine via the Baralaba North Continued Operations Project (**BNCOP**). The project was referred to the Commonwealth Department of the Environment (**DotE**) and the department subsequently granted [redacted] ([redacted]) the Final Approval for EPBC 2013/7036 on the 22nd December 2014. This Approval (shown at ***Appendix E***) allows for the impacts to Listed Threatened Species and communities (sections 18 and 18A) of the *Environment Protection and Biodiversity Conservation Act 1999* (**EPBC Act**). These impacts will be offset as per the Offsets Policy and the offset sites, management actions, monitoring and reporting actions are detailed in this document. For ease of use, this document is structured as follows.

This Offset Delivery Plan, including its schedules and appendices, is equivalent to the Management Plan as described in the EPBC Act conditions imposed on the Project and contains the pertinent information required by DotE to assess the proposed offset against the Offset Policy and the Conditions imposed on the Project. The Offset Area Management Plans (located at ***Schedule 1***) for the offset areas are to be tied to the respective Property Titles via a Legally Binding Mechanism of a Voluntary Declaration (located at ***Schedule 2***). These legally binding mechanisms and management plans are to be read in conjunction with this Offset Delivery Plan and are legal elements of the Plan. The separation of these elements of the Offset Delivery Plan provides for ease of attaching to the Property Titles and guide landholder management of the offset areas, as the preferred approach of the Queensland Department of Natural Resources and Mines who implement the Voluntary Declaration. These Schedules may not be updated without the prior approval of the Minister for the Department of the Environment, its successors or assigns, who administer the project's offset requirements.

The offset proposed is on two properties, both located within the Brigalow Belt South bioregion and experiencing similar habitat and climatic conditions as the impact site. The summary of the impacts that are to be offset are detailed in ***Table 1***.

The first property on which 400ha of the EPBC offset will be located is the same property on which the offset for impacts to *Solanum elachophyllum* and *Solanum johnsonianum* under the *Nature Conservation Act (Qld) 1992* (**NCA**) for associated infrastructure, being the Train Load Out Facility and Private Access Road, are to be located. This property is 65km to the south-west of the BNCOP. The real property description of the offset property is Lot 9 BH194 ("[redacted]") which is owned by the [redacted]. The "[redacted]" property has Brigalow Threatened Ecological Community (**TEC**) patches already established and substantial areas of Brigalow regrowth. This area will also rehabilitate to habitat for Ornamental snake, Squatter pigeon (southern), and South-eastern long-eared bat. There is a 38.8ha patch of the Brigalow TEC within the [redacted] Conservation Park which is located adjacent to the south-western portion of the property. Squatter pigeon (southern) and South-eastern long-eared bat were observed and/or recorded during field verification studies of the property undertaken in October 2014. It was noted at this time that there is habitat for the Ornamental snake present, which would be co-located with the Brigalow TEC due to the presence of deep cracking soils and gilgai formations. However the presence of the species was not verified at this time due to the dry conditions. Subsequent field verification was undertaken in January 2015 during the wet season and positively verified the presence of both juvenile and adult Ornamental snakes as well as 13 species of frog on which the Ornamental snake preys.

The second property, Lot 22 AU37 known as "[redacted]", is 720ha in area and will contain an offset of 420ha to be managed for the South-eastern long-eared bat. The property is located in the Surat Basin and was selected due to the presence of the species as well as its connectivity to [redacted] and subsequently to the 232,500ha Barakula State Forest which is 4.8km to the east of the property.

Together, the offsets designed on these properties fulfil the offset obligation that is incurred by the BNCOP.

1.2 Description of Project

[redacted] propose to expand the Baralaba Coal Mine which is located in the lower (south-east) Bowen Basin region of central Queensland. The BNCOP is located approximately 115 kilometres south-west of Rockhampton in the Central Highlands Regional Council area ***(Figure 1).*** The BNCOP provides for the continuation and expansion of open cut coal mining and introduction of processing activities at the existing Baralaba Coal Mine (Mining Lease (**ML**) 80157 and ML5605) and the approved Baralaba North/Wonbindi North Mine (ML80169 and ML80170). The proposed mine expansion (the Environmental Impact Statement for which was submitted in mid-2014) will increase operations from approximately 1 Million tonnes per annum (**Mtpa**) up to 3.5 Mtpa. Final approval for EPBC 2013/7036 was granted on the 22nd December 2014.

For clarification, the BNCOP EPBC Act approval is in the name of [redacted]. The two NC Act approvals for the associated infrastructure, being the Train Load Out Facility and Private Access Road (to be located 65km to the south-west of the BNCOP), are in the name of [redacted].

Table 1: Summarised BNCOP Impact vs Proposed Offset Areas

Protected Matter	Status	Impact area (ha)	Impact Habitat Quality Score	Offset Area (ha)	Habitat Start Quality Score	Regional Ecosystem	Offset Property
Threatened Ecological Communities							
Acacia harpophylla Brigalow Threatened Ecological Community	Endangered	9.0	4	3.6ha tree age remnant 6.4ha tree age regrowth	7 for the remnant area 2 for the regrowth area	11.4.8/11.4.9 Endangered	[redacted]
Threatened Species							
Nyctophilus corbeni South-eastern long-eared bat	Vulnerable	277.0	5	108.0 + 420.0	4 8	11.3.1, 11.3.3, 11.4.9 11.7.4/11.7.7/11.7.5/11.7.2	[redacted] **Note:** an additional offset area of 420ha for this species is secured at a separate property – Lot 22 on AU37, known as [redacted]
Denisonia maculata Ornamental snake	Vulnerable	33.5	3	23.0	4	11.4.8/11.4.9 Endangered	[redacted]
Geophaps scripta scripta Squatter pigeon (southern)	Vulnerable	277.0	7	400.0	5	11.4.8/11.4.9 Endangered	[redacted]

1.3 Purpose of Offset Proposal

This offset proposal provides summary information to the technical reports provided in the Appendices and has been prepared to address the Project's residual significant impacts to MNES as identified in ***Table 1***. The offset proposed will provide environmental benefits to counterbalance the significant impacts of the Project that will remain after measures to avoid, mitigate and manage have been implemented. The offset proposal includes:

- Analysis of the likely offset requirements of the Project under the EPBC Act *Environmental Offsets Policy* (October 2012);
- Assessment of the offsets and process proposed to meet the likely offset requirements of the Project in accordance with the EPBC Act *Environmental Offsets Policy* and associated *Offsets Assessment Guide*; and
- Determination of the overall suitability of and environmental outcome provided by the offsets proposed.

2 OFFSET REQUIREMENT

Under the EPBC Act *Environmental Offsets Policy*, consideration of offsets are required for MNES where a residual significant impact is likely to remain after avoidance, mitigation and management measures have been undertaken. For the BNCOP project, residual significant impacts are presented for the proposed clearing of the Brigalow TEC and habitat for three listed threatened species.

2.1 Policy Principles

The EPBC Act *Environmental Offsets Policy* (*October 2012)*, sets out eight key overarching principles that must be applied in determining the suitability of offsets, summarised as follows:

1. Deliver an overall conservation outcome that improves or maintains viability;
2. Be built around direct offsets but may include other compensatory measures;
3. Be in proportion to the level of statutory protection that applies;
4. Be of a size and scale proportionate to the residual impacts on the protected matter;
5. Manage the risks of the offset not succeeding;
6. Be additional to what is already required;
7. Be efficient, effective, timely, transparent, scientifically robust and reasonable; and
8. Have transparent governance arrangements.

Considering the above policy principles in relation to the likely offset requirements of the Project, [redacted] has undertaken suitability assessment of four areas. An investigation was conducted on a number of properties adjacent to the property on which the Project is located, and additionally, a number of other properties owned by [redacted]. The final offset solution is located on two properties that offer the potential to provide additional environmental values over and above those required. The two properties are known as [redacted] (North Portion) owned by the [redacted] and [redacted] owned by [redacted]. These two properties jointly offer 820 ha of offset in total with 400 ha being located on [redacted] and the balance 420ha located on [redacted].

3 PROPOSED OFFSETS

3.1 Overview of Impact Site

The details of the quantum and quality of the habitat to be impacted are detailed in ***Tables 2 – 5.***

Table 2: Offset Calculator Inputs – BNCOP – Brigalow

Attribute	Value	Rationale/Assumption
Impact Area	9 ha	In accordance with the definitions of the listing advice for the Brigalow TEC, the Brigalow TEC in the BNCOP Area are comprised of one 2.5 ha patch of remnant RE 11.3.1 [Brigalow woodland (Vegetation Community (VC 1a)], 2.5 ha of remnant RE 11.4.8a [Brigalow palustrine wetland (VC 3a)] and 4 ha of regrowth RE 11.4.8a [disturbed Brigalow palustrine wetland (VC 3b)].
Quality	4/10	**Site Condition = 3.6** The areas of Brigalow woodland (VC 1a) and Brigalow palustrine wetland (VC 3a) support moderately intact distributions of Brigalow that is approaching remnant state, comprises a diverse mid-stratum and groundcover layer and has microhabitat features such as fallen woody debris, well developed gilgai and minimal weed infiltration. The Brigalow TEC that will be impacted by the BNCOP Project was given a 'Community Condition' score of '3.6', based on the above factors. This component of the habitat assessment was allocated a weighting of 70%, as outlined above. **Community context = 0.4** The Brigalow patches were identified in small patches of less than 10 ha with little to no connectivity to larger patches of remnant habitat. These patches are currently threatened by existing land uses and occur in a fragmented landscape. There is limited connectivity to large intact remnant areas, except for in the far north of the BNCOP. All of these patches will be completely removed by the Project. The Brigalow TEC that will be impacted by the BNCOP was given a 'Community Context' score of '0.4', based on the above factors. This component of the habitat quality assessment was allocated a weighting of 30%, as outlined above.

Table 3: Offset Calculator Inputs - BNCOP – South-eastern long-eared bat

Attribute	Value	Rationale/Assumption
Impact Area	277 ha	The calls of the South-eastern long-eared bat, which are recorded with an Anabat detector, cannot be distinguished from calls of other *Nyctophilus spp*. that are also potentially present in the area. Calls of a *Nyctophilus spp*. were recorded at five locations throughout the BNCOP area by [redacted] in April and October 2013. [redacted] described that the calls are more likely to be from a common long-eared bat species since the common long-eared bat species were caught in harp traps and the closest record of the South-eastern long-eared bat is approximately 130 km to the south-east of the BNCOP area. However, it remains a possibility that the South-eastern long-eared bat is present (and some of the calls may be of the South-eastern long-eared bat). If the South-eastern long-eared bat is present in the area, foraging habitat would be removed through the clearance of woodland and open forest (277 ha) and some breeding habitat where there are hollow-bearing trees. No habitat within the BNCOP locality has been identified as important or critical habitat for the South-eastern long-eared bat in any recovery plans or listed on the EPBC Act Register of Critical Habitat maintained by the Minister of the Environment under the EPBC Act (DotE, 2014d). Past disturbance and clearance has resulted in reduced abundance of tree hollows across the BNCOP area and regrowth vegetation is common. Hollow-bearing trees are more abundant outside of the BNCOP area

Attribute	Value	Rationale/Assumption
		along the Dawson River and Dawson River anabranch as the vegetation is typically older. The habitat in the BNCOP area may also be suboptimal for the South-eastern long-eared bat due to the high levels of fragmentation. Habitat fragmentation is considered a potential threat to the South-eastern long-eared bat because the species displays a preference for larger areas of intact habitat (DotE, 2014d).
Quality	5/10 (rounded up from 4.7)	**Site Condition = 2.7** The majority of the BNCOP area has been degraded through various rural land uses, particularly grazing, clearing and associated management practices. Extant vegetation is generally limited to the Dawson River and its associated tributaries and a broad overflow floodplain linking the Dawson River floodplain with that of Saline Creek, along fence lines, small wetlands, and road reserves. These areas are impacted by a variety of disturbances include exploration, historical clearing, grazing and weed invasion. The largest patch of vegetation in the BNCOP Additional Footprint is the Eucalypt open forest (VCs 6a, 7, 8a and 8b), but it has been cleared in the past and subsequently regrown. The structural complexity of this vegetation is relatively good with multiple vegetation layers, fallen woody debris and leaf litter. This habitat consists of a moderately intact canopy layer (40% cover) of medium to large trees (19 m high and 25-40 cm DBH), a low abundance of hollow-bearing trees (1 per ha), a distinct mid-storey and shrub layer (11% cover). However the condition of VC 8a is poor and weed cover is high (average 88% cover). This habitat type has a highly simplified structure with a low but moderately intact canopy layer (9 m high and 39% cover) of small to medium sized trees (15-25 cm DBH), and a sparse shrub layer (5% cover). The external connectivity of the habitats is relatively low, except for habitat along watercourses and the overflow floodplain linking the Dawson River and Saline Creek. Nevertheless the distribution and configuration of such disconnected patches when considered together provide flyways for some birds and bats. The South-eastern long-eared bat habitat that will be impacted by the BNCOP Project was given a 'Site Condition' score of '2.7', based on the above factors. This component of the habitat quality assessment was allocated a weighting of 40%, as outlined above. **Site Context = 2.0** Although several small patches of habitat were identified in patches of less than 10 ha there was little to no connectivity to larger patches of remnant habitat. The majority of suitable habitat was identified along the northern boundary of the BNCOP and was either remnant and/or contiguous with vast tracks of remnant vegetation to the north of the BNCOP site. This habitat is currently threatened by existing land uses and occurs in a fragmented agricultural landscape. There is limited connectivity to large intact remnant areas, except for the large area of remnant in the far north of the BNCOP as mentioned above. All areas of habitat on site will be removed by the Project. The South-eastern long-eared bat habitat that will be impacted by the BNCOP Project was given a 'Site Context' score of '2.0', based on the above factors. This component of the habitat quality assessment was allocated a weighting of 40%, as outlined above. **Species stocking rate = 0** The species was not positively identified as occurring within the BNCOP area. The Anabat calls are far more likely to be from the more common *Nyctophilus* species that

Attribute	Value	Rationale/Assumption
		occur in the area. The South-eastern long-eared bat habitat that will be impacted by the BNCOP Project was given a 'Species stocking rate' score of '0', based on the above factors. This component of the habitat quality assessment was allocated a weighting of 20%, as outlined above.

Table 4: Offset Calculator Inputs – BNCOP – Ornamental snake

Attribute	Value	Rationale/Assumption
Impact Area	33.5 ha	The species was not recorded in the BNCOP Project Area during targeted fauna surveys consistent with Commonwealth (SEWPaC 2011a; SEWPaC 2011b) and State (DSITIA 2012) survey guidelines. However the species was identified in the local area and a number of areas of potential habitat comprising 2.5 ha of remnant RE 11.3.1 [Brigalow woodland (Vegetation Community (VC) 1a)], 11.5 ha of regrowth RE 11.3.1 [disturbed Brigalow woodland (VCs 1b and 1c)], 2.5 ha of remnant RE 11.4.8a [Brigalow palustrine wetland (VC 3a)], 12 ha of regrowth RE 11.4.8a [disturbed Brigalow palustrine wetland (VC 3b)] and 5 ha of remnant RE 11.3.4 [Riparian woodland (VC 5)], which may provide Ornamental snake habitat, will be impacted by the BNCOP additional footprint ([redacted]).
Quality	3/10	**Site Condition = 1.6** The areas of Brigalow woodland (VC 1a) and Brigalow palustrine wetland (VC 3a) support moderately intact distributions of Brigalow that is approaching remnant state, comprises a diverse mid-stratum and groundcover layer and has microhabitat features such as fallen woody debris, well developed gilgai and minimal weed infiltration. The areas of disturbed Brigalow woodland (VCs 1b and 1c) and disturbed Brigalow palustrine wetland (VC 3b) have a simple structure consisting of Brigalow overstorey with no midstorey and a heavily grazed understorey with no obvious gilgai depressions, an important habitat resource that is required to sustain the Ornamental snake (i.e. food and refuge habitat). Nevertheless, these currently deficient habitats for this species could provide habitat for the snake in the future under improved management (control of grazing, weeds and pests). The poor condition and relative size of the disturbed patches of Brigalow have lessened the overall community condition score compared with the score that was achieved by the Brigalow TEC (above). The Ornamental snake habitat that will be impacted by the Haul Route Project was given a 'Community Condition' score of '1.6', based on the above factors. This component of the habitat quality assessment was allocated a weighting of 40%, as outlined above. **Site context = 0.4** The Ornamental snake habitat within the Project Area was identified in small patches of less than 10 ha with little to no connectivity to large remnant areas, except for in the far north of the BNCOP. This habitat is currently threatened by existing land uses and occurs in a fragmented landscape. The areas of gilgai in adjacent paddocks generally lacked native regrowth and microhabitat features due to farming practices (e.g. clearing and grazing). All areas of habitat described above fall within the disturbance footprint of the project and therefore will be completely removed by the Project. The Ornamental snake habitat that will be impacted by the Haul Route Project was given a

Attribute	Value	Rationale/Assumption
		'Site Context' score of '0.4' based on the above factors. This component of the habitat quality assessment was allocated a weighting of 40%, as outlined above. **Species stocking rate = 1.0** Ornamental snake was not identified within the Project Area, but was identified in low numbers within Brigalow communities immediately adjacent to the BNCOP. In consideration that there were none identified on-site but there is the possibility that they may be present in low numbers, a score of 1 had a weighting of 20% in the context of an assessment of overall quality.

Table 5: Offset Calculator Inputs - BNCOP – Squatter pigeon (southern)

Attribute	Value	Rationale/Assumption
Impact Area	277 ha	The Squatter pigeon (southern), which was recorded at six locations throughout the BNCOP area, shows resilience due to its persistence in the already highly cleared and fragmented landscape. BNCOP would result in the following direct and indirect adverse impacts on the Squatter pigeon (southern). Known habitat for the Squatter pigeon (southern) (totalling approximately 277 ha eucalypt woodland to open forest habitat and approximately 1,164 ha of cleared grazing paddocks would be progressively cleared. This would include removal of patches of potential habitat in the BNCOP area and reduction in the area of three patches of potential habitat that extends outside of the BNCOP area. Potential localised indirect impacts on surrounding habitats (dust, noise, edge effects). No adverse water-related impacts are likely to occur on habitats surrounding the BNCOP (e.g., Dawson River, Dawson River anabranch or wetland to the north of the BNCOP Operational Land). This is because no measurable impacts on surface water quality are likely to occur from changes in surface water and no measurable impacts on surface water quantity or quality are likely to occur regardless of changes in captured catchment areas and groundwater (drawdown). Other minor potential impacts on this species include increased risk of attack from feral animals and bushfire risk.
Quality	7/10 (rounded up from 6.7)	**Site Condition = 2.7** The majority of the BNCOP area has been degraded through various rural land uses, particularly grazing, clearing and management practices. Extant vegetation is generally limited to the Dawson River and its associated tributaries and a broad overflow floodplain linking the Dawson River floodplain with that of Saline Creek, along fence lines, small wetlands, and road reserves. These areas are impacted by a variety of disturbances include exploration, historical clearing, grazing and weed invasion. The largest patch of vegetation in the BNCOP Additional Footprint is the Eucalypt open forest (VCs 6a, 7, 8a and 8b), but it has been cleared in the past and regrown. The structural complexity of this vegetation is relatively good with multiple vegetation layers, fallen woody debris and leaf litter. This habitat consists of a moderately intact canopy layer (40% cover) of medium to large trees (19 m high and 25-40 cm DBH), a low abundance of hollow bearing trees (1 per ha), a distinct mid-storey and shrub layer (11% cover). However the condition of VC 8a is poor and weed cover is high (average 88% cover). This habitat type has a highly simplified structure with a low but moderately intact

Attribute	Value	Rationale/Assumption
		canopy layer (9 m high and 39% cover) of small to medium sized trees (15-25 cm DBH), and a sparse shrub layer (5% cover). The external connectivity of the habitats is relatively low, except for habitat along watercourses and the overflow floodplain linking the Dawson River and Saline Creek. Nevertheless the distribution and configuration of such disconnected patches when considered together, provide flyways for some birds and bats. The Squatter pigeon (southern) habitat that will be impacted by the BNCOP project was given a 'Site Condition' score of '2.7' based on the above factors. This component of the habitat quality assessment was allocated a weighting of 40%, as outlined above. **Site context = 2.0** Although several small patches of habitat were identified in small patches of less than 10 ha with little to no connectivity to larger patches of remnant habitat, the majority of suitable habitat was identified along the northern boundary of the BNCOP and was either remnant and/or contiguous with vast tracks of remnant vegetation to the north of the BNCOP. This habitat is currently threatened by existing land uses and occurs in a fragmented agricultural landscape. There is limited connectivity to large intact remnant areas, except for in the far north of the BNCOP. All areas of habitat will be completely removed by the Project. The Squatter pigeon (southern) habitat that will be impacted by the BNCOP project was given a 'Site Context' score of '2.0' based on the above factors. This component of the habitat quality assessment was allocated a weighting of 40%, as outlined above. **Species stocking rate = 2** The species was recorded at only six locations in the BNCOP area. The Squatter pigeon (southern) habitat that will be impacted by the BNCOP Project was given a 'Species stocking rate' score of '2.0' based on the above factors. This component of the habitat quality assessment was allocated a weighting of 20%, as outlined above.

3.2 Overview of Offset Property – [redacted]

Lot 9 BH194, known as the[redacted] property (north section), is located on the northern side of the Dawson Highway and situated on and to the east of[redacted]. The property is characterised by floodplain coolabah, floodplain eucalypt woodland (RE11.3.3/11.3.4), Brigalow - Bauhinia regrowth (RE11.4.9a, Brigalow – blackbutt (11.4.8) and stands of remnant Brigalow (RE11.9.5). The Offset Area will be managed to enable the natural regeneration process of the TEC and associated habitat to occur which will result in enhanced connectivity to the [redacted] Conservation Park and [redacted] itself.

[redacted], which forms the western boundary of the property, supports a diverse range of foraging habitats due to the creek containing a well vegetated riparian corridor including tall treed canopy layer, tall shrub layer and ground cover including native grasses and leaf litter layer. The low shrub layer and leaf litter layers have been significantly impacted upon by cattle which has greatly reduced these resources and subsequently reduced the value of the site. The area contains large tracts of treed areas, with decorticating bark and tree hollows. These resources provide suitable roosting/breeding resources and breeding habitat resources, for a number of species including the South-eastern long-eared bat.

Table 6: Property Details – [redacted]

Property Details			
Property name: [redacted] (North portion) Note: this property is owned by [redacted]			
Real property description (lot on Plan/s): Lot 9 BH194			
Tenure: Freehold		Primary Local Government Area: Woorabinda Aboriginal Shire Council	
Planning Scheme Zone: Rural		Property area (ha): 2784.7 ha Offset management area (ha): 400.0ha	
Landzone/geology		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.	
Soils		Land zone 3 - Cainozoic alluvial plains or levees with clay or sometimes texture contrast soils. Land zone 4 - Deep cracking black clay with gilgai present.	
Pre-clear regional ecosystem (V.)		11.3.1/11.3.3, 11.4.3/11.4.8	
Existing vegetation (RE)		Remnant **11.3.1**/**11.3.3**, 11.4.3/11.4.8 Regrowth 11.4.8 and 11.4.9	
Estimated age of vegetation		>25 years >8 years	
Is there a PMAV currently over all or part of the property?		Yes – PMAV 2005/109907	
[redacted] Site 32	11.3.3/11.3.1	Wedge of dryland vegetation in between anabranches of [redacted]. Tall open woodland of Brigalow 18-20m tall, 10% cover, with variable height understorey to 10m tall (avg. 5m)	108 ha
BioCondition Site 2 Observation site 27	11.4.8	Patch of disturbed mapped remnant brigalow-belah, canopy circa 16m tall with about 30% canopy cover	6.4 ha
BioCondition Site 3 Observation sites 39-40	11.4.9	Patch of disturbed unmapped remnant brigalow-belah, canopy circa 14m tall with 10% canopy cover. This patch is able to be cleared as it is in a Category X area on the Property Map of Assessable Vegetation (*Vegetation Management Act 1999*)	3.6 ha
	11.4.8/11.4.9	Regrowth Brigalow with gilgai formations. This entire area is able to be cleared, and it is in the Property Management Plan to be cleared, as it is in a Category X area on the Property Map of Assessable Vegetation (*Vegetation Management Act 1999*)	281.6 ha
		Total Offset Area	400 ha

3.2.1 Mapped Vegetation

The Regional Ecosystem mapping for the property is generally correct based on field validation. However, there is a large wedge of Brigalow and belah, between the anabranches of [redacted], which meets the criteria for Brigalow TEC.

The large Brigalow remnant of [redacted] Conservation Park, which is located adjacent to the property, is correctly mapped as a mosaic of two Brigalow REs (11.4.9a and 11.4.8). For more detail, see ***Section 4.3.2.2*** in the Field Report attached as ***Appendix C3***.

3.2.2 Site Surveys and Results

There is up to approximately 55 ha of Brigalow (with or without belah) in between the two anabranches of [redacted], with connectivity to the creek, and with structure and condition equivalent to the adjacent [redacted] Conservation Park.

Additional to this area are two small patches of suitable remnant Brigalow. One 6ha patch has blackbutt (RE 11.4.8) and the other patch of 4ha is with Brigalow (RE 11.4.3).

There is also circa 85ha of Brigalow regrowth on gilgai, which is of high value for fauna species offsets (e.g. Ornamental snake). There is also circa 200 ha of additional Brigalow regrowth without gilgai which functions as fauna habitat for the Squatter pigeon and as connective vegetation, therefore improving the value of the remnant patches of vegetation.

Key features of this property are:

- 65 ha of remnant Brigalow and 285 ha of regrowth Brigalow in various stages of regeneration are available as potential offsets for the Brigalow TEC;
- Current surveys have confirmed the presence of squatter pigeon on site and habitat assessments have identified that the entire site supports suitable habitat, approximately 400 ha, for this species;
- 100 ha of gilgai habitat, that is considered suitable for the ornamental snake; and
- 108 ha of potential habitat for South-eastern long-eared bat associated with the riparian vegetation and immediate surrounds of [redacted].

3.2.3 Offset Site Start Values

The Offset Site start values for each MNES are detailed in ***Table 2, Table 3, Table 4, and Table 5*** above. Full details may be found at ***Appendix C2***.

3.2.4 Brigalow TEC – Suggested Site attributes

A copy of the EPBC Offset Assessment Guide calculator output worksheets for the Brigalow TEC is provided at ***Appendix A1.1*** and ***Appendix A1.2***. ***Table 7*** below provides a description of the input values used for the calculation.

Table 7: Offset Area EPBC Calculator Inputs (start) and offset area future quality (outcome) scores – Brigalow TEC – [redacted]

Offset Calculator Step	Score attributed	Comments
Step 8 – Time horizon	20 years	Time over which loss is averted. The value selected for time over which loss is averted was the maximum of 20 years for the offset site.
Time until ecological benefit	10 years	This is estimated as a reasonable time to achieve improvement as the remnant areas will only have to re-establish a sub-canopy and understorey to achieve the desired outcome as well as to increase the amount of fallen woody debris. This period of time will enable the regrowth (circa 8 years of age at the baseline) to attain a greater canopy cover and density thus reducing the buffel grass cover. This is due to the increased shading and competition from the thickening Brigalow stand competing for sunlight and soil moisture with the buffel grass species. It is not uncommon for Brigalow regrowth to achieve a stem density of 17,000 stems/ha (*Restoration thinning accelerates structural development and carbon sequestration in an endangered Australian ecosystem John M. Dwyer, Rod Fensham and Yvonne M. Buckley)*. The document "*Conserving Biodiversity in Brigalow Landscapes" (University of Queensland)* makes reference that even intermediate Brigalow Regrowth is a valuable habitat for many species. This regrowth has an age range of 16-30 years which is within the 10 year timeframe suggested.
Step 9 – Start area and quality	Remnant (ha) – 4.0 Regrowth (ha) – 6.0 Remnant Quality Score - 7 Regrowth Quality Score - 2	The Brigalow being used as offsets on site are comprised of: • 4ha of remnant vegetation connected to an area of regrowth, which in turn is connected to [redacted], • a further 6ha of remnant vegetation that is connected to an extensive area of regrowth, and • a riparian remnant component approximately 20% of [redacted] vegetation (7ha). For the remnant areas a 'Start Quality' score of '7' has been given as the mature trees were mostly unaffected by grazing, however the understorey has been impacted by cattle grazing over an extended period of time. For the regrowth areas a 'Start Quality' score of '2' has been applied as mechanical control of regrowth via blade ploughing (see [redacted] imagery in ***Appendix B1*** – the old blade ploughing lines can been seen in the imagery) and hot fires are currently used to control the regrowth of the TEC. Another impact to the blade ploughing is the partial levelling of the gilgai formations as soil is moved during the process. This effect diminishes over time with the continual swelling and cracking of the clay soils typical of this landscape. .

Offset Calculator Step	Score attributed	Comments
Step 10 – Future area and quality without offset Risk of loss (%) Without Offset	Remnant (ha) – 0.4 Regrowth (ha) – 0.6 Remnant Quality – 1 Regrowth Quality – 0 Remnant Loss Risk – 90% Regrowth Loss Risk – 90%	Provided that the remaining areas of woody vegetation (remnant and regrowth) are not cleared from the site, or these communities are not destroyed by fire, or grazed more heavily, then it is considered most likely that the existing ecological values for these communities will persist. Therefore the following 'Future Quality without Offset' scores have been given. For remnant vegetation a score of '1' was given. This score is because the remnant area of Brigalow that is being utilised as the Brigalow offset is not protected from clearing due to the area being a Category X on the Property Map of Assessable Vegetation. The entire offset area to the east of [redacted] is targeted for mechanical clearing for pasture production. Further, understorey disturbance due to the area being used by cattle as a cattle camp prevents the ability of the patch to generate new cohorts of Brigalow regrowth for successive generations, particularly following drought or the death of mature trees. For regrowth vegetation, a score of '0' was given, because of the scheduled loss due to blade-ploughing to increase pasture production. This is within the Pastoral Company's Development Plan.
Step 11 – Future area and quality with offset Risk of loss (%)With Offset	Remnant (ha) – 3.6 Regrowth (ha) – 5.4 Remnant Quality – 8 Regrowth Quality – 7 Remnant Loss Risk – 10% Regrowth Loss Risk – 10%	The future quality of the offset is predicated on the effective implementation of the management plan as attached in ***Schedule 1***. The implementation of the actions within the plan will lead to several improvements in condition. Existing remnant vegetation in good condition has less chance of being degraded, and if under drought stress, will be better able to generate new cohorts of Brigalow regrowth for successive generations. Existing remnant vegetation with understorey and ground layer in poor condition will be allowed to recover, as will existing advanced regrowth on channels with denuded ground layer. Various forms of regrowth will be able to reach maturity, and those with gilgai will be allowed to see a recovery of gilgai structure and floristics. The aggressive growth nature of Brigalow regrowth (O'Dwyer) leads to a high stem density of up to 17,000 stems/ha. Once regrowth is at an age whereby it is resilient in the landscape and not prone to death (apart from mechanical or chemical treatment), the competition for resources, especially soil moisture leads to the incremental reduction in buffel grass cover. This results in a lower risk of fire and the gradual accumulation of leaf matter and woody debris. It is noted in the "*Conservation of Biodiversity in Brigalow Landscapes*" that regrowth of an age greater than 16 years has considerable habitat qualities for a number of species. The use of grazing during the dry season further manages the risk of intense fire which is the predominant risk to the TEC. (*"Recovery plan for the 'Brigalow (Acacia harpophylla dominant and co-dominant) endangered ecological community", Butler, D., 2008*)

Offset Calculator Step	Score attributed	Comments
Step 12 – Start quality and future quality without offset	Remnant Quality – 7 Regrowth Quality – 2 Remnant Quality – 1 Regrowth Quality – 0	See commentary in Step 9 and 10 respectively
Step 13 – Future quality (with offset)	Remnant Quality – 8 Regrowth Quality – 7	See commentary Step 11
Step 14 – Calculating adjusted gain using confidence in result (%) Confidence in Result	Remnant – 2.40 Regrowth – 3.60 Remnant – 75% Regrowth – 75%	Automatic Calculator Outputs
Step 15 – Net present value (adjusted hectares)	Remnant – 1.71 Regrowth – 2.28	Automatic Calculator Outputs
Step 16 – Percentage of impact offset	Remnant – 47.51% Regrowth – 63.39%	Automatic Calculator Outputs

The offset area is proposed to be managed in accordance with the Offset Area Management Plan prepared (see ***Schedule 1***). The management strategies will aim to protect and improve the value of the offset area. This will be primarily achieved through rehabilitation of the offset area (for example, with weed control) and implementation of other strategies such as restricting livestock access within the offset area for fuel reduction purposes only, fire management and pest animal management.

3.2.5 South-eastern long-eared bat – suggested site attributes

A copy of the EPBC Offset Assessment Guide calculator output worksheets for the South-eastern long-eared bat is provided at ***Appendix A2.1***. ***Table 8*** below provides a description of the input values used for the calculation for the offset areas on the [redacted] property. As outlined above, additional South-eastern long-eared bat offsets will be secured on the [redacted] property – refer ***Section 3.3***.

Table 8: Offset Area EPBC Calculator Inputs (start) and offset area future quality (outcome) scores – South-eastern long-eared bat – [redacted]

Offset Calculator Step	Score attributed	Comments
Step 8 – Time horizon	20 years	Time over which loss is averted. The value selected for time over which loss is averted was the maximum of 20 years for the offset site.
Time until ecological benefit	10 years	Ecologist advice indicates that the ecological benefit predicated following the implementation of the management actions will be achieved by year 10 of the offset.
Step 9 – Start area and quality	108 ha Score - 4	The site supports a diverse range of foraging habitats within the well vegetated riparian corridor along [redacted] and the adjacent [redacted] Conservation Park. There is a remnant patch of Brigalow nearby that has a tall treed canopy layer, tall shrub layer and ground cover including native grasses and leaf litter layer. The low shrub layer and leaf litter layers have been significantly impacted upon by cattle which have greatly reduced these resources and subsequently reduced the value of the site. There are large tracts of treed areas, within the remnant areas that have decorticating bark and tree hollows resources considered common, to provide suitable roosting/breeding resources and breeding habitat resources, i.e. tree hollows, supported on-site for the species. For these reasons, a 'Start Quality' score of '4' has been given for South-eastern long-eared bat habitat present on the site.
Step 10 – Future area and quality without offset Risk of loss (%) Without Offset	94.5 ha Score - 3 10%	Provided that the remaining areas of remnant vegetation are not cleared from the site, or the habitat resources supported therein are not destroyed by fire, it is considered most likely that the existing habitat values for this species will persist and the status quo remain. However, any change/s to the structure of the remaining vegetation communities (cleared/regrowth areas excluded) will result in a decline in the value of the site to the South-eastern long-eared bat. Consequently, a 'Future Quality without Offset' score of '3' has been given.
Step 11 – Future area and quality with offset Risk of loss (%)With Offset	94.5 ha Score - 7 10%	This Offset Delivery Plan outlines a number of planned management actions that will be implemented to enable the quality of the habitat on site for the South-eastern long-eared bat to improve. For example, the specific actions include the exclusion of cattle grazing in the 108 ha defined as the offset for the species within the riparian areas of [redacted] in the western portion of the site, and the exclusion of forestry operations or native timber harvesting across the entire 400 ha of offset area on the [redacted] property. Additionally, fire will be excluded from management actions with the exception of low intensity burns undertaken at a period of not less than 20 years interval. These actions align with mitigating the 'Threatening Processes' as listed in the Queensland Department of the Environment and Heritage Protection advice for the species,

Offset Calculator Step	Score attributed	Comments
		and the EPBC Act Listing Advice, being: • Habitat loss and fragmentation – refer management actions in Table 13 • Fires that destroy roosting sites and foraging habitat – refer fire management actions in Table 13 • Forestry activities – refer forestry operations management actions in Table 13 • Overgrazing – refer grazing management actions in Table 13 • Predation by feral species – refer pest (pest animals) management actions in Table 13 • Competition for tree hollows – refer management actions in Table 13 • Exposure to agrichemicals – refer pest (weeds) management actions in Table 13 Habitat improvements will primarily include an increase in the structural diversity, abundance and availability of foraging habitats supported on-site. Therefore the predicted 'Future Quality with Offset' score of '7' has been applied within the calculator based upon the effective implementation of a management plan that includes these key strategies.
Step 12 – Start quality and future quality without offset	 Score – 4 Score - 3	See commentary in Step 9 and 10 respectively
Step 13 – Future quality (with offset)	 Score - 9	See commentary Step 11
Step 14 – Calculating adjusted gain using confidence in result (%) Confidence in Result	 3.00% 75%	Automatic Calculator Outputs
Step 15 – Net present value (adjusted hectares)	28.07%	Automatic Calculator Outputs
Step 16 – Percentage of impact offset	20.06% **Note** – additional 80.26% located on Lot 22 AU37 – refer ***Section 3.3***	Automatic Calculator Outputs

3.2.6 Ornamental snake – suggested Site Attributes

A copy of the EPBC Offset Assessment Guide calculator output worksheets for the ornamental snake is provided at ***Appendix A3***. ***Table 9*** below provides a description of the input values used for the calculation.

Table 9: Offset Area EPBC Calculator Inputs (start) and offset area future quality (outcome) scores – Ornamental snake – [redacted]

Offset Calculator Step	Score attributed	Comments
Step 8 – Time horizon	20 years	Time over which loss is averted: the value selected for time over which loss is averted was the maximum of 20 years for the offset site.
Time until ecological benefit	10 years	As noted in the Conservation of Biodiversity in Brigalow Landscapes, regrowth with an age of 16-30 years begins to have the characteristics of older regrowth with density of stems beginning to thin due to competition for resources and a reduction in grasscover. The improvements from herein are related to stem size and the accumulation of leaf litter and fallen woody debris which is augmented by the exclusion of fire in the area. As the regrowth area is already circa 8 years of age, a time of 10 years to achieve an intermediate stage is reasonable. During this time, gilgai re-establish, due to the exclusion of mechanical control and the reduction in grazing pressure and impacting on the gilgai during the wet season.
Step 9 – Start area and quality	23 ha Score - 4	Targeted surveys positively identified the species on-site, both adult and sub-adult. There were a diverse range of gilgai habitats supported on-site in terms of depth and sizes of depressions and heights and sizes of mounds, and extensive evidence of long term water holding (presence of dense aquatic growth including bogmarsh and sedges). Positive identification of sub-adult animal on-site indicates that site supports suitable breeding habitat for the species. Identification of 13 species of frogs in abundance of different age classes on-site, which included "preferred" prey species (Andrew Veary pers. obs and Steve Wilson pers. comm.). However, due to historic land management practices and the abundant presence of cane toads on the site, a 'Start Quality' score of '4' has been given for the ornamental snake habitat present on site.
Step 10 – Future area and quality without offset Risk of loss (%) Without Offset	2.3 ha Score - 1 90%	The site has been subjected to various land management techniques including vegetation clearing and pulling, blade ploughing and inappropriate fire regimes. In addition, active cattle grazing and unfettered access to gilgai areas, particularly during wet environmental conditions, significantly reduces the habitat values of the site. In association with cattle grazing and associated impacts, cane toad populations also have an impact on ornamental snake populations and thus the value of the site. Typically, increased cane toad densities are linked to increasing

Offset Calculator Step	Score attributed	Comments
		grazing pressure. Without the offset and the subsequent inability to eliminate these three primary threatening impacts, it is considered highly likely that the habitat values for the ornamental snake will most likely continue to decline which may result in the loss of this species from this property. Therefore, a 'Future Quality without Offset' score of '1' has been given.
Step 11 – Future area and quality with offset Risk of loss (%)With Offset	 20.7 ha Score - 7 10%	This Offset Delivery Plan outlines a number of planned management actions that will be implemented to enable the quality of the habitat on site for the Ornamental Snake to improve. For example, cattle will be excluded from the gilgaied area of the site (i.e., greater than the offset area) with the exception of controlled grazing activities during dry periods to reduce grass fuel loads. The removal of cattle when there is any evidence of moisture in the gilgais will enable the swelling and cracking nature of the soil to increase the depth of the gilgais over time as well as to enable the cracks in the soil to stay intact (further assisted by exclusion of mechanical control) which will improve the extent of time that moisture is present in the gilgais, thus enabling a longer period for use of these areas by frogs, as the primary food source for the Ornamental snake. These improvements will primarily include increases to longevity of the existing population and breeding success which will lead to more successful recruitment of the site and local area. The values of the gilgai (i.e., the depth of the depressions and the height of the mounds through the process of the clay shrinking and swelling) will improve over time, but will be dependent on rainfall events (and the removal of mechanical disturbance), both in terms of occurrence and severity. The exclusion of chemical control methods for regrowth control (both pelleted and foliar spray) should have a positive effect on the native frog population, again enabling a greater food source for the Ornamental snake. Further, the risk of mechanical and chemical control of the Brigalow community, which provides key habitat attributes for the species, is removed and frequent/high intensity fire is excluded from the offset area to allow the accumulation of leaf litter and fallen woody debris. The management actions proposed align with mitigating the threats to this species identified in the Department of the Environment's *Approved Conservation Advice for Denisonia maculata (Ornamental Snake)* (approved 29 April 2014), being: • continued legacy of past broadscale land clearing – refer forestry operations and grazing management actions in Table 13 • habitat degradation – refer grazing management actions in

Offset Calculator Step	Score attributed	Comments
		Table 13 • modification of habitat through agricultural land and urban development – refer forestry operations and grazing management actions in Table 13 • destruction of wetland habitat by feral pigs – refer pest (pest animals) management actions in Table 13 • destruction of frog habitat (being the key prey source) refer forestry operations and grazing management actions in Table 13 • direct competition for food sources – refer pests (pest animals) management actions in Table 13 The conservation advice for the Ornamental Snake also identifies a potential threat of poisoning resulting from the ingestion of Cane Toads. As outlined in Table 13, there is difficulty in in-field control of cane toads (e.g., as chemical control poses further threats for a range of native species). Research into effective control measures is in its infancy, particularly with regard to control methods in an extended area, such as the [redacted] offset area. Provided that these key strategies are effectively employed, the habitat values of the offset will improve. The predicted "Future Quality with Offset" score of '7' has been applied within the calculator based upon the effective implementation of a management plan.
Step 12 – Start quality and future quality without offset	 Score – 4 Score - 1	See commentary in Step 9 and 10 respectively
Step 13 – Future quality (with offset)	 Score – 7	See commentary Step 11
Step 14 – Calculating adjusted gain using confidence in result (%) Confidence in Result	 13.80ha 4.5 75%	Automatic Calculator Outputs
Step 15 – Net present value (adjusted hectares)	10.3 ha	Automatic Calculator Outputs
Step 16 – Percentage of impact offset	102.45%	Automatic Calculator Outputs

3.2.7 Squatter pigeon (southern) – suggested Site Attributes

A copy of the EPBC Offset Assessment Guide calculator output worksheets for the Squatter pigeon (southern) is provided at ***Appendix A4***. ***Table 10*** below provides a description of the input values used for the calculation.

Table 10: Offset Area EPBC Calculator Inputs (start) and offset area future quality (outcome) scores – Squatter pigeon (southern) – [redacted]

Offset Calculator Step	Score attributed	Comments
Step 8 – Time horizon	20 years	Time over which loss is averted The value selected for time over which loss is averted was the maximum of 20 years for the offset site.
Time until ecological benefit	10 years	Ecologist advice indicates that the ecological benefit predicated following the implementation of the management actions will be achieved by year 10 of the offset.
Step 9 – Start area and quality	400 ha Score - 5	The site supports a diverse range of foraging resources supported across the site including both native and introduced (pasture grasses) supported on sandy to heavier clay soils. There is semi-permanent (most likely permanent) water within the deeper pools of [redacted]. Large tracts of treed areas associated with the remnant vegetation and advanced regrowth areas provide suitable roosting resources for the Squatter pigeon. There are also suitable areas on-site to support breeding for the species. However, due to the presence of predators on site (cats, dogs and pigs) and historic land management practices, a 'Start Quality' score of '5' has been given for Squatter pigeon (southern) habitat present on site.
Step 10 – Future area and quality without offset Risk of loss (%) Without Offset	40.0 ha Score - 4 90%	Given the historical and current land management practices and the variability of land management in the local area, if an offset is not established, it is expected that the status quo for the Squatter pigeon for this site will probably stay the same if not decline thus remaining Vulnerable. However, if there is a significant change/s in land use or practices, e.g., pastoral to cropping and/or clearing of regrowth vegetation, there will be a significant reduction in available habitat suitable for the squatter pigeon, which may result in the loss of this species from this property. Consequently, given the tenuous nature of the habitats supported on the property, the 'Future Quality without Offset' has been given a score of 4.
Step 11 – Future area and quality with offset Risk of loss (%)With Offset	360.0 ha Score - 8 10%	Squatter pigeon are threatened by predation by feral cats and foxes which have been observed to be in very low numbers on the site currently with none being observed during field verification and studies or noted as being seen by the landholder. As the risk of predation is increased in areas where ground cover is reduced by intensive grazing and extensive fire, the management of grazing for fuel reduction purposes and the predominant exclusion of fire (refer management

Offset Calculator Step	Score attributed	Comments
		actions in Table 13) mitigates these threats. The continuation of the existing, ongoing annual baiting program maintains wild dog and pig numbers to a low transient population removing further threats to the Squatter pigeon. High intensity fire and heavy grazing can also alter vegetation structure and composition, leading to a replacement of perennial grasses and forbs with introduced annual species. The use of controlled grazing, exclusion of fire and allowing the Brigalow community to re-establish will reverse the occurrence of introduced annual grasses (buffel) and enable the regeneration of native grasses and forbs as this annual grass retreats due to competition from the Brigalow scrub (refer also http://www.australianwildlife.org/wildlife/squatter-pigeon.aspx#sthash.2jMLzYI1.dpuf and http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64440). The above management actions are consistent with the addressing the defined threats to this species under the *Approved Conservation Advice for Geophaps scripta scripta (Squatter Pigeon (southern))* (approved by the Minister 3 July 2008), being: • ongoing clearance of habitat for farming or development purposes – refer forestry operations management actions in Table 13 • grazing of habitat by livestock and feral herbivores – refer grazing management actions in Table 13 • predation, especially by feral cats (*Felis catus*) and foxes (*Vulpes vulpes*) – refer pest (pest animals) management actions in Table 13 There will be a significant increase in the habitat values of the site for the squatter pigeon due to the increases in canopy cover, stem density, native grass and forb cover and the continued management of feral pest species. Improvements will primarily include increases to the diversity, abundance and availability of forage species, and a reduction in predation and nest disruption/destruction. The predicted 'Future Quality with Offset' score of '8' been applied within the calculator.
Step 12 – Start quality and future quality without offset	Score – 5 Score - 1	See commentary in Step 9 and 10 respectively
Step 13 – Future quality (with offset)	Score - 8	See commentary Step 11

Offset Calculator Step	Score attributed	Comments
Step 14 – Calculating adjusted gain using confidence in result (%) Confidence in Result	240.0ha 3 75%	Automatic Calculator Outputs
Step 15 – Net present value (adjusted hectares)	196.45	Automatic Calculator Outputs
Step 16 – Percentage of impact offset	101.32%	Automatic Calculator Outputs

3.3 Overview of Offset Property – [redacted]

Lot 22 on AU37, known as "[redacted]", is located 4.8km to the west of the Barakula State Forest, and its northern boundary abuts [redacted]. The property is comprised predominantly of remnant vegetation but is impacted by the effects of historical timber harvesting, over-grazing and the inappropriate use of fire.

The [redacted] property will be managed to enable the natural regeneration process of the habitat along the riparian zone of [redacted] (Stream Order 4) and associated adjacent forage areas. The use of the creek's riparian area as part of the offset will therefore enhance connectivity to the 232,500ha Barakula State Forest.

Table 11: Property Details – [redacted]

Property Details	
Property name: [redacted] Note: this property is owned by [redacted]	
Real property description (lot on Plan/s): Lot 22 AU37	
Tenure: Freehold	Primary Local Government Area: Western Downs Regional Council
Planning Scheme Zone: Rural	Property area (ha): 720.34 ha Offset management area (ha): 420.0ha
Landzone/geology	Landzone 7 - Cainozoic duricrusts formed on a variety of rock types, usually forming mesas or scarps. Includes exposed ferruginous, siliceous or mottled horizons and associated talus and colluvium, and remnants of these features, for example low stony rises on downs.
Soils	Soils are usually shallow Rudosols and Tenosols, with minor Sodosols and Chromosols on associated pediments, and shallow Kandosols on plateau margins and larger mesas.
Pre-clear regional ecosystem (V.)	11.7.4/11.7.7/11.7.5/11.7.2
Existing vegetation (RE)	Remnant REs - 11.7.4/11.7.7/11.7.5/11.7.2

Property Details		
Estimated age of vegetation	>25 years	
Is there a PMAV currently over all or part of the property, Please detail	No	
[redacted] Sites 45, 46, 47, 48	Remnant REs - 11.7.4/11.7.7/11.7.5/11.7.2	420ha
	Total Offset Area	420ha

3.3.1 South-eastern long-eared bat – suggested Site Attributes

A copy of the EPBC Offset Assessment Guide calculator output worksheets for the South-eastern long-eared bat is provided at ***Appendix A2.2***. ***Table 12*** below provides a description of the input values used for the calculation.

Table 12: Offset Area EPBC Calculator Inputs (start) and offset area future quality (outcome) scores – South-eastern long-eared bat – [redacted]

Offset Calculator Step	Score attributed	Comments
Step 8 – Time horizon	20 years	Time over which loss is averted. The value selected for time over which loss is averted was the maximum of 20 years for the offset site.
Time until ecological benefit	10 years	Ecologist advice indicates that the ecological benefit predicated following the implementation of the management actions will be achieved by year 10 of the offset.
Step 9 – Start area and quality	420 ha Score - 8	The South-eastern long-eared bat was not positively identified on-site, but 100 (including one female with two young) microbats from five species were captured. This included 33 *Nyctophilus spp.*; 9 *N. geoffroyi* and 24 *N. gouldi* (inc. 2 young). Diverse range of foraging habitats for this species are supported across the whole site, including tall treed canopy layer, tall shrub layer, low shrub layer and ground cover including native grasses and leaf litter layer. The site supported structurally diverse and abundant treed, tall canopy layer with decorticating bark and tree hollows resources considered abundant, to provide suitable roosting/breeding resources. The shrub layers were equally diverse and abundant. The ground and leaf litter layer were diverse, yet patchy, which is common in the local area. Breeding habitat resources, i.e., tree hollows, supported on-site for the species.

Offset Calculator Step	Score attributed	Comments
		For these reasons, a 'Start Quality' score of '8' has been given for the south-eastern long-eared bat habitat present on the site.
Step 10 – Future area and quality without offset Risk of loss (%) Without Offset	378.0 ha Score - 5 10%	Historically, the site has been selectively logged for timber resources. With the exception of the broadscale clearing of the LNG pipeline corridors on-site, there has been little disturbance to the remaining vegetation on-site and consequently, the habitat values supported on-site have improved over time since the cessation of logging activities. In addition, there is limited cattle grazing on-site which has had some impact on the values supported, primarily associated with the decline in the structure, nature and extent of the low shrub, ground and leaf litter layers supported. Without the offset, it is likely that the values of the site will decline over time if cattle grazing pressure continues/increases and/or a wildfire occurs across the site. Both these impacting processes have the potential to significantly impact on the values of the site. The property management practices are currently limited in this regard, and are likely to be maintained as such, therefore a "Future Quality without Offset" score of 5 has been given.
Step 11 – Future area and quality with offset Risk of loss (%)With Offset	378 ha Score - 9 10%	This Offset Delivery Plan outlines a number of planned management actions that will be implemented to enable the quality of the habitat on site for the South-eastern long-eared bat to improve. For example, the specific actions include the exclusion of heavy cattle grazing from the defined offset area on the [redacted] property which can impact the understorey vegetation community, with the exception of controlled grazing for fuel reduction purposes as required. Further, the exclusion of forestry operations or native timber harvesting across the offset area and exclusion of intense, frequent fire (which can reduce the number of tree bearing hollows as well as cause mortality) with the exception of low intensity burns undertaken at a period of not less than 20 years interval, will assist in improving habitat quality for the species by controlling weed cover and maintaining woody vegetation. These actions align with mitigating the 'Threatening Processes' as listed in the Queensland Department of the Environment and Heritage Protection advice for the species, and the EPBC Act Listing Advice, being: • Habitat loss and fragmentation – refer management actions in Table 14 • Fires that destroy roosting sites and foraging habitat – refer fire management actions in Table 14

Offset Calculator Step	Score attributed	Comments
		• Forestry activities – refer forestry operations management actions in Table 14 • Overgrazing – refer grazing management actions in Table 14 • Predation by feral species – refer pest (pest animals) management actions in Table 14 • Competition for tree hollows – refer management actions in Table 14 • Exposure to agrichemicals – refer pest (weeds) management actions in Table 14 Habitat improvements will primarily include an increase in the structural diversity, abundance and availability of foraging habitats supported on-site. Therefore the predicted "Future Quality with Offset" score of '9' has been applied within the calculator based upon the effective implementation of a management plan that includes these key strategies.
Step 12 – Start quality and future quality without offset	 Score - 8 Score - 5	See commentary in Step 9 and 10 respectively
Step 13 – Future quality (with offset)	 Score - 9	See commentary Step 11
Step 14 – Calculating adjusted gain using confidence in result (%) Confidence in Result	 315ha 6.75% 75%	
Step 15 – Net present value (adjusted hectares)	111.16%	
Step 16 – Percentage of impact offset	80.26% **Note** – additional 20.06% located on Lot 9 BH194	

4 LEGALLY BINDING MECHANISM

All direct offset sites will be secured using one of the legally binding mechanisms on title that are available to ensure the protection of the offset and implementation of the Offset Area Management Plan. These legally binding mechanisms are:

- an environmental offset protection area under section 30 of the *Environmental Offsets Act 2014;*
- an area declared as an area of high nature conservation value under section 19F of the *Vegetation Management Act 1999*, where it is secured for the purposes of an environmental offset;
- declared as a nature refuge under section 46 of the *Nature Conservation Act 1992*, where it is secured for the purposes of an environmental offset;

- declared as a protected area under section 29(1) of the *Nature Conservation Act 1992*, where it is secured for the purposes of an environmental offset; or
- secured as a statutory covenant for environmental purposes under the *Land Act 1994* or *Land Title Act 1994*. The mechanisms adopted to secure offsets will ultimately depend upon the mechanisms available and agreed to by the relevant parties.

In this instance, the offset will be secured via a Voluntary Declaration as an area of high conservation value under the *Vegetation Management Act 1999 (Qld).* Once this has been registered on the property title, the offset area will be mapped as a Category A area on the PMAV. A Category A area on a PMAV is red in colour and is described as an "Area subject to compliance notices, offsets and voluntary declarations". A copy of the draft Request for Voluntary Declaration for each property is provided at ***Schedule 2***.

The Queensland Government's *Guide to voluntary declarations under the Vegetation Management Act 1999* states that the declaration cannot end (i.e., be removed from the property title) until the management outcomes of the management plan have been achieved – therefore the legally binding mechanisms, and by extension implementation of the Offset Area Management Plans, will remain in place until these outcomes are realised. Further, the Guide also states that the offset area will be mapped under the *Vegetation Management Act 1999* as Category A on a Property Maps of Assessable Vegetation (PMAV) until the area is mapped as remnant vegetation on the Regional Ecosystems mapping, and is therefore protected from clearing under the *Vegetation Management Act 1999* and relevant regional vegetation management codes during and following the period of the offset.

5 OFFSET MANAGEMENT ACTIONS

An Offset Area Management Plan (**OAMP**) has been prepared in accordance with the specific requirements contained within the final Offset Strategy approved by DotE. The OAMP includes, but is not limited to, information on the threats and the management actions required on the offset site to abate those threats identified to the MNES impacted by the Project. The OAMP contains details of the management and the reporting and monitoring program that will extend until the management outcomes are achieved.

Management actions recommended include:

- Limitations on the clearing of vegetation to that required for maintenance of fencing and fire control lines;
- Exclusion of domestic livestock from the offset area except for the infrequent grazing associated with fuel reduction;
- Feral pest animal management;
- Management of fire; and
- A weed management program.

Please see ***Schedule 1A*** and ***Schedule 1B*** for the OAMP for each property,

5.1 [redacted]

The schedule of management actions for the [redacted] property is shown in ***Table 13*** below.

Table 13: Schedule of management actions – [redacted]

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
Forestry Operations, Native Timber Harvesting and general Vegetation clearing	Vegetation clearing on the Offset Area is restricted to: a) that necessary for the removal of non-native weeds or declared pests; b) establishing and maintaining fencing around the boundary of the declared area; c) establishing and maintaining fire breaks; and d) ensure public safety Vegetation clearing for any other purpose **is not** permitted within the offset area.	Only in those areas subject to non-native weed control, fire control lines and fences.	As required and identified in the quarterly inspections of the fences and collocated fire control lines.	Landowner or suitable qualified person appointed by the Landowner.	No evidence of recent forestry or timber harvesting activities are evident during term of the offset management plan. Any illegal clearing to be recorded in the landholder records and identified during the monitoring and reporting program.	Any evidence of clearing apart from weeds is to be noted in the Annual Landholder reports. If evidence of recent timber harvesting is noted during inspections, the landholder is to reassess access protocols for any lessees etc., signage and general access.

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
Fire	Fire is to be, excluded from the Offset Area except for low intensity ecological burns by: a) Maintaining firebreaks relative to the Offset Area; b) Using a low intensity fire >20 years interval; and c) Firebreaks are to be co-located with roads and fence lines on the property where possible. **Note:** Fire is not to be used as a tool for regrowth management on the Offset Area. It is recognised that high-intensity burns are detrimental to the *Solanum spp*, and hence the importance of adopting these management practices.	Throughout the Offset Area.	Fire Control lines are to be inspected weekly and maintenance undertaken as required but at an interval of at least each 2 years. If fire is used at all, it is to be at a low intensity fire at >20 years interval.	Caretaker will undertake weekly inspections, [redacted] monthly inspections. Grading of the fire breaks is to be undertaken by a suitable qualified person appointed by the [redacted] or council [redacted].	No evidence of fire is observed during the term of the offset management plan, except for prescribed mosaic burns. Any incidence of wild fire or illegal burning (Force Majeure) is to be identified during weekly inspections and documented within the monitoring and reporting program.	Any occurrence of fire in the Offset Area is to be noted during weekly inspections of the property and recorded in the Annual Landholder reports. **Corrective action:** Check and repair all fire control management lines. Destock the offset area, re-establish fire breaks and control lines and if appropriate, widen fire control lines and reassess fuel load reduction practices. Fire and grazing excluded until the grass cover has increased to 50% using the methodology in the Land Manager's Monitoring Guide as attached.

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
Grazing	There is no set stocking rates as this region is subject to significant changes in grass cover with seasonal conditions. It is recognised that competition from non-native pasture species can have a negative effect on the establishment of the *Solanum spp*, Grazing is therefore restricted as per these management actions to reduce the risk of high-intensity fires and to manage the levels of ground cover of the non-native pastures.	A new fence is to be established to exclude cattle from [redacted] and another fence is to be established along the eastern boundary of the offset area, as shown in the Fencing Plan at Figure 9. Grazing is excluded from the [redacted] South-eastern long- eared bat Offset Area. Stock will be grazed in the Offset Area to the east of [redacted] fence line for fuel reduction purposes only during the dry season.	As required when grass fuel loads exceed 50%. During the dry season. Establish the new fence by December 2016 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 bottom of the gilgais to ensure that no "pugging" of the soil occurs by livestock. .	[redacted]	The Landowner, at their discretion, is to graze stock during the dry season, at rates and times necessary to reduce the fuel load in the Offset Area without lowering the grass cover to below 30% at the end of the dry season. No evidence of "pugging" is to occur.	The property Caretaker will undertake twice weekly inspections when stock are grazing the offset area. The [redacted] will undertake monthly inspections of the property to ensure that cattle are not present when there is any evidence of moisture in the gilgai formations. If cattle are in the offset area when rainfall occurs, they are to be removed to the area to the east of the offset area within 24 hours. Fence lines are to be inspected weekly during grazing periods and along with Photo point and Terrestrial Habitat Quality Assessment results of grass cover and groundcover, grazing instances, stocking rates, timeframes and rainfall records are to be incorporated into the Annual Landholder Reports and the Compliance reports to [redacted] and the regulator/s. **Corrective action:** grazing excluded until grass cover has increased to 30% using the methodology in the Land Manager's Monitoring Guide as attached.

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
Pests	**Pest Animal Management** Minimise the introduction of pest animals and control of existing populations of pest animals (wild pigs) within the Offset Area in accordance with the *Land Protection (Pest and Stock Route Management) Act 2002 (Qld)*. There are currently no incidence of foxes on the property. Wild pig and dog populations are transient and are infrequent and of short duration and impact due to the small numbers that occur. Current control of pigs and wild dogs is undertaken via an annual baiting programme on the property. Additional to this measure, the caretaker, during weekly inspections of the offset area is to shoot any wild pigs or wild dogs that are seen. If an increase in pig or dog activity is noted, an additional trapping and shooting programme is to be instigated until the increased activity has ceased. Investigate any realistic methods of cane toad control/management. This research is in its infancy with regards the ability to undertake the control methods in an extended area. It is recommended that [redacted] and [redacted] explore partnership opportunities with the [redacted] with regards commercial scale implementation. This would involve training of the local [redacted] and hence the [redacted] for training. [redacted]	Throughout the Offset Area.	As required.	[redacted], caretaker or suitable qualified person appointed by the Landowner.	Scrappings, wallow holes, tracks and visual incidents along with control measures are to be noted in the Annual Landholders Reports after weekly inspections by the caretaker and monthly inspections by the [redacted]. This evidence is to be collected quarterly and included in the Monitoring and Reporting to the Regulator.	**Corrective action:** if an increase in pig or wild dog numbers is observed, the landholder will implement a pest animal management programme to control the feral animal population. If an increase in pig or wild dog activity is noted during regular landholder inspections of the offset area, then a programme of baiting and or pig trapping is to be instigated until the population and occurrence of these pests is reduced. This will have a greater impact if control measures are integrated with neighbouring properties. Potential cane toad management investigations to be incorporated into the first Annual Report and if a pragmatic training and scaled approach can be identified, incorporated into the Pest Animal Control Programme.

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
	<u>*Solanum spp.* Offset – Qld Government</u> The results of the Year 1 monitoring programme will be used to determine the most appropriate locations for installation of pig exclusion fencing. It is intended that, as a minimum, pig exclusion fencing will be installed around distinct populations of *Solanum spp.*. Where broad distribution of the species/large patches of populations are located within the *Solanum spp.* offset area and/or the distribution of the species expands in the offset areas, broader establishment of pig exclusion fencing will be implemented. Proposed methodology and locations of pig exclusion fencing will be included in the Year 1 reporting to EHP for their review and approval prior to implementation.	Within the *Solanum spp.* offset area.	After Year 1 *Solanum spp.* monitoring programme		Further monitored and recorded during the *Solanum spp.* monitoring program as shown in *Table 11.*	

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
	Weeds 1. Keep the introduction, establishment and spread of non-native weeds including Declared Pest Plants listed under the Land Protection (Pest and Stock Route Management) Act 2002 (Qld) to less than 10% weed cover over the Offset Area. 2. Control existing infestations of non-native weeds including Declared Pest Plants under the Land Protection (Pest and Stock Route Management) Act 2002 (Qld) to ensure that the non-native weeds cover less than 10% of the Offset Area. e.g., Parthenium, mother of millions, and velvety tree pear. 3. Buffel in this instance is recognised as being a threat to the ecological community however is not referred to as a weed. Control of Buffel is best managed via grazing during the dry season and by increasing tree canopy cover. 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 bottom of the gilgais to ensure that no "pugging" of the soil occurs. 4. The use of broadscale herbicide is not recommended due to the potential impact on frog species in the creek and gilgai formations. This impact would lead to a negative impact on the Ornamental Snake population via the loss of frog species and population on which it is reliant. 5. Spot spraying of patches of Parthenium and mother of millions is allowed as required. 6. The rare occurrences of tree pear are to be treated as per the recommended advice at the time of treatment.	Throughout the Offset Area.	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.	[redacted], caretaker or suitable qualified person appointed by the Landowner.	Observations during routine property inspections by the caretaker (weekly) or by the [redacted] (monthly). Incidence, observations and resultant control measures are to be recorded via photos and additionally by the photo point and Terrestrial Habitat Quality Assessment results of grass cover and non-native groundcover to be incorporated into the Annual Landholder Reports and the Compliance reports to [redacted] and the regulator.	**Corrective action:** The level of weed infestation is low in the observed areas and spot spraying of small outbreaks observed during routine property inspections should suffice. Broadscale chemical spraying is NOT supported due to the potential negative effect on the native frog population thus impacting on the Ornamental snake population due to ingestion of the chemicals and the reduction in the frog population.

5.2 [redacted]

The schedule of management actions for the [redacted] property is shown in ***Table 14*** below.

Table 14: Schedule of management actions – [redacted]

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
Forestry Operations, Native Timber Harvesting and general Vegetation clearing	Vegetation clearing on the Offset Area is restricted to: e) that necessary for the removal of non-native weeds or declared pests; f) establishing and maintaining fencing around the boundary of the declared area; g) establishing and maintaining fire breaks; and h) ensure public safety Vegetation clearing for any other purpose **is not** permitted within the offset area.	Only in those areas subject to non-native weed control, fire control lines and boundary fences.	As required and identified in the Annual inspections of the boundary fence and co-located fire control lines.	Landowner or suitable qualified person appointed by the Landowner.	No evidence of recent forestry or timber harvesting activities is evident during term of the offset management plan. Any illegal clearing to be identified by the monitoring and reporting program.	Any evidence of clearing apart from weeds is to be noted in the Annual Landholder reports. If evidence of recent timber harvesting is noted during inspections, the landholder is to reassess access protocols for any lessees etc., signage and general access.

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
Fire	Fire is to be, excluded from the Offset Area except for low intensity ecological burns by: d) Maintaining firebreaks relative to the Offset Area; e) Using a low intensity fire >20 years interval; and f) Firebreaks are to be co-located with existing roads and fence lines on the property where possible. **Note:** Fire is not to be used as a tool for regrowth management on the Offset Area.	Throughout the Offset Area.	Fire Control lines as required but at an interval of at least each 2 years with annual inspections to identify the need for maintenance of the fire control lines. Low intensity fire at >20 years interval.	Landowner or suitable qualified person appointed by the Landowner.	No evidence of fire is observed during the term of the offset management plan, except for prescribed mosaic burns. Any incidence of wild fire or illegal burning (Force Majeure) is to be identified during annual inspections and documented within the monitoring and reporting program.	Any occurrence of fire in the Offset Area is to be noted in the Annual Landholder reports. **Corrective 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. Fire and grazing excluded until ground level cover has increased to the benchmark level of 15%.

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
Grazing	Stock will be grazed in the Offset Area for fuel reduction purposes only. There is no set stocking rates or times throughout the year where stock is to be permitted to graze.	Throughout the Offset Areas. Repair fence at Observation Point 46 Easting – [redacted], Northing -[redacted]. This site is located at a Grid on [redacted] and has a gate. There is no east-west fence to the east of the grid.	As required. Fence repair by December 2016.	Landowner	The Landowner, at their discretion, is to graze stock, at rates and times necessary to reduce the fuel load in the Offset Area without lowering the grass cover to below 15% at the end of the dry season.	Photo point and quaternary assessment site results of grass cover and groundcover to be incorporated into the Annual Landholder Reports and the Compliance reports to [redacted] and the regulator/s. **Corrective action**: grazing excluded until grass cover has increased to the Qld Herbarium Benchmark of 15% for this vegetation community.
Other	**Pest Animal Management** Minimise the introduction of pest animals and control of existing populations of pest animals (wild pigs) within the Offset Area in accordance with the *Land Protection (Pest and Stock Route Management) Act 2002*.	Throughout the Offset Area.	As required.	Landowner or suitable qualified person appointed by the Landowner.	Incidents and control measures to be noted in the Annual Landholders Reports. Anecdotal evidence collected yearly and included in the Monitoring and Reporting to the Regulator.	**Corrective action**: if an increase in pig numbers is observed, the landholder will implement a pest animal management program to control the feral animal population.

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
	Weeds 1. Keep the introduction, establishment and spread of non-native weeds including Declared Pest Plants listed under the *Land Protection (Pest and Stock Route Management) Act 2002* to less than 10% weed cover over the Offset Area. 2. Control existing infestations of non-native weeds including Declared Pest Plants under the *Land Protection (Pest and Stock Route Management) Act 2002* to ensure that the non-native weeds cover less than 10% of the Offset Area. e.g., Tree Pear.	Throughout the Offset Area.	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.	Landowner or suitable qualified person appointed by the Landowner	Observations during routine property inspections, Photo point and Quaternary site assessment results of grass cover and groundcover to be incorporated into the Annual Landholder Reports and the Compliance reports to [redacted] and the regulator.	**Corrective action:** There is potential for the cleared gas pipeline routes to be a significant source of weed infestation and these areas should be monitored after rain events and the respective companies contacted to undertake control actions if weed infestations increase. The level of weed infestation is low in the observed areas and spot spraying of small outbreaks observed during routine property inspections should suffice.

6 MONITORING AND REPORTING

Annual reports will be submitted to the Department of the Environment for the first five years of the offset, and will include:

- Photo point records
- Summary of Landholder Records, identifying:
    - Incidences of fire
    - Presence (or evidence) of pest animals species
    - Presence of weeds species
    - Grazing records (include dates, stocking rates)
    - Rainfall records
    - Any corrective actions undertaken in accordance with the Management Actions in ***Table 13*** and ***Table 14*** (e.g., treatment of weeds, pest animal management)

The collation and submission of these reports is the responsibility of [redacted].

Additionally, BioCondition/quaternary site assessments will be conducted every five years at the same locations as undertaken for the baseline measurements and annual photo points respectively (refer to figures at ***Appendix B1*** ([redacted]) and ***Appendix B2*** ([redacted]).

The ongoing BioCondition/quaternary site monitoring will be used to measure the increase in individual ecological attributes under the BioCondition/quaternary site methodology for comparison to the baseline BioCondition/quaternary site assessment, providing a scientifically-based demonstration of increased habitat quality over the life of the Offset Area Management Plans for each property. These assessments will be interpreted by ecologists to determine the habitat quality scores for each species offset, in a method consistent with that used to populate the offset calculators from the baseline BioCondition/quaternary site assessment, to confirm such increases.

Where BioCondition/quaternary site assessments do not demonstrate improvements in each of the individual attributes, and therefore the overall habitat quality for any of the offset species, a review of management actions and corrective actions will be undertaken to determine if additional measures are required, and approval sought from the Minister if required.

As outlined in the tables in ***Sections 3.2*** and ***3.3***, it is expected that the defined habitat quality increases for each species will be achieved by year 10 of the offset (i.e., 2024). A BioCondition/quaternary site assessment is scheduled for this time to confirm habitat quality for each species at the time. A final BioCondition/quaternary site assessment will be undertaken in 2030 (year 15 of the offset), to demonstrate that the habitat quality has been maintained to the completion of implementation of the Offset Area Management Plans.

Where the overall habitat quality scores identified in the offset calculators (i.e., 'Habitat Quality with Offset') are not achieved for the offset species by the end of implementation of the Offset Area Management Plans for each property, management actions will continue until the management outcomes are achieved. Although it is defined that the legally binding mechanisms (Voluntary Declarations on each property title) will be complete in 2030, as outlined above in ***Section 4***, the Queensland Government's *Guide to voluntary declarations under the Vegetation Management Act 1999* states that the declaration cannot end (i.e., be removed from the property title) until the management outcomes of the management plan have been achieved – therefore the legally binding mechanisms, and by extension implementation of the Offset Area Management Plans, will remain in place until these outcomes are realised. Further, the Guide also states that the offset area will be mapped under the *Vegetation Management Act 1999* as Category A on a Property Maps of Assessable Vegetation (PMAV) until the area is mapped as remnant vegetation on the Regional Ecosystems mapping, and is therefore

protected from clearing under the *Vegetation Management Act 1999* and relevant regional vegetation management codes during and following the period of the offset.

The schedule of Monitoring and Reporting is summarised in ***Table 15***.

Table 15: Schedule of monitoring and recording – [redacted] and [redacted] properties

Monitoring	Attributes monitored	Frequency	Method	Location/s
Surveys undertaken by Ecologists				
Baseline monitoring	Refer 'ecological condition, habitat assessment' below	At commencement of Plan (year 0)	Field observations, vegetation assessment as per Qld Herbarium BioCondition/quaternary site methodology.	Observation sites listed in the Management Plans.
Ecological condition, habitat assessment	Recruitment of woody perennial species	At commencement (year 0) and then every 5 years to (and including) year 2030; reported every 5 years	Field observations, and vegetation assessment as per Queensland Herbarium BioCondition/quaternary site methodology	Observation sites listed in the Management Plans.
	Native plant species richness	At commencement (year 0) and then every 5 years to (and including) year 2030; reported every 5 years		Observation sites listed at in the Management Plans.
	Native perennial grass cover	At commencement (year 0) and then every 5 years to (and including) year 2030; reported every 5 years		Observation sites listed at in the Management Plans.
	Weed cover	At commencement (year 0) and then every 5 years to (and including) year 2030; reported every 5 years		Observation sites listed at in the Management Plans.
Landholder Records				
Photo Points	Visual appearance of offset	Annually for first 5 years, then every 5 years along with 'ecological condition, habitat assessment' monitoring; reported annually for the first 5 years and then every 5 years to (and including) year 2030.	Photographs of offset area taken at defined locations for medium to long-term comparison	Observation sites listed in the Management Plans.
Grazing	Stocking rates, rates and timing	Reported annually for the first 5 years and	[redacted]/landholder	Within Offset Area

		then every 5 years to (and including) year 2030.	representative will undertake inspections of the offset area to observe and record grass cover levels, weed occurrence and any evidence of pest animal incursion. These records are to be collated and reported every year for the first 5 years. Subsequently, they are to be included in the five yearly reports along with the BioCondition/quaternary site reports.	
Fire	Incidence and extent	As required; reported annually for the first 5 years and then every 5 years to (and including) year 2030.		
Weeds	Occurrence, control measures, timing and result of the control measures	Reported annually for the first 5 years and then every 5 years to (and including) year 2030.		
Pest animals	Occurrence, control measures adopted, timing of the control measures and the result	Reported annually for the first 5 years and then every 5 years to (and including) year 2030.		

7 GOVERNANCE ARRANGEMENTS

The two offset sites will be managed as per the Offset Area Management Plans (OAMP) as attached at ***Schedule 1a*** and ***Schedule 1b*** respectively. The key risks and corresponding management actions from the management plan are detailed at ***Section 4*** of each OAMP. The Monitoring and Reporting as detailed previously will be undertaken to verify the management actions have been undertaken and that the offset site is improving. The OAMP is attached to the title of the property via the Voluntary Declaration under the *Vegetation Management Act 1999 (Qld)* which gives the State legislative powers to oversee the offset's implementation.

SCHEDULE 1: OFFSET AREA MANAGEMENT PLANS

Schedule 1a ([redacted] – OAMP)

Please refer to pdf file supplied separately.

[redacted]

- EPBC 2013/7036
- Protected Plant Clearing Permits: WIPA14447814 and WIPA15148514

Baralaba North Continued Operations Project (BNCOP) and Associated Infrastructure

Offset Area Management Plan

"[redacted]"

May 2015

Table of Contents

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)* or the *Environment Protection & Biodiversity Conservation Act 1999*.

The plan template 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 impacted on the clearing 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 landowner and the delegate

Part 3 - Attachments

1. Baseline data
    (a) Ecological equivalence assessment of the Offset Area
    (b) Weed and pest species
    (c) Flora and fauna present on the Offset Area or adjacent to Offset Area
    (d) Monitoring data:
        - GPS points
        - Photo monitoring
        - Flora quadrats
2. Land Manager's Monitoring Guide

Parts 1, 2 and 3 must be completed to fulfil the management plan requirements

1. Summary Information

1.1 Departmental Reference Details

Departmental Reference Details for application that triggers offset	
Departmental Reference Number and Case Name: Offset reference number (if applicable):	EPBC reference: **2013/7036** Protected plant Clearing Permit: **WIPA14447814** dated 8 September 2014 (QBOP) and **WIPA15148514** dated 22 April 2015 (QEOP).
Tenure: Freehold and State Controlled Road Reserve	Primary Local Government Area: Banana Shire Council

Offset Triggers and Values	
Offset Trigger	**Values requiring to be offset**
☐ Regional Vegetation Management Code ☐ Part P ☐ Part S ☐ Part Xa ☐ Part Xb ☐ Material Change of Use / Reconfiguration of a lot Policies (Table F1) ☒ *Environment Protection and Biodiversity Conservation Act 1999* (Cth) ☒ *Nature Conservation Act 1992 (Qld)/Environmental Offsets Act 2014* (Qld)	☒ EPBC TEC and/or Protected Spp. ☐ Assessable vegetation adjacent to a wetland, significant wetland ☐ Assessable vegetation adjacent to a watercourse ☐ Connectivity ☐ Endangered regional ecosystem ☐ Of concern regional ecosystem ☐ Threshold regional ecosystem ☐ Critically limited regional ecosystem ☐ Essential habitat ☐ Essential habitat for koalas in SEQ ☐ Values within a highly vegetated bioregion ☒ Protected Plant under the *Nature Conservation Act 1992*

1.2 Offset Area Details

Landholder Details	
Register Owner/s on Title: [redacted]	
Lessee:	Trustee:
Business/Company name: [redacted]	
ABN/ACN: [redacted]	
Phone number: [redacted]	Mobile phone:
Facsimile number:	Contact person (if required): [redacted]
Email: [redacted]	
Postal Address: c/- Post Office, [redacted]	

Property Details		
Property name: [redacted] North Section)		
Real property description (lot on Plan/s): Lot 9 BH194		
Tenure: Freehold	Primary Local Government Area: Woorabinda Aboriginal Council	
Planning Scheme Zone: Rural	Property area (ha): 2,794.76	Offset Area (ha): 400
Landzone / geology	Landzone 4 - Tertiary-early Quaternary clay deposits, usually forming level to gently undulating plains not related to recent Quaternary alluvial systems.	
Soils	Mainly Vertosols, Deep cracking black clay with gilgai present	
Pre-clear regional ecosystem (V.)	11.4.3/11.4.8	
Existing vegetation	Remnant 11.4.3/11.4.8 , Regrowth 11.4.8 and 11.4.9	
Estimated age of vegetation	Remnant – minimum of 25 years, regrowth – minimum of 8 years	
Is there a PMAV currently over all or part of the property, Please detail	Yes – PMAV – 2005/109907	

Legally Binding Mechanism	
☒ Voluntary Declaration (*Vegetation Management Act 1999*)	☐ Covenant (*Land Act 1994/ Land Title Act 1994*)
Reference Number:	Reference Number:
☐ Nature Refuge (*Nature Conservation Act 1992*)	☐ Other
Reference Number:	Reference Number:

1.3 Description of State clearing and offset values

Table 1 identifies the values impacted on and captured under the *Nature Conservation Act 1992 (Qld)* – in the Train Load Out Facility and Private Access Road clearing area for which an offset is provided for within the Offset Area.

Table 1: Clearing area values - *Nature Conservation Act 1992 (Qld)*

Clearing Area				
Value (as identified in the Offset Policy)	**Conservation Status**	**Regional ecosystem**	**Essential habitat (species)**	**Area (ha)**
Protected plant Clearing Permit: WIPA14447814 dated 8 September 2014	Endangered	*11.4.8 and 11.4.9*	*Solanum elachophyllum*	4.0
Protected Plant Clearing Permit: WIPA15148514 dated 22 April 2015	Endangered	*11.4.8 and 11.4.9*	*Solanum elachophyllum* *Solanum johnsonianum*	12.3
			Total	**16.3**

Table 2: Offset Area values - *Nature Conservation Act 1992 (Qld)*

Offset Area					
Value (as identified in the Offset Policy)	**Conservation Status**	**Regional ecosystem**	**Broad vegetation group**	**Essential habitat (species)**	**Area (ha)**
Protected Plant NC Act	*Endangered*	11.4.3	25a	*Solanum elachophyllum* *Solanum johnsonianum*	49.2 (Private Access Road)
		11.4.8	25a		3.6 (TLO)
		11.4.9	25a		16.4 (TLO)
				Total	**69.2**

The 20.0 ha Solanum offset is illustrated in **Figure 5** and the 49.2ha Solanum offset for the Private Access Road is illustrated in **Figure 6.**

Figure 1: Location of State Significant Biodiversity Values within the Clearing Area – Train Load Out Facility

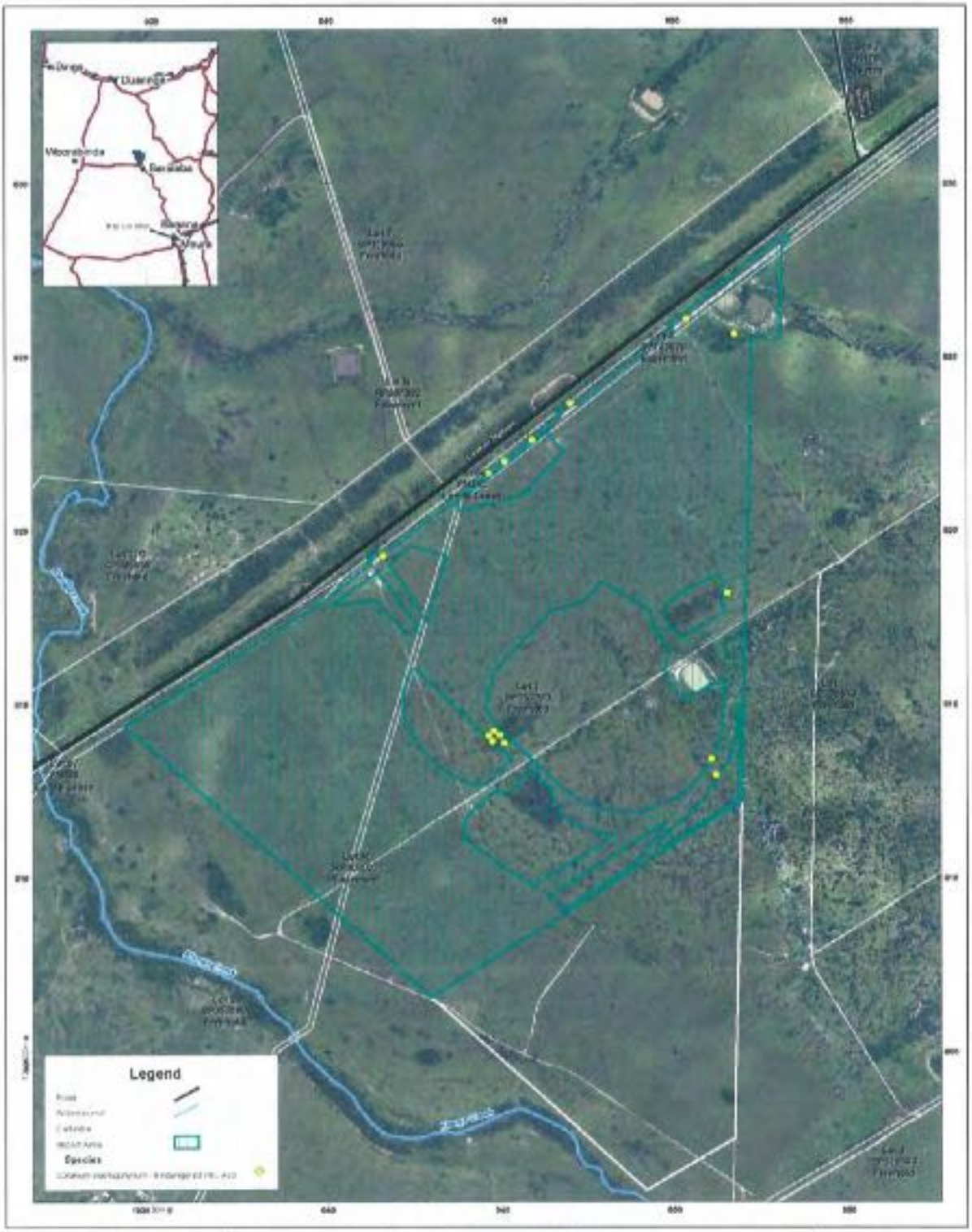
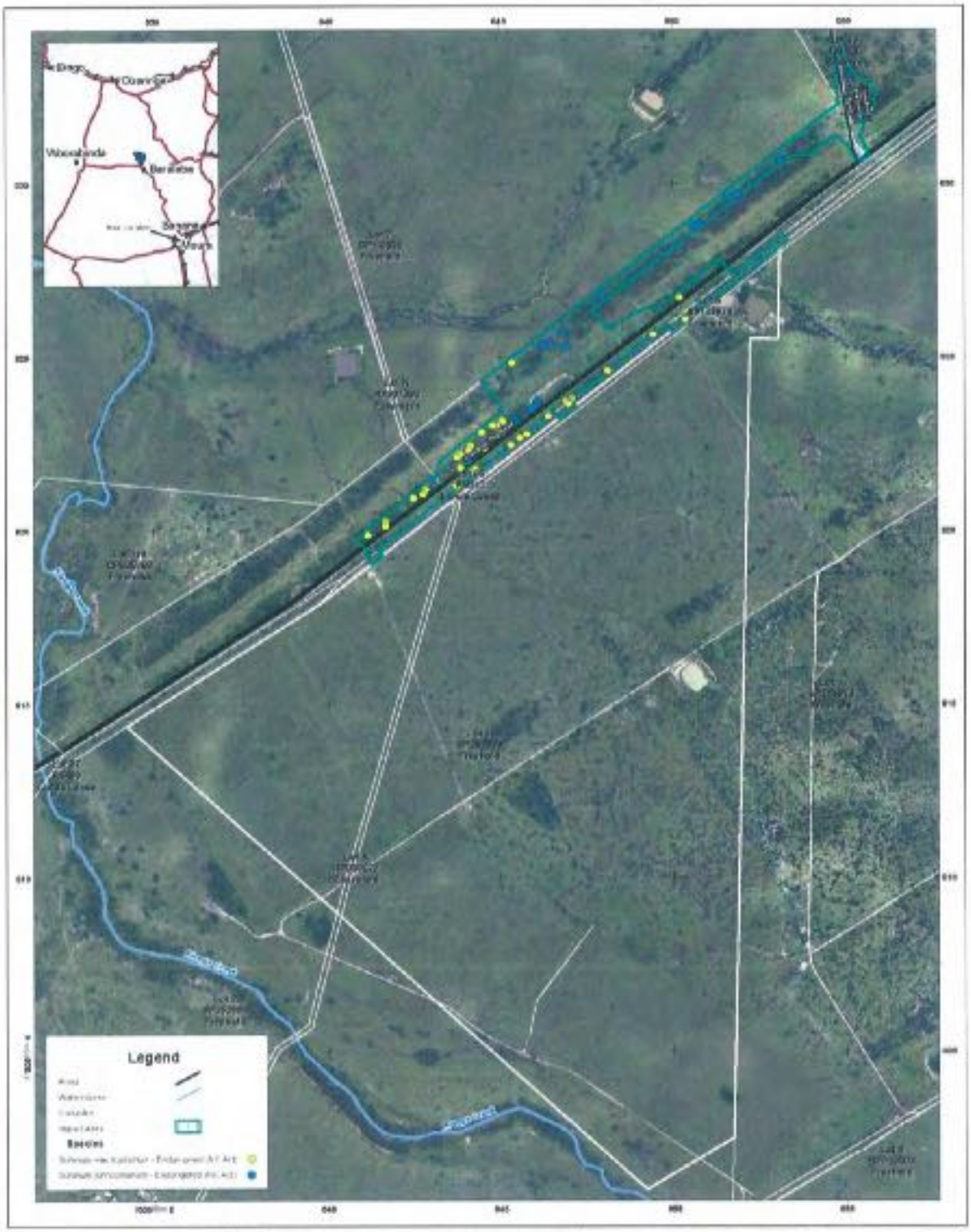


Figure 2: Location of State Significant Biodiversity Values within the Clearing Area – Private Access Road



1.4 Ecological Equivalence Assessment

Ecological Equivalence Assessment	
Clearing area	**Offset Area**
Date of Assessment: 23 June 2013, and 11 and 12 March 2014. Upon suggestion by EHP, areas surrounding the TLO Facility were assessed on 3 and 4 Jun 2014.	Date of Assessment: 8-11 October 2014; 1-4 November 2014; 20-22 January 2015
Ecological Condition assessment score:	Ecological Condition assessment score:
Special Features indicators 1-14:	Special Features indicators 1-14:
Undertaken using Ecological Equivalence Methodology V Yes ☐ No ☒	Undertaken using BioCondition Methodology (DERM 2011a). Yes ☒ No ☐
Score sheets/assessment attached Yes: ☐ No ☒	Score sheets/assessment attached Yes: ☒ No ☐
Other comments:	Other comments: BioCondition assessment was undertaken across the entire 400ha EPBC offset area, which the *Solanum spp.* offsets form part thereof. This assessment was carried out as per the BioCondition methodology (DERM 2011a). This data was also used to populate both the EPBC and Terrestrial Habitat Quality Assessment calculators. The data collected for the TLO offset site satisfies QBOP requirements as it is BioCondition data extrapolated from BioCondition Site 1. Additional data will be collected at Site B. Private Access Road baseline data will be supplemented with additional data to be collected at Site C, which will augment Terrestrial Habitat Quality Assessment site data. Extra data for the *Solanum spp.* density will be collected as per Tables 11, 12 and 13. Ecological data will be collected across the entire 400ha EPBC offset area as per Table 11, 12 and 13.

1.5 Description of MNES clearing and offset values

Table 3 identifies the MNES impacted on and captured under the *Environmental Protection and Biodiversity Conservation Act 1999* – in the BNCOP clearing area for which an offset is provided in the Offset Area. These values are illustrated in **Figure 3**.

Table 3: Summary BNCOP Clearing and Offset area values – *Environmental Protection and Biodiversity Conservation Act 1999*

Protected Matter	Status	Impact area (ha)	Impact Area Habitat Quality Score	Offset Area (ha)	Offset Area Start Habitat Quality Score	Regional Ecosystem	Offset Property
Threatened Ecological Communities							
Acacia harpophylla Brigalow Threatened Ecological Community	Endangered	9.0	4	3.6ha tree age remnant 6.4ha tree age regrowth	7 for the remnant area 2 for the regrowth area	11.4.8/11.4.9 Endangered	[redacted]
Threatened Species							
Nyctophilus corbeni South-eastern long-eared bat	Vulnerable	277.0	5	108.0	4	11.3.1, 11.3.3, 11.4.9	[redacted] **Note:** additional offset area for this species is secured at a separate property – Lot 22 on AU37, known as [redacted]
Denisonia maculata Ornamental snake	Vulnerable	33.5	3	23.0	4	11.4.8/11.4.9 Endangered	[redacted]
Geophaps scripta scripta Squatter pigeon (southern)	Vulnerable	277.0	7	400.0	5	11.4.8/11.4.9 Endangered	[redacted]

Table 4a: South-eastern long-eared bat - Impact Site EPBC Calculator input scores

Attribute	Value	Rationale/Assumption
Impact Area	277 ha	The calls of the South-eastern long-eared bat, which are recorded with an Anabat detector, cannot be distinguished from calls of other *Nyctophilus spp.* that are also potentially present in the area. Calls of a *Nyctophilus spp.* were recorded at five locations throughout the BNCOP area by [redacted] in April and October 2013. [redacted] described that the calls are more likely to be from a common long-eared bat species since the common long-eared bat species were caught in harp traps and the closest record of the South-eastern long-eared bat is approximately 130 km to the south-east of the BNCOP area. However, it remains a possibility that the South-eastern long-eared bat is present (and some of the calls may be of the South-eastern long-eared bat). If the South-eastern long-eared bat is present in the area, foraging habitat would be removed through the clearance of woodland and open forest (277 ha) and some breeding habitat where there are hollow-bearing trees. No habitat within the BNCOP locality has been identified as important or critical habitat for the South-eastern long-eared bat in any recovery plans or listed on the EPBC Act Register of Critical Habitat maintained by the Minister of the Environment under the EPBC Act (DotE, 2014d). Past disturbance and clearance has resulted in reduced abundance of tree hollows across the BNCOP area and regrowth vegetation is common. Hollow-bearing trees are more abundant outside of the BNCOP area along the Dawson River and Dawson River anabranch as the vegetation is typically older. The habitat in the BNCOP area may also be suboptimal for the South-eastern long-eared bat due to the high levels of fragmentation. Habitat fragmentation is considered a potential threat to the South-eastern long-eared bat because the species displays a preference for larger areas of intact habitat (DotE, 2014d).
Quality	5/10 (rounded up from 4.7)	**Site Condition = 2.7** The majority of the BNCOP area has been degraded through various rural land uses, particularly grazing, clearing and associated management practices. Extant vegetation is generally limited to the Dawson River and its associated tributaries and a broad overflow floodplain linking the Dawson River floodplain with that of Saline Creek, along fence lines, small wetlands, and road reserves. These areas are impacted by a variety of disturbances include exploration, historical clearing, grazing and weed invasion. The largest patch of vegetation in the BNCOP Additional Footprint is the Eucalypt open forest (VCs 6a, 7, 8a and 8b), but it has been cleared in the past and subsequently regrown. The structural complexity of this vegetation is relatively good with multiple vegetation layers, fallen woody debris and leaf litter. This habitat consists of a moderately intact canopy layer (40% cover) of medium to large trees (19 m high and 25-40 cm DBH), a low abundance of hollow-bearing trees (1 per ha), a distinct mid-storey and shrub layer (11% cover). However the condition of VC 8a is poor and weed cover is high (average 88% cover). This habitat type has a highly simplified structure with a low but moderately intact canopy layer (9 m high and 39% cover) of small to medium sized trees (15-25 cm DBH), and a sparse shrub layer (5% cover). The external connectivity of the habitats is relatively low, except for habitat along watercourses and the overflow floodplain linking the Dawson River and Saline Creek. Nevertheless the distribution and configuration of such disconnected patches when considered together provide flyways for some birds and bats. The South-eastern long-eared bat habitat that will be impacted by the BNCOP Project was given a 'Site Condition' score of '2.7', based on the above factors. This component of the habitat quality assessment was allocated a weighting of 40%, as outlined above. **Site Context = 2.0** Although several small patches of habitat were identified in patches of less than 10 ha there was little to no connectivity to larger patches of

		remnant habitat. The majority of suitable habitat was identified along the northern boundary of the BNCOP and was either remnant and/or contiguous with vast tracks of remnant vegetation to the north of the BNCOP site. This habitat is currently threatened by existing land uses and occurs in a fragmented agricultural landscape. There is limited connectivity to large intact remnant areas, except for the large area of remnant in the far north of the BNCOP as mentioned above. All areas of habitat on site will be removed by the Project. The South-eastern long-eared bat habitat that will be impacted by the BNCOP Project was given a 'Site Context' score of '2.0', based on the above factors. This component of the habitat quality assessment was allocated a weighting of 40%, as outlined above. **Species stocking rate = 0** The species was not positively identified as occurring within the BNCOP area. The Anabat calls are far more likely to be from the more common *Nyctophilus* species that occur in the area. The South-eastern long-eared bat habitat that will be impacted by the BNCOP Project was given a 'Species stocking rate' score of '0', based on the above factors. This component of the habitat quality assessment was allocated a weighting of 20%, as outlined above.

Table 5a: *Denisonia maculata* (Ornamental snake) - <u>Impact</u> Site EPBC Calculator input scores

Attribute	Value	Rationale/Assumption
Impact Area	33.5 ha	The species was not recorded in the BNCOP Project Area during targeted fauna surveys consistent with Commonwealth (SEWPaC 2011a; SEWPaC 2011b) and State (DSITIA 2012) survey guidelines. However the species was identified in the local area and a number of areas of potential habitat comprising 2.5 ha of remnant RE 11.3.1 [Brigalow woodland (Vegetation Community (VC) 1a)], 11.5 ha of regrowth RE 11.3.1 [disturbed Brigalow woodland (VCs 1b and 1c)], 2.5 ha of remnant RE 11.4.8a [Brigalow palustrine wetland (VC 3a)], 12 ha of regrowth RE 11.4.8a [disturbed Brigalow palustrine wetland (VC 3b)] and 5 ha of remnant RE 11.3.4 [Riparian woodland (VC 5)], which may provide Ornamental snake habitat, will be impacted by the BNCOP additional footprint ([redacted]2014).
Quality	3/10	**Site Condition = 1.6** The areas of Brigalow woodland (VC 1a) and Brigalow palustrine wetland (VC 3a) support moderately intact distributions of Brigalow that is approaching remnant state, comprises a diverse mid-stratum and groundcover layer and has microhabitat features such as fallen woody debris, well developed gilgai and minimal weed infiltration. The areas of disturbed Brigalow woodland (VCs 1b and 1c) and disturbed Brigalow palustrine wetland (VC 3b) have a simple structure consisting of Brigalow overstorey with no midstorey and a heavily grazed understorey with no obvious gilgai depressions, an important habitat resource that is required to sustain the Ornamental snake (i.e. food and refuge habitat). Nevertheless, these currently deficient habitats for this species could provide habitat for the snake in the future under improved management (control of grazing, weeds and pests). The poor condition and relative size of the disturbed patches of Brigalow have lessened the overall community condition score compared with the score that was achieved by the Brigalow TEC (above). The Ornamental snake habitat that will be impacted by the Haul Route Project was given a 'Community Condition' score of '1.6', based on the above factors. This component of the habitat quality assessment was allocated a weighting of 40%, as outlined above. **Site context = 0.4** The Ornamental snake habitat within the Project Area was identified in small patches of less than 10 ha with little to no connectivity to large remnant areas, except for in the far north of the BNCOP. This habitat is currently threatened by existing land uses and occurs in a fragmented landscape. The areas of gilgai in adjacent paddocks generally lacked native regrowth and microhabitat features due to farming practices (e.g.

		clearing and grazing). All areas of habitat described above fall within the disturbance footprint of the project and therefore will be completely removed by the Project. The Ornamental snake habitat that will be impacted by the Haul Route Project was given a 'Site Context' score of '0.4' based on the above factors. This component of the habitat quality assessment was allocated a weighting of 40%, as outlined above. **Species stocking rate = 1.0** Ornamental snake was not identified within the Project Area, but was identified in low numbers within Brigalow communities immediately adjacent to the BNCOP. In consideration that there were none identified onsite but there is the possibility that they may be present in low numbers, a score of 1 had a weighting of 20% in the context of an assessment of overall quality.

Table 6a: *Geophaps scripta scripta* (Squatter pigeon - southern) - Impact Site EPBC Calculator input scores

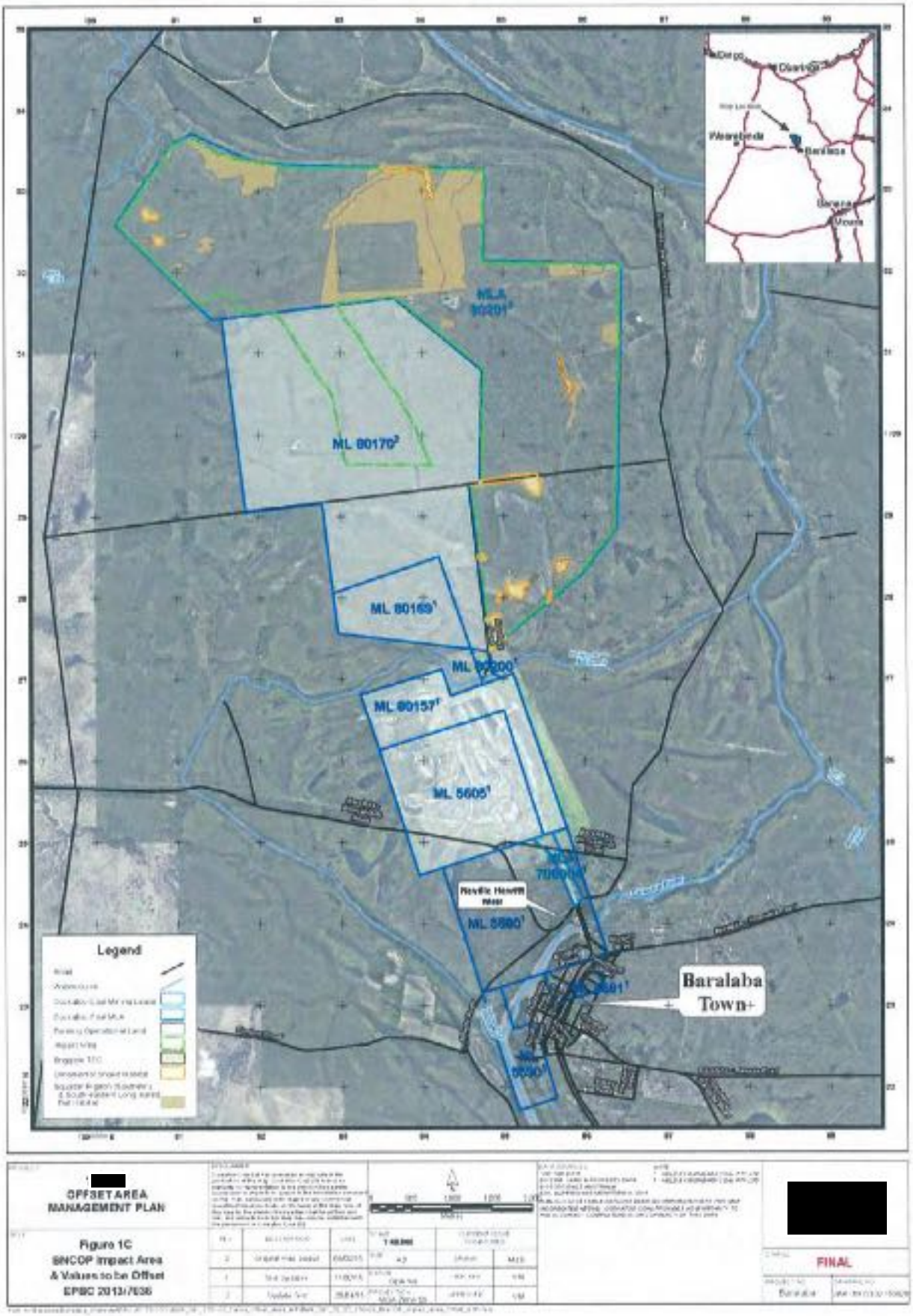
Attribute	Value	Rationale/Assumption
Impact Area	277 ha	The Squatter pigeon (southern), which was recorded at six locations throughout the BNCOP area, shows resilience due to its persistence in the already highly cleared and fragmented landscape. BNCOP would result in the following direct and indirect adverse impacts on the Squatter pigeon (southern). Known habitat for the Squatter pigeon (southern) (totalling approximately 277 ha eucalypt woodland to open forest habitat and approximately 1,164 ha of cleared grazing paddocks would be progressively cleared. This would include removal of patches of potential habitat in the BNCOP area and reduction in the area of three patches of potential habitat that extends outside of the BNCOP area. Potential localised indirect impacts on surrounding habitats (dust, noise, edge effects). No adverse water-related impacts are likely to occur on habitats surrounding the BNCOP (e.g., Dawson River, Dawson River anabranch or wetland to the north of the BNCOP Operational Land). This is because no measurable impacts on surface water quality are likely to occur from changes in surface water and no measurable impacts on surface water quantity or quality are likely to occur regardless of changes in captured catchment areas and groundwater (drawdown). Other minor potential impacts on this species include increased risk of attack from feral animals and bushfire risk.
Quality	7/10 (rounded up from 6.7)	**Site Condition = 2.7** The majority of the BNCOP area has been degraded through various rural land uses, particularly grazing, clearing and management practices. Extant vegetation is generally limited to the Dawson River and its associated tributaries and a broad overflow floodplain linking the Dawson River floodplain with that of Saline Creek, along fence lines, small wetlands, and road reserves. These areas are impacted by a variety of disturbances include exploration, historical clearing, grazing and weed invasion. The largest patch of vegetation in the BNCOP Additional Footprint is the Eucalypt open forest (VCs 6a, 7, 8a and 8b), but it has been cleared in the past and regrown. The structural complexity of this vegetation is relatively good with multiple vegetation layers, fallen woody debris and leaf litter. This habitat consists of a moderately intact canopy layer (40% cover) of medium to large trees (19 m high and 25-40 cm DBH), a low abundance of hollow bearing trees (1 per ha), a distinct mid-storey and shrub layer (11% cover). However the condition of VC 8a is poor and weed cover is high (average 88% cover). This habitat type has a highly simplified structure with a low but moderately intact canopy layer (9 m high and 39% cover) of small to medium sized trees (15-25 cm DBH), and a sparse shrub layer (5% cover). The external connectivity of the habitats is relatively low, except for habitat along watercourses and the overflow floodplain linking the Dawson River and Saline Creek. Nevertheless the distribution and configuration of such disconnected patches when considered together, provide flyways for some birds and bats. The Squatter pigeon (southern) habitat that will be impacted by the BNCOP project was given a 'Site Condition' score of '2.7' based on the above factors. This component of the habitat quality assessment was allocated a

		weighting of 40%, as outlined above. **Site context = 2.0** Although several small patches of habitat were identified in small patches of less than 10 ha with little to no connectivity to larger patches of remnant habitat, the majority of suitable habitat was identified along the northern boundary of the BNCOP and was either remnant and/or contiguous with vast tracks of remnant vegetation to the north of the BNCOP. This habitat is currently threatened by existing land uses and occurs in a fragmented agricultural landscape. There is limited connectivity to large intact remnant areas, except for in the far north of the BNCOP. All areas of habitat will be completely removed by the Project. The Squatter pigeon (southern) habitat that will be impacted by the BNCOP project was given a 'Site Context' score of '2.0' based on the above factors. This component of the habitat quality assessment was allocated a weighting of 40%, as outlined above. **Species stocking rate = 2** The species was recorded at only six locations in the BNCOP area. The Squatter pigeon (southern) habitat that will be impacted by the BNCOP Project was given a 'Species stocking rate' score of '2.0' based on the above factors. This component of the habitat quality assessment was allocated a weighting of 20%, as outlined above.

Table 7a: Threatened Ecological Community *Acacia harpophylla* (Brigalow) - Impact Site EPBC Calculator input scores

Attribute	Value	Rationale/Assumption
Impact Area	9 ha	In accordance with the definitions of the listing advice for the Brigalow TEC, the Brigalow TEC in the BNCOP Area are comprised of one 2.5 ha patch of remnant RE 11.3.1 [Brigalow woodland (Vegetation Community (VC 1a)], 2.5 ha of remnant RE 11.4.8a [Brigalow palustrine wetland (VC 3a)] and 4 ha of regrowth RE 11.4.8a [disturbed Brigalow palustrine wetland (VC 3b)].
Quality	4/10	**Site Condition = 3.6** The areas of Brigalow woodland (VC 1a) and Brigalow palustrine wetland (VC 3a) support moderately intact distributions of Brigalow that is approaching remnant state, comprises a diverse mid-stratum and groundcover layer and has microhabitat features such as fallen woody debris, well developed gilgai and minimal weed infiltration. The Brigalow TEC that will be impacted by the BNCOP Project was given a 'Community Condition' score of '3.6', based on the above factors. This component of the habitat assessment was allocated a weighting of 70%, as outlined above. **Community context = 0.4** The Brigalow patches were identified in small patches of less than 10 ha with little to no connectivity to larger patches of remnant habitat. These patches are currently threatened by existing land uses and occur in a fragmented landscape. There is limited connectivity to large intact remnant areas, except for in the far north of the BNCOP. All of these patches will be completely removed by the Project. The Brigalow TEC that will be impacted by the BNCOP was given a 'Community Context' score of '0.4', based on the above factors. This component of the habitat quality assessment was allocated a weighting of 30%, as outlined above.

Figure 3: Location of MNES within the BNCOP Impact Area



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 2030, or when the brigalow regrowth achieves remnant status (defined as per the *Vegetation Management Act 1999 (Qld)*), whichever comes first. It is recognised that the timeframes are subject to natural conditions and unexpected events, and the risks identified in section 4, Risk Analysis.

The definition of remnant vegetation is:

> *remnant vegetation means vegetation—*
> *(a) that is—*
> *(i) an endangered regional ecosystem; or*
> *(ii) an of concern regional ecosystem; or*
> *(iii) a least concern regional ecosystem; and*
> *(b) forming the predominant canopy of the vegetation—*
> *(i) covering more than 50% of the undisturbed predominant canopy; and*
> *(ii) averaging more than 70% of the vegetation's undisturbed height; and*
> *(iii) composed of species characteristic of the vegetation's undisturbed predominant canopy.*
> *regulated vegetation management map is the map certified by the chief executive as the regulated vegetation management map for a part of the State and showing the vegetation category areas for the part.*

The management area objectives and outcomes for the Offset Area are for the enhancement of the condition of the MNES of Brigalow TEC, and Ornamental snake, Squatter pigeon, South-eastern long-eared bat habitat that are in a degraded condition within the offset area.

2.1.1 Management area objectives

EPBC Act

The management area objectives are to protect and enhance the condition of the endangered Threatened Ecological Community Brigalow, and to improve the habitat conditions for the listed threatened species *Nyctophilus corbeni*, (South-eastern long-eared bat), *Denisonia maculata* (Ornamental snake), and *Geophaps scripta scripta* (Squatter pigeon - southern). Management actions will enable the natural regeneration of the TEC and habitat via weed control, fire management, management of livestock, pest animal management and restrictions on access within the Offset Areas to meet the offset requirements of the Approval Conditions EPBC 2013/7036 for the Baralaba North Continued Operations Project (BNCOP).

A legally binding mechanism, in the form of a Voluntary Declaration under the *Vegetation Management Act 1999 (Qld)* will protect this vegetation from clearing and require the actions within the management plan to be implemented. The areas will be actively managed until 30 June 2030, or until the brigalow regrowth areas attain remnant status and are mapped as such by the Queensland government regulated vegetation mapping.

Protected Plants (Qld NC Act)

The offset management areas for the *Solanum spp.* are managed to maintain and enhance the condition of Regional Ecosystem 11.4.3/11.4.8/11.4.9 and the associated habitat, specifically:

- The ecosystem retains remnant status as defined by the *Vegetation Management Act 1999 (Qld)* and remains mapped on a certified regional ecosystem map.
- Habitat quality is managed through exclusion of stock during the wet season and enabling the natural regeneration of vegetation communities to a good condition.
- Weed cover is managed via a weed control program in parallel with the existing pest control program on the property

Refer to **Attachment 3** for the Terrestrial Habitat Quality Assessment Tool outputs.

2.1.2 Offset Area Outcomes

(a) **Site Condition**: The offset management area is managed to improve the ecological condition of the Brigalow TEC through appropriate restoration and management actions as detailed in **Table 10**. These actions include the exclusion of any forestry and/or timber harvesting operations therefore allowing the regeneration of large hollow bearing trees, natural regeneration of canopy and sub canopy species, 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 4b, 5b, 6b** and **7b** align with the scores recorded as the baseline at the monitoring and reporting locations as detailed in section 6 and **Figure 8** of this management plan.

(c) **Site Context**: the Offset Area is managed to enable the natural regeneration process of the TEC and associated habitat to occur and to therefore achieve enhanced connectivity to the [redacted] Conservation Park and [redacted].

Table 4b: South-eastern long-eared bat - Offset Area EPBC Calculator Input (start) and offset area future quality (outcome) scores

Offset Calculator Step	Score attributed	Comments
Step 8 – Time horizon	20 years	Time over which loss is averted The value selected for time over which loss is averted was the maximum of 20 years for the offset site.
Time until ecological benefit	10 years	Ecologist advice indicates that the ecological benefit predicated following the implementation of the management actions will be achieved by year 10 of the offset.
Step 9 – Start area and quality	108 ha Score - 4	The site supports a diverse range of foraging habitats within the well vegetated riparian corridor along [redacted] and the adjacen[redacted] Conservation Park. There is a remnant patch of Brigalow nearby that has a tall treed canopy layer, tall shrub layer and ground cover including native grasses and leaf litter layer. The low shrub layer and leaf litter layers have been significantly impacted upon by cattle which have greatly reduced these resources and subsequently reduced the value of the site. There are large tracts of treed areas, within the remnant areas that have decorticating bark and tree hollows resources considered common, to provide suitable roosting/breeding resources and breeding habitat resources, i.e. tree hollows, supported on-site for the species. For these reasons, a 'Start Quality' score of '4' has been given for South-eastern long-eared bat habitat present on the site.
Step 10 – Future area and quality without offset Risk of loss (%) Without Offset	94.5 ha Score - 3 10%	Provided that the remaining areas of remnant vegetation are not cleared from the site, or the habitat resources supported therein are not destroyed by fire, it is considered most likely that the existing habitat values for this species will persist and the status quo remain. However, any change/s to the structure of the remaining vegetation communities (cleared/regrowth areas excluded) will result in a decline in the value of the site to the South-eastern long-eared bat. Consequently, a 'Future Quality without Offset' score of '3' has been given.
Step 11 – Future area and quality with offset Risk of loss (%)With Offset	94.5 ha Score - 7 10%	This Offset Delivery Plan outlines a number of planned management actions that will be implemented to enable the quality of the habitat on site for the South-eastern long-eared bat to improve. For example, the specific actions include the exclusion of cattle grazing in the 108 ha defined as the offset for the species within the riparian areas of [redacted] n the western portion of the site, and the exclusion of forestry operations or native timber harvesting across the entire 400 ha of offset area on the [redacted] property. Additionally, fire will be excluded from management actions with the exception of low intensity burns undertaken at a period of not less than 20 years interval. These actions align with mitigating the 'Threatening Processes' as listed in the Queensland Department of the Environment and Heritage Protection advice for the species, and the EPBC Act Listing Advice, being:

		• Habitat loss and fragmentation – refer management actions in Table 10 • Fires that destroy roosting sites and foraging habitat – refer fire management actions in Table 10 • Forestry activities – refer forestry operations management actions in Table 10 • Overgrazing – refer grazing management actions in Table 10 • Predation by feral species – refer pest (pest animals) management actions in Table 10 • Competition for tree hollows – refer management actions in Table 10 • Exposure to agrichemicals – refer pest (weeds) management actions in Table 10 Habitat improvements will primarily include an increase in the structural diversity, abundance and availability of foraging habitats supported on-site. Therefore the predicted 'Future Quality with Offset' score of '7' has been applied within the calculator based upon the effective implementation of a management plan that includes these key strategies.
Step 12 – Start quality and future quality without offset	 Score – 4 Score - 3	See commentary in Step 9 and 10 respectively
Step 13 – Future quality (with offset)	Score - 9	See commentary Step 11
Step 14 – Calculating adjusted gain using confidence in result (%) Confidence in Result	3.00% 75%	Automatic Calculator Outputs
Step 15 – Net present value (adjusted hectares)	28.07%	Automatic Calculator Outputs
Step 16 – Percentage of impact offset	20.06% **Note** – balance 80.26% located on Lot 22 AU37	Automatic Calculator Outputs

Table 5b: *Denisonia maculata* (Ornamental snake) - Offset Area EPBC Calculator Input (start) and offset area future quality (outcome) scores

Offset Calculator Step	Score attributed	Comments
Step 8 – Time horizon	20 years	Time over which loss is averted: the value selected for time over which loss is averted was the maximum of 20 years for the offset site.
Time until ecological benefit	10 years	As noted in the Conservation of Biodiversity in Brigalow Landscapes, regrowth with an age of 16-30 years begins to have the characteristics of older regrowth with density of stems beginning to thin due to competition for resources and a reduction in grasscover. The improvements from herein are related to stem size and the accumulation of leaf litter and fallen woody debris which is augmented by the exclusion of fire in the area. As the regrowth area is already circa 8 years of age, a time of 10 years to achieve an intermediate stage is reasonable. During this time, gilgai re-establish, due to the exclusion of mechanical control and the reduction in grazing pressure and impacting on the gilgai during the wet season.
Step 9 – Start area and quality	 23 ha Score - 4	Targeted surveys positively identified the species on-site, both adult and sub-adult. There were a diverse range of gilgai habitats supported on-site in terms of depth and sizes of depressions and heights and sizes of mounds, and extensive evidence of long term water holding (presence of dense aquatic growth including bogmarsh and sedges). Positive identification of sub-adult animal on-site indicates that site supports suitable breeding habitat for the species. Identification of 13 species of frogs in abundance of different age classes on-site, which included "preferred" prey species (*Andrew Veary pers. obs and Steve Wilson pers. comm.)* However, due to historic land management practices and the abundant presence of cane toads on the site, a 'Start Quality' score of '4' has been given for the ornamental snake habitat present on site.

Step 10 – Future area and quality without offset Risk of loss (%) Without Offset	 2.3 ha Score - 1 90%	The site has been subjected to various land management techniques including vegetation clearing and pulling, blade ploughing and inappropriate fire regimes. In addition, active cattle grazing and unfettered access to gilgai areas, particularly during wet environmental conditions, significantly reduces the habitat values of the site. In association with cattle grazing and associated impacts, cane toad populations also have an impact on ornamental snake populations and thus the value of the site. Typically, increased cane toad densities are linked to increasing grazing pressure. Without the offset and the subsequent inability to eliminate these three primary threatening impacts, it is considered highly likely that the habitat values for the ornamental snake will most likely continue to decline which may result in the loss of this species from this property. Therefore, a 'Future Quality without Offset' score of '1' has been given.
Step 11 – Future area and quality with offset Risk of loss (%)With Offset	 20.7 ha Score - 7 10%	This Offset Delivery Plan outlines a number of planned management actions that will be implemented to enable the quality of the habitat on site for the Ornamental Snake to improve. For example, cattle will be excluded from the gilgaied area of the site (ie greater than the offset area) with the exception of controlled grazing activities during dry periods to reduce grass fuel loads. The removal of cattle when there is any evidence of moisture in the gilgais will enable the swelling and cracking nature of the soil to increase the depth of the gilgais over time as well as to enable the cracks in the soil to stay intact (further assisted by exclusion of mechanical control) which will improve the extent of time that moisture is present in the gilgais, thus enabling a longer period for use of these areas by frogs, as the primary food source for the Ornamental snake. These improvements will primarily include increases to longevity of the existing population and breeding success which will lead to more successful recruitment of the site and local area. The values of the gilgai (i.e., the depth of the depressions and the height of the mounds through the process of the clay shrinking and swelling) will improve over time, but will be dependent on rainfall events (and the removal of mechanical disturbance), both in terms of occurrence and severity. The exclusion of chemical control methods for regrowth control (both pelleted and foliar spray) should have a positive effect on the native frog population, again enabling a greater food source for the Ornamental snake. Further, the risk of mechanical and chemical control of the Brigalow community, which provides key habitat attributes for the species, is removed and frequent/high intensity fire is excluded from the offset area to allow the accumulation of leaf litter and fallen woody debris. The management actions proposed align with mitigating the threats to this species identified in the Department of the Environment's Approved Conservation Advice for *Denisonia maculata* (Ornamental snake) • continued legacy of past broadscale land clearing – refer forestry operations and grazing management actions in Table 10 • habitat degradation – refer grazing management actions in Table 10 • modification of habitat through agricultural land and urban development – refer forestry operations and grazing management actions in Table 10 • destruction of wetland habitat by feral pigs – refer pest (pest animals) management actions in Table 10 • destruction of frog habitat (being the key prey source) refer forestry operations and grazing management actions in Table 10 • direct competition for food sources – refer pests (pest animals) management actions in Table 10 The conservation advice for the Ornamental Snake also identifies a potential threat of poisoning resulting from the ingestion of Cane Toads. As outlined in Table 10, there is difficulty in in-field control of cane toads (e.g., as chemical control poses further threats for a range of native species). Research into effective control measures is in its infancy, particularly with regard to control methods in an extended area, such as the [redacted] offset area. Provided that these key strategies are effectively employed, the habitat values of the offset will improve. The predicted 'Future Quality with Offset' score of '7' has been applied within the calculator based upon the effective implementation of a management plan.
Step 12 – Start quality and future quality without offset	 Score – 4 Score - 1	See commentary in Step 9 and 10 respectively
Step 13 – Future quality (with offset)	 Score – 7	See commentary Step 11

Step 14 – Calculating adjusted gain using confidence in result (%) Confidence in Result	13.80 ha 4.5 75%	Automatic Calculator Outputs
Step 15 – Net present value (adjusted hectares)	10.3 ha	Automatic Calculator Outputs
Step 16 – Percentage of impact offset	102.45%	Automatic Calculator Outputs

Table 6b: *Geophaps scripta scripta* (Squatter pigeon - southern) - Offset Area EPBC Calculator Input (start) and offset area future quality (outcome) scores

Offset Calculator Step	Score attributed	Comments
Step 8 – Time horizon	20 years	Time over which loss is averted The value selected for time over which loss is averted was the maximum of 20 years for the offset site.
Time until ecological benefit	10 years	Ecologist advice indicates that the ecological benefit predicated following the implementation of the management actions will be achieved by year 10 of the offset.
Step 9 – Start area and quality	400 ha Score - 5	The site supports a diverse range of foraging resources supported across the site including both native and introduced (pasture grasses) supported on sandy to heavier clay soils. There is semi-permanent (most likely permanent) water within the deeper pools of [redacted]. Large tracts of treed areas associated with the remnant vegetation and advanced regrowth areas provide suitable roosting resources for the squatter pigeon. There are also suitable areas on-site to support breeding for the species. However, due to the presence of predators on site (cats, dogs and pigs) and historic land management practices, a 'Start Quality' score of '5' has been given for squatter pigeon (southern) habitat present on site.
Step 10 – Future area and quality without offset Risk of loss (%) Without Offset	40.0 ha Score - 4 90%	Given the historical and current land management practices and the variability of land management in the local area, if an offset is not established, it is expected that the status quo for the squatter pigeon for this site will probably stay the same if not decline thus remaining Vulnerable. However, if there is a significant change/s in land use or practices, e.g. pastoral to cropping and/or clearing of regrowth vegetation, there will be a significant reduction in available habitat suitable for the squatter pigeon, which may result in the loss of this species from this property. Consequently, given the tenuous nature of the habitats supported on the property, the 'Future Quality without Offset' has been given a score of 4.
Step 11 – Future area and quality with offset: Risk of loss (%)With Offset	360.0 ha Score - 8 10%	Squatter Pigeon are threatened by predation by feral cats and foxes which have been observed to be in very low numbers on the site currently with none being observed during field verification and studies or noted as being seen by the landholder. As the risk of predation is increased in areas where ground cover is reduced by intensive grazing and extensive fire, the management of grazing for fuel reduction purposes and the predominant exclusion of fire (refer management actions in Table 10) mitigates these threats. The continuation of the existing, ongoing annual baiting program maintains wild dog and pig numbers to a low transient population removing further threats to the Squatter pigeon. High intensity fire and heavy grazing can also alter vegetation structure and composition, leading to a replacement of perennial grasses and forbs with introduced annual species. The use of controlled grazing, exclusion of fire and allowing the Brigalow community to re-establish will reverse the occurrence of introduced annual grasses (buffel) and enable the regeneration of native grasses and forbs as this annual grass retreats due to competition from the Brigalow scrub (refer also http://www.australianwildlife.org/wildlife/squatter-pigeon.aspx#sthash.2jMLzYI1.dpuf , and http://www.environment.gov.au/cgi-

		bin/sprat/public/publicspecies.pl?taxon_id=64440) The above management actions are consistent with the addressing the defined threats to this species under the Approved Conservation Advice for *Geophaps scripta scripta* (Squatter Pigeon (southern)) (approved by the Minister 3 July 2008), being: • ongoing clearance of habitat for farming or development purposes – refer forestry operations management actions in Table 10 • grazing of habitat by livestock and feral herbivores – refer grazing management actions in Table 10 • predation, especially by feral cats (*Felis catus*) and foxes (*Vulpes vulpes*) – refer pest (pest animals) management actions in Table 10 There will be a significant increase in the habitat values of the site for the squatter pigeon due to the increases in canopy cover, stem density, native grass and forb cover and the continued management of feral pest species. Improvements will primarily include increases to the diversity, abundance and availability of forage species, and a reduction in predation and nest disruption/destruction. The predicted 'Future Quality with Offset' score of '8' been applied within the calculator.
Step 12 – Start quality and future quality without offset	 Score – 5 Score - 1	See commentary in Step 9 and 10 respectively
Step 13 – Future quality (with offset)	 Score - 8	See commentary Step 11
Step 14 – Calculating adjusted gain using confidence in result (%) Confidence in Result	 240 ha 75%	Automatic Calculator Outputs
Step 15 – Net present value (adjusted hectares)	196.45	Automatic Calculator Outputs
Step 15 – Percentage of impact offset	101.32%	Automatic Calculator Outputs

Table 7b: Threatened Ecological Community *Acacia harpophylla* (Brigalow) - Offset Area EPBC Calculator Input (start) and offset area future quality (outcome) scores

Offset Calculator Step	Score attributed	Comments
Step 8 – Time horizon	20 years	Time over which loss is averted The value selected for time over which loss is averted was the maximum of 20 years for the offset site.
Time until ecological benefit	10 years	This is estimated as a reasonable time to achieve improvement as the remnant areas will only have to re-establish a sub-canopy and understorey to achieve the desired outcome as well as to increase the amount of fallen woody debris. This period of time will enable the regrowth (circa 8 years of age at the baseline) to attain a greater canopy cover and density thus reducing the buffel grass cover. This is due to the increased shading and competition from the thickening Brigalow stand competing for sunlight and soil moisture with the buffel grass species. It is not uncommon for Brigalow regrowth to achieve a stem density of 17,000 stems/ha (*Restoration thinning accelerates structural development and carbon sequestration in an endangered Australian ecosystem John M. Dwyer, Rod Fensham and Yvonne M. Buckley*). The document *"Conserving Biodiversity in Brigalow Landscapes" (University of Queensland)* makes reference that even intermediate Brigalow Regrowth is a valuable habitat for many species. This regrowth has an age range of 16-30 years which is within the 10 year timeframe suggested.
Step 9 – Start area and quality	 Remnant (ha) – 4.0 Regrowth (ha) – 6.0	The Brigalow being used as offsets on site are comprised of: • 4ha of remnant vegetation connected to an area of regrowth, which in turn is connected to [redacted] Conservation Park, • a further 6ha of remnant vegetation that is connected to an

	Remnant Score - 7 Regrowth Score - 2	extensive area of regrowth, and • a riparian remnant component approximately 20% of [redacted] vegetation (7ha). For the remnant areas a 'Start Quality' score of '7' has been given as the mature trees were mostly unaffected by grazing, however the understorey has been impacted by cattle grazing over an extended period of time. For the regrowth areas a 'Start Quality' score of '2' has been applied as mechanical control of regrowth via blade ploughing (see [redacted] imagery in Figure 6 – the old blade ploughing lines can been seen in the imagery) and hot fires are currently used to control the regrowth of the TEC. Another impact to the blade ploughing is the partial levelling of the Gilgai formations as soil is moved during the process. This effect diminishes over time with the continual swelling and cracking of the clay soils typical of this landscape. .
Step 10 – Future area and quality without offset Risk of loss (%) Without Offset	Remnant (ha) – 3.4 Regrowth (ha) – 0.6 Remnant Quality – 1 Regrowth Quality – 0 Remnant Loss Risk – 90% Regrowth Loss Risk – 90%	Provided that the remaining areas of woody vegetation (remnant and regrowth) are not cleared from the site, or these communities are not destroyed by fire, or grazed more heavily, then it is considered most likely that the existing ecological values for these communities will persist. Therefore the following 'Future Quality without Offset' scores have been given. For remnant vegetation a score of '1' was given. This score is because the remnant area of Brigalow that is being utilised as the Brigalow offset is not protected from clearing due to the area being a Category X on the Property Map of Assessable Vegetation. The entire offset area to the east of [redacted] is targeted for mechanical clearing for pasture production. Further, understorey disturbance due to the area being used by cattle as a cattle camp prevents the ability of the patch to generate new cohorts of Brigalow regrowth for successive generations, particularly following drought or the death of mature trees. For regrowth vegetation, a score of '0' was given, because of the scheduled loss due to blade-ploughing to increase pasture production. This is within the Pastoral Company's Development Plan.
Step 11 – Future area and quality with offset Risk of loss (%)With Offset	Remnant (ha) – 3.8 Regrowth (ha) – 5.4 Remnant Quality – 8 Regrowth Quality – 7 Remnant Loss Risk – 10% Regrowth Loss Risk – 10%	The future quality of the offset is predicated on the effective implementation of the management plan as attached in *Schedule 1*. The implementation of the actions within the plan will lead to several improvements in condition. Existing remnant vegetation in good condition has less chance of being degraded, and if under drought stress, will be better able to generate new cohorts of Brigalow regrowth for successive generations. Existing remnant vegetation with understorey and ground layer in poor condition will be allowed to recover, as will existing advanced regrowth on channels with denuded ground layer. Various forms of regrowth will be able to reach maturity, and those with gilgai will be allowed to see a recovery of gilgai structure and floristics. The aggressive growth nature of Brigalow regrowth (O'Dwyer) leads to a high stem density of up to 17,000 stems/ha. Once regrowth is at an age whereby it is resilient in the landscape and not prone to death (apart from mechanical or chemical treatment), the competition for resources, especially soil moisture leads to the incremental reduction in buffel grass cover. This results in a lower risk of fire and the gradual accumulation of leaf matter and woody debris. It is noted in the *"Conservation of Biodiversity in Brigalow Landscapes"* that regrowth of an age greater than 18 years has considerable habitat qualities for a number of species.. The use of grazing during the dry season further manages the risk of intense fire which is the predominant risk to the TEC. *("Recovery plan for the 'Brigalow (Acacia harpophylla dominant and co-dominant) endangered ecological community", Butler, D., 2008).*
Step 12 – Start quality and	Remnant Quality – 7 Regrowth Quality – 2	See commentary in Step 9 and 10 respectively

future quality without offset	Remnant Quality – 1 Regrowth Quality – 0	
Step 13 – Future quality (with offset)	Remnant Quality – 8 Regrowth Quality – 7	See commentary Step 11
Step 14 – Calculating adjusted gain using confidence in result (%) Confidence in Result	Remnant – 2.40 Regrowth – 3.60 Remnant – 75% Regrowth – 75%	Automatic Calculator Outputs
Step 15 – Net present value (adjusted hectares)	Remnant – 1.71 Regrowth – 2.26	Automatic Calculator Outputs
Step 16 – Percentage of impact offset	Remnant – 47.51% Regrowth – 63.39%	Automatic Calculator Outputs

2.2 Detailed Offset Area Mapping

The following figures demonstrate the Offset Areas within the region being the Location Map (**Figure 4**) and the EPBC Offset Area (**Figure 5**) (which includes the Queensland offset for the *Solanum spp.*) including surrounding values, and [redacted] Conservation Park. Additionally, the State offset areas for the *Solanum spp.* are shown in **Figure 6** and **Figure 7**, and the offsets monitoring points in **Figure 8**.

Figure 4: Offset Location Map

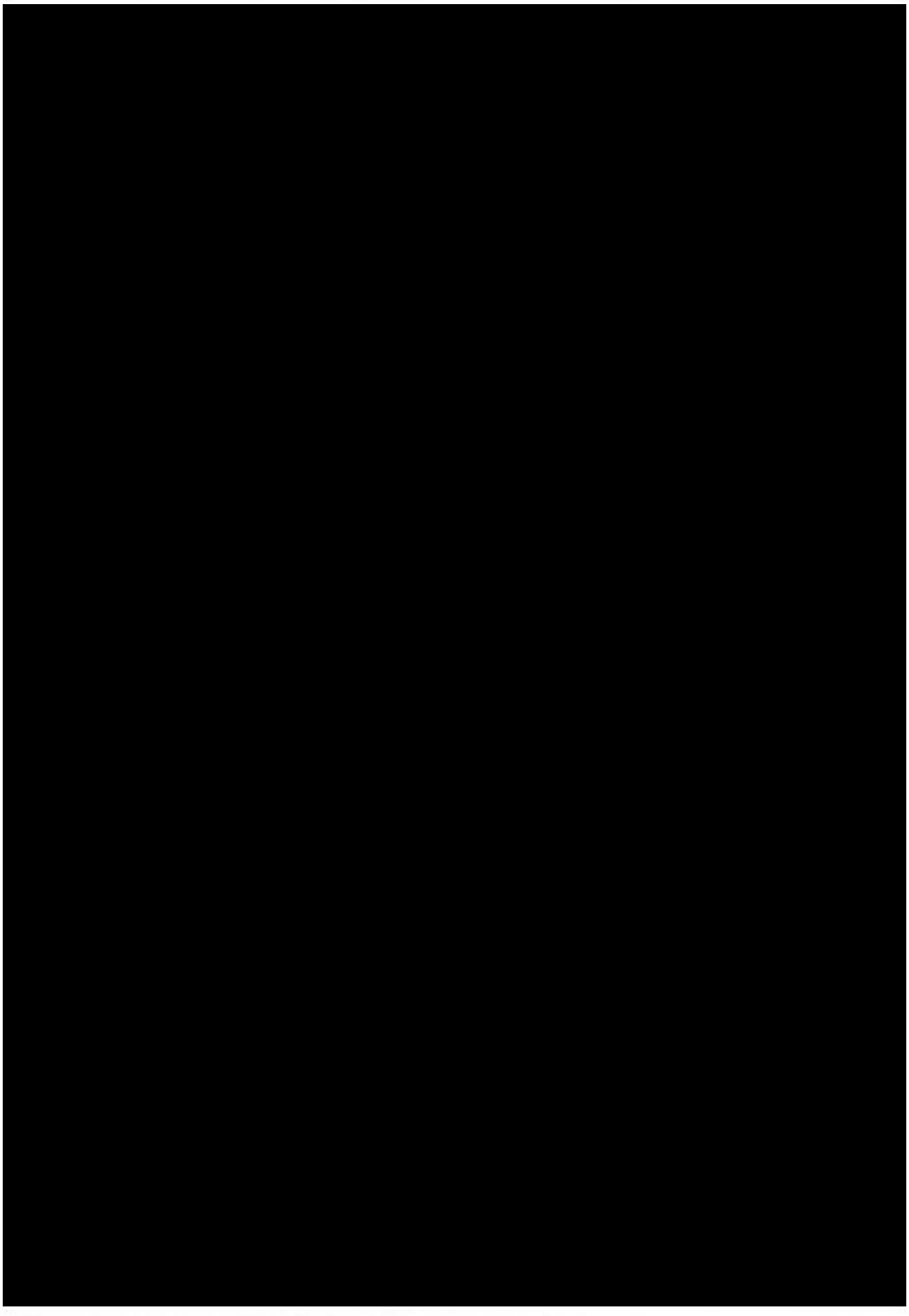


Figure 5: State offset area – TLO Facility *Solanum spp.* offset

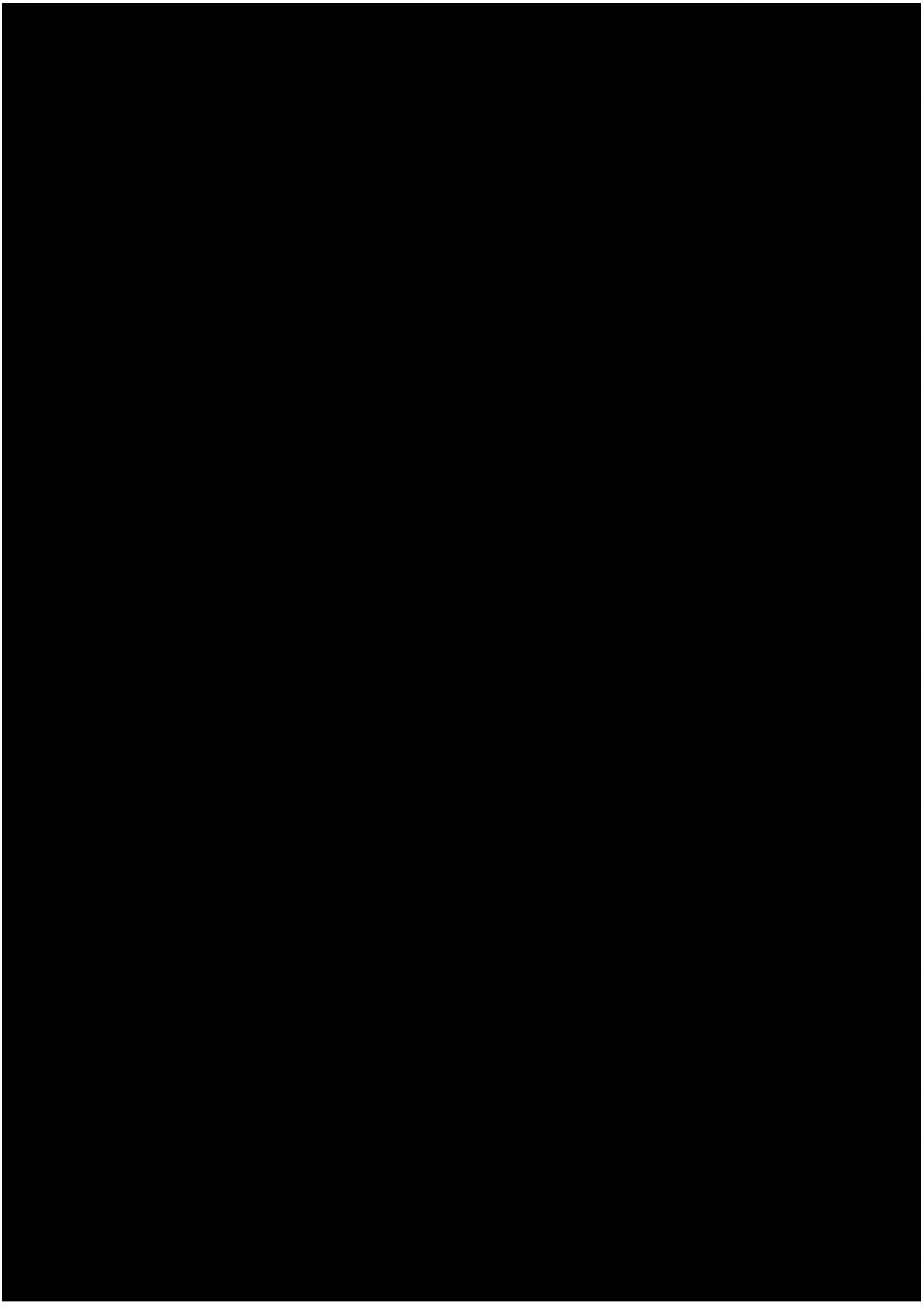


Figure 6: State offset area – Private Access Road *Solanum spp.* Offset

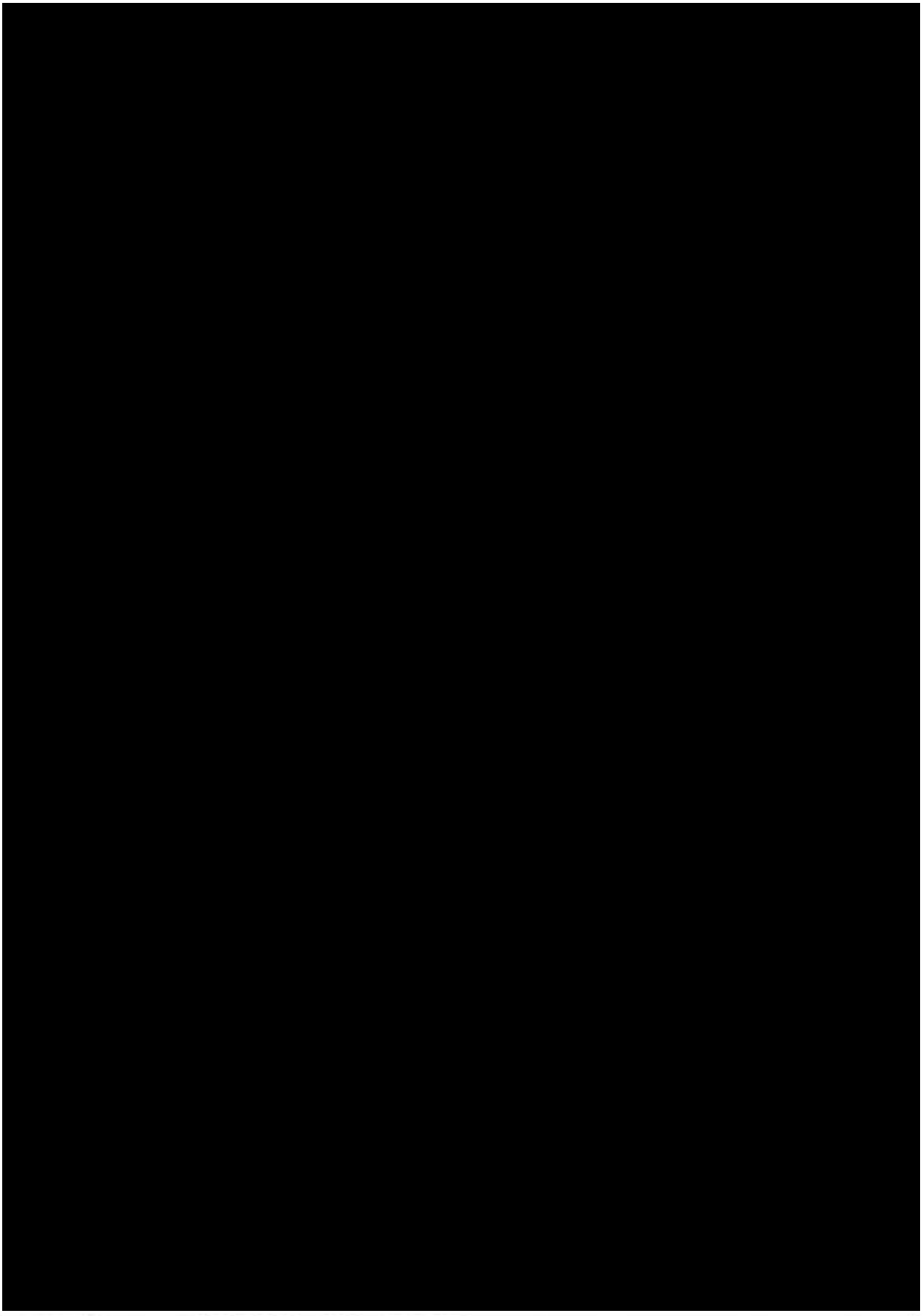


Figure 7: EPBC Offset Area Map including the Queensland offset within the boundaries

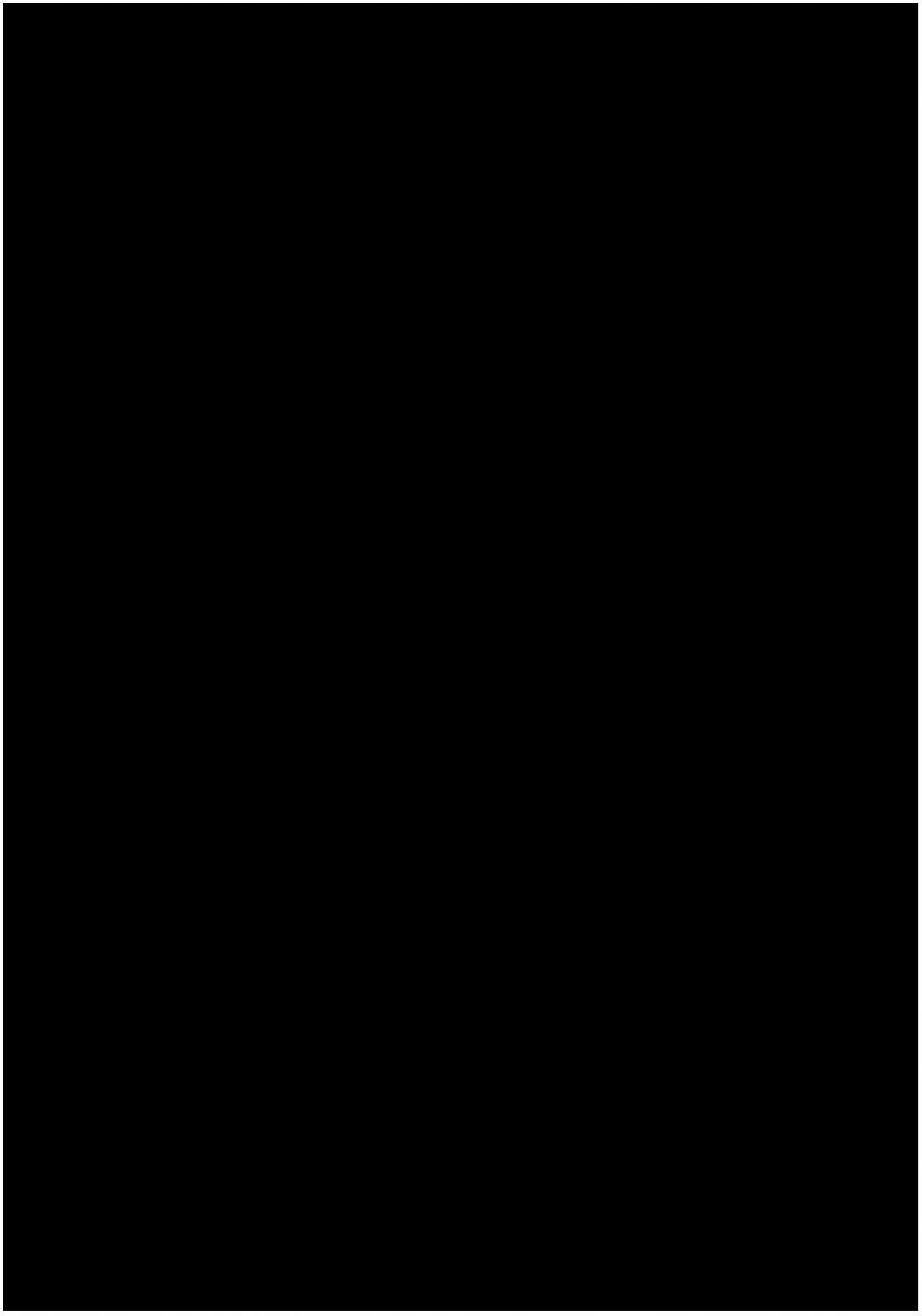


Figure 8: Survey Site Locations

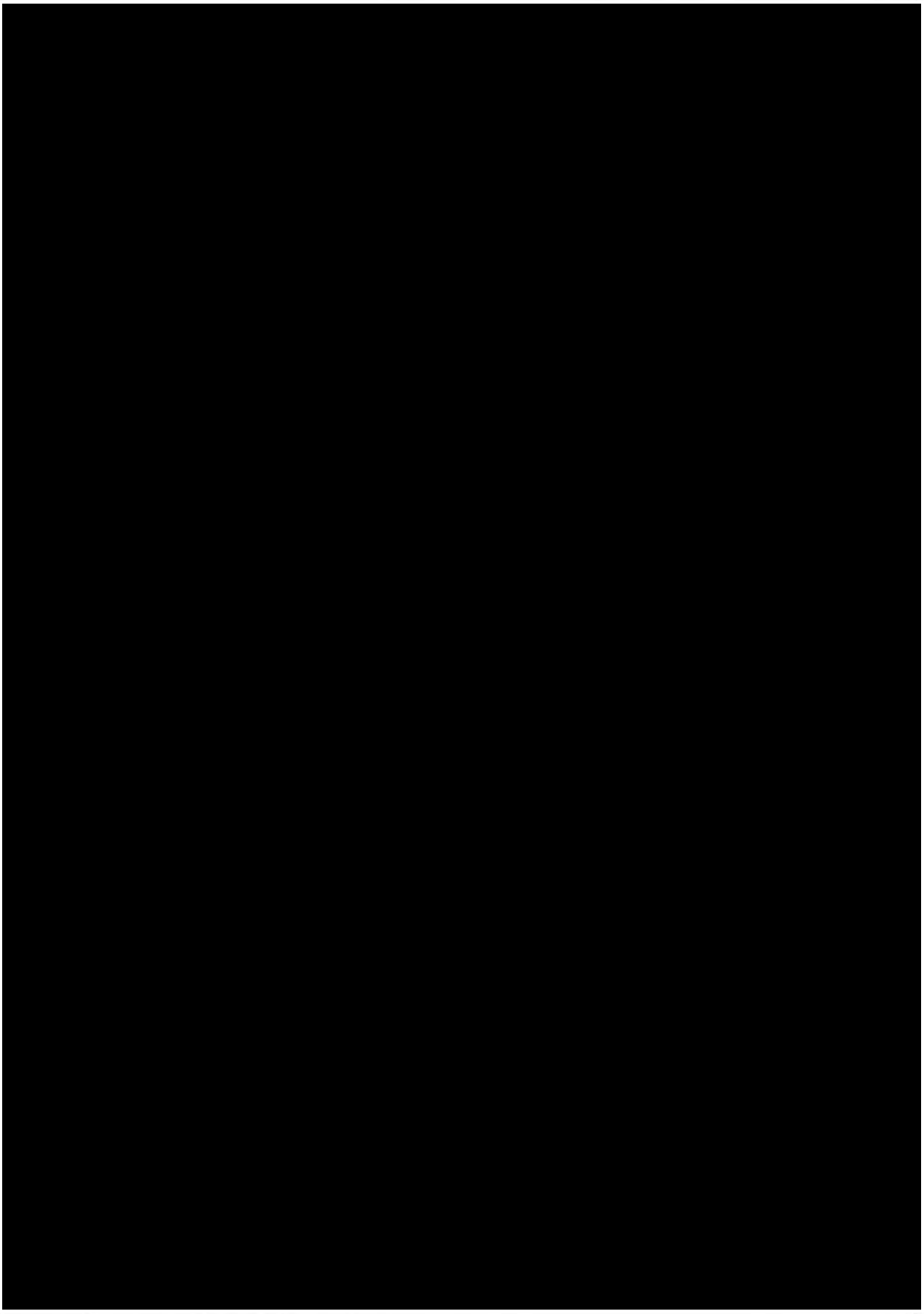


Figure 9: Fencing Plan

[redacted]

3. Restrictions imposed on the use of the Offset Area

The restrictions below (**Table 8**) will be implemented within the Offset Area Management Plan.

Cultural Values and Practices

It is noted and agreed that nothing in **Table 8** or this Offset Area Management Plan limits the traditional Indigenous owners of the property from carrying out actions on the property and within the Offset Area Management Plan, including, but not limited to, hunting, fishing, cultural ceremonies, clearing of selected trees, debarking trees and allowing fire in the offset management area, provided that the acts do not intentionally destroy the offset management area.

Table 8: Offset Area Restrictions

Restriction	Details
Vegetation clearing	1. Vegetation clearing on the Offset Area is restricted to: 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. Where vegetation clearing is sought for any other purpose, the landowner must contact the relevant department administering the *Vegetation Management Act 1999 (Qld)*. 2. Vegetation clearing is restricted to the use of non-mechanical means. 3. Native forest practice (harvesting of timber for forestry purposes) is not allowed under this Offset Area management plan. **Note:** Any vegetation clearing must be undertaken in accordance with: • 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 *Nature Conservation Act 1992 (Qld)*.
Grazing ***Grazing will not occur in the area identified in Figure 7 as areas being offset for the South-eastern long-eared bat***	1. Grazing will not occur in the area identified in **Figure 7** as areas being offset for the South-eastern long-eared bat. 2. Grazing of domestic livestock will occur in the balance of the Offset Area under the following arrangements: a) for fuel reduction purposes only during the dry season; and b) noting that there are no set stocking rates or times throughout the year where stock are to be permitted to graze. The Landowner, at their discretion, is to graze stock at rates and times necessary to reduce the fuel load in the Offset Area without lowering the total grass cover to below 30% at the end of the dry season. The ground cover is to be determined as per ***Attachment 2: Land Manager's Monitoring Guide***. c) the grazing regime should allow native grasses and *Solanum spp.* to flower and set seed at least every two years (6-8 week period during the wet/summer season).
Fire	1. Fire is to be, where possible, excluded from the Offset Area except for ecological burns by: a) maintaining firebreaks relative to the Offset Area; b) using a low intensity fire > 20 years in a mosaic pattern

	c) co-locating firebreaks with roads and fence lines on the property where possible; and d) not using fire as a tool for regrowth management in the Offset Area.
Pest animals and weeds	**Animal** Minimise the introduction of pest animals and control of existing populations of pest animals within the Offset Area in accordance with *the Land Protection (Pest and Stock Route Management) Act 2002*. 1. Increase the current pest animal control effort with regards wild pigs, dogs and cats 2. Investigate any realistic methods of cane toad control/management http://sydney.edu.au/science/biology/shine/canetoad_research/scientific-publications-cane-toad-control.shtml **Weeds** 1. Keep the introduction; establishment and spread of non-native weeds including Declared Pest Plants listed under the *Land Protection (Pest and Stock Route Management) Act 2002 (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 *Land Protection (Pest and Stock Route Management) Act 2002 (Qld)* to ensure that the non-native weeds do not cover more than 10% of the Offset Area, e.g., parthenium, velvety tree pear, and mother of millions. 3. Minimise the spread of any non-native pasture species within the Offset Area in accordance with **Table 10: Management Actions**. **Note:** existing weed control efforts on this property are effective (i.e. the current levels of weed infestation are low). 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.

4. Analysis of Risks to Achieving Management Objectives and Outcomes

The following risk assessment (**Table 9**) has considered:

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

Table 9: Risk Analysis

Number	Risk	Level of Risk (Extreme, High, Moderate or Low)	Proposed Actions to Minimise Risk	Proposed Remedial Actions if Risk Occurs
1	Fire	**High** Due to the small populations of South-eastern long-eared bat, fires pose a major threat to the species. They not	Maintaining firebreaks at appropriate widths to enable fires on adjoining properties to be prevented from impacting on the offset area. Manage fuel loads through	Fire to be excluded wherever possible from the offset area with low intensity fires >20year intervals. **Remedial action:**

Number	Risk	Level of Risk (Extreme, High, Moderate or Low)	Proposed Actions to Minimise Risk	Proposed Remedial Actions if Risk Occurs
		only directly kill the animal, but also destroy roosting sites.	controlled grazing. *Force Majeure* events are acknowledged being separate from general fire use practices. Fire control lines to be checked annually for condition and adequacy.	Destock the offset area, re-establish fire breaks and control lines and if appropriate, widen fire control lines and reassess fuel load reduction practices.
2	Forestry	**High** The South-eastern long-eared bat is known to roost in deadwood or hollow trunks/branches. Standard forestry and Native Timber Harvesting practices remove such items from the environment and are hence considered a potential threat.	Forestry and Native Timber Harvesting are **excluded** from the offset area. Signs at entrance points to the property with regards that it is an offset area and that any harvesting of timber is prohibited.	No clearing of native trees are to occur within the offset area. **Remedial action**: Reassess access protocols for any lessees etc., signage and general access.
3	Grazing	**Low** The South-eastern long-eared bat is believed to forage on low ground and shrubs. High density grazing around such regions destroys shrubs and limits the regeneration of the habitat. The natural condition of this vegetation community has a low grass cover (30%) and hence any grazing undertaken is at low stocking rates and for short periods of time.	Grazing will not occur in the area identified in Figure 7 as areas being offset for the South-eastern long-eared bat. Grazing of domestic livestock will occur in the balance of the Offset Area during the dry season for fuel reduction purposes with a minimum of 30% grass cover to be present at the end of the dry season. Boundary fencing to be checked annually and maintained in a stock proof condition.	Grazing is determined by the amount of dry matter available and is used conservatively for that necessary for fuel reduction purposes only **Remedial action**: Any entry points due to fencing breaks etc. to be repaired to a stock proof condition within a 30 day period.
4	Erosion	**Low**	Maintaining grass cover at a minimum of 30% at the end of the dry season. This will ensure groundcover is even higher (due to the presence of fallen woody debris, organic matter etc.) thus minimising the risk of sheet erosion.	**Remedial action**: Further reduction of grazing levels and checking on the cause of any point source erosion (such as illegal vehicle access) and rectifying access if this is the cause.
5	Drought	**Low** The risk incurred by drought would be an increase in the likelihood of fire due to the dry conditions and accumulated fuel loads.	Maintain fire control lines as detailed above and manage grazing levels according to the amount of dry matter available for grazing.	**Remedial action**: Allow Offset Area to recover post drought/fire, particularly through the control of weeds. Maintain a minimum of 30% grass cover at the end of the dry season.

5. Management actions

The following table (**Table 10**) identifies the actions which will be undertaken for the Offset Area, by whom, when and more specific information relating to the action.

Table 10: 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
Forestry Operations, Native Timber Harvesting and general Vegetation clearing	Vegetation clearing on the Offset Area is restricted to: a) that necessary for the removal of non-native weeds or declared pests; b) establishing and maintaining fencing around the boundary of the declared area; c) establishing and maintaining fire breaks; and d) ensure public safety Vegetation clearing for any other purpose **is not** permitted within the offset area.	Only in those areas subject to non-native weed control, fire control lines and fences.	As required and identified in the quarterly inspections of the fences and collocated fire control lines.	Landowner or suitable qualified person appointed by the Landowner.	No evidence of recent forestry or timber harvesting activities are evident during term of the offset management plan. Any illegal clearing to be recorded in the landholder records and identified during the monitoring and reporting program.	Any evidence of clearing apart from weeds is to be noted in the Annual Landholder reports. If evidence of recent timber harvesting is noted during inspections, the landholder is to reassess access protocols for any lessees etc., signage and general access.
Fire	Fire is to be, excluded from the Offset Area except for low intensity ecological burns by: a) Maintaining firebreaks relative to the Offset Area; b) Using a low intensity fire >20 years interval; and c) Firebreaks are to be co-located with roads and fence lines on the property where possible. **Note:** Fire is not to be used as a tool for regrowth management on the Offset Area. It is recognised that high-intensity burns are detrimental to the *Solanum spp*, and hence the importance of adopting these management practices.	Throughout the Offset Area.	Fire Control lines are to be inspected weekly and maintenance undertaken as required but at an interval of at least each 2 years. If fire is used at all, it is to be at a low intensity fire at >20 years interval.	Caretaker will undertake weekly inspections, [redacted] monthly inspections. Grading of the fire breaks is to be undertaken by a suitable qualified person appointed by the [redacted] or [redacted]	No evidence of fire is observed during the term of the offset management plan, except for prescribed mosaic burns. Any incidence of wild fire or illegal burning (Force Majeure) is to be identified during weekly inspections and documented within the monitoring and reporting program.	Any occurrence of fire in the Offset Area is to be noted during weekly inspections of the property and recorded in the Annual Landholder reports. **Corrective action:** Check and repair all fire control management lines. Destock the offset area, re-establish fire breaks and control lines and if appropriate, widen fire control lines and reassess fuel load reduction practices. Fire and grazing excluded until the grasscover has increased to 50% using the methodology in the Land Manager's Monitoring Guide as attached.

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
Grazing	There is no set stocking rates as this region is subject to significant changes in grass cover with seasonal conditions. It is recognised that competition from non-native pasture species can have a negative effect on the establishment of the *Solanum spp*. Grazing is therefore restricted as per these management actions to reduce the risk of high-intensity fires and to manage the levels of ground cover of the non-native pastures.	A new fence is to be established to exclude cattle from [redacted] and another fence is to be established along the eastern boundary of the offset area, as shown in the Fencing Plan at Figure 9. Grazing is excluded from the [redacted] South-eastern long-eared bat Offset Area. Stock will be grazed in the Offset Area to the east of [redacted] fence line for fuel reduction purposes only during the dry season.	As required when grass fuel loads exceed 50%. During the dry season. Establish the new fence by December 2016 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 bottom of the gilgais to ensure that no "pugging" of the soil occurs by livestock.	[redacted]	The Landowner, at their discretion, is to graze stock during the dry season, at rates and times necessary to reduce the fuel load in the Offset Area without lowering the grass cover to below 30% at the end of the dry season. No evidence of "pugging" is to occur.	The property Caretaker will undertake twice weekly inspections when stock are grazing the offset area. The [redacted] will undertake monthly inspections of the property to ensure that cattle are not present when there is any evidence of moisture in the gilgai formations. If cattle are in the offset area when rainfall occurs, they are to be removed to the area to the east of the offset area within 24 hours. Fence lines are to be inspected weekly during grazing periods and along with Photo point and Terrestrial Habitat Quality Assessment results of grass cover and groundcover, grazing instances, stocking rates, timeframes and rainfall records are to be incorporated into the Annual Landholder Reports and the Compliance reports to [redacted] and the regulators. **Corrective action:** grazing excluded until grass cover has increased to 30% using the methodology in the Land Manager's Monitoring Guide as attached.
Pests	**Pest Animal Management** Minimise the introduction of pest animals and control of existing populations of pest animals (wild pigs) within the Offset Area in accordance with the *Land Protection (Pest and Stock Route Management) Act 2002 (Qld)*. There are currently no incidence of foxes on the property. Wild pig and dog populations are transient and are infrequent and of short duration and impact due to the small numbers that occur.	Throughout the Offset Area.	As required.	[redacted] caretaker or suitable qualified person appointed by the Landowner.	Scrappings, wallow holes, tracks and visual incidents along with control measures are to be noted in the Annual Landholders Reports after weekly inspections by the caretaker and monthly inspections by the [redacted]. This evidence is to be	**Corrective action:** if an increase in pig or wild dog numbers is observed, the landholder will implement a pest animal management programme to control the feral animal population. If an increase in pig or wild dog activity is noted during regular landholder inspections of the offset area, then a programme of baiting and or pig trapping is to be instigated until the population and

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
	Current control of pigs and wild dogs is undertaken via an annual baiting programme on the property. Additional to this measure, the caretaker, during weekly inspections of the offset area is to shoot any wild pigs or wild dogs that are seen. If an increase in pig or dog activity is noted, an additional trapping and shooting programme is to be instigated until the increased activity has ceased. Investigate any realistic methods of cane toad control/management. This research is in its infancy with regards the ability to undertake the control methods in an extended area. It is recommended that [redacted] and [redacted] explore partnership opportunities with the [redacted] with regards commercial scale implementation. This would involve training of the local indigenous community and hence the Department of Aboriginal and Torres Strait Islander and Multicultural Affairs for training. [redacted] <u>*Solanum spp.* offset</u> The results of the Year 1 monitoring programme will be used to determine the most appropriate locations for installation of pig exclusion fencing. It is intended that, as a minimum, pig exclusion fencing will be installed around distinct populations of *Solanum spp.*. Where broad distribution of the species/large patches of populations are located within the *Solanum spp.* offset area and/or the distribution of the species expands in the offset areas, broader establishment of pig exclusion fencing will be implemented. Proposed methodology and locations of pig exclusion fencing will be included in the Year 1 reporting to EHP for their review and approval prior to implementation.	Within the *Solanum spp.* offset area.	After Year 1 *Solanum spp.* monitoring programme		collected quarterly and included in the Monitoring and Reporting to the Regulator. Further monitored and recorded during the *Solanum spp.* monitoring program as shown in *Table 11*.	occurrence of these pests is reduced. This will have a greater impact if control measures are integrated with neighbouring properties. Potential cane toad management investigations to be incorporated into the first Annual Report and if a pragmatic training and scaled approach can be identified, incorporated into the Pest Animal Control Programme.

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
	Weeds 1. Keep the introduction, establishment and spread of non-native weeds including Declared Pest Plants listed under the Land Protection (Pest and Stock Route Management) Act 2002 (Qld) to less than 10% weed cover over the Offset Area. 2. Control existing infestations of non-native weeds including Declared Pest Plants under the Land Protection (Pest and Stock Route Management) Act 2002 (Qld) to ensure that the non-native weeds cover less than 10% of the Offset Area. e.g., Parthenium, mother of millions, and velvety tree pear. 3. Buffel in this instance is recognised as being a threat to the ecological community however is not referred to as a weed. Control of Buffel is best managed via grazing during the dry season and by increasing tree canopy cover. 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 bottom of the gilgais to ensure that no "pugging" of the soil occurs. 4. The use of broadscale herbicide is not recommended due to the potential impact on frog species in the creek and gilgai formations. This impact would lead to a negative impact on the Ornamental Snake population via the loss of frog species and population on which it is reliant. 5. Spot spraying of patches of Parthenium and mother of millions is allowed as required. 6. The rare occurrences of tree pear are to be treated as per the recommended advice at the time of treatment.	Throughout the Offset Area.	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.	[redacted] caretaker or suitable qualified person appointed by the Landowner.	Observations during routine property inspections by the caretaker (weekly) or by the [redacted] (monthly). Incidence, observations and resultant control measures are to be recorded via photos and additionally by the photo point and Terrestrial Habitat Quality Assessment results of grass cover and non-native groundcover to be incorporated into the Annual Landholder Reports and the Compliance reports to [redacted] and the regulator.	**Corrective action:** The level of weed infestation is low in the observed areas and spot spraying of small outbreaks observed during routine property inspections should suffice. Broadscale chemical spraying is NOT supported due to the potential negative effect on the native frog population thus impacting on the Ornamental snake population due to ingestion of the chemicals and the reduction in the frog population.

6. Monitoring requirements

Monitoring of the Offset Area will occur in accordance with Table 11.

Table 11: Offset Area monitoring

Monitoring	Attributes monitored	Frequency	Method	Location/s
		Surveys undertaken by Ecologists		
Baseline monitoring	Ecological Condition attributes (refer below in this table)	At commencement of Plan (year 0)	Field observations, vegetation assessment as per Queensland Terrestrial Habitat Quality Assessment methodology (using former BioCondition methodology).	Monitoring sites 28, 33 and 39 listed at *Table 12*.
	Terrestrial Habitat Quality Assessment	Year 1 monitoring programme, in the months of February, March and September (likely flowering periods) following at least 100mm of rainfall in the preceding 2 months.	Field observations, vegetation assessment as per Queensland Terrestrial Habitat Quality Assessment methodology (**THQA**).	Monitoring sites A (EPBC brigalow regrowth) and C (Private Access Road offset/THQA) as listed in *Table 12*.
	Ecological Condition	Year 1 monitoring programme, in the months of February, March and September (likely flowering periods) following at least 100mm of rainfall in the preceding 2 months.	Field observations, vegetation assessment as per former BioCondition methodology.	Monitoring site B (TLO offset/QBOP).
	Solanum spp. density	Year 1 monitoring programme, in the months of February, March and September (likely flowering periods) following at least 100mm of rainfall in the preceding 2 months	• *Solanum spp.* density • Additional Monitoring as per Queensland Herbarium advice (refer below)	Monitoring sites B and C (*Solanum spp.* habitat) as listed in *Table 12*.
Ecological condition	Recruitment of woody perennial species Native plant species richness Native perennial grass cover Weed cover	<u>Monitoring sites 28, 33 and 39</u> At commencement (year 0) and then every 5 years to (and including) year 2030; reported every 5 years <u>Monitoring sites A, B and C</u> Year 1, Year 5 and then every 5 years to (and including) year 2030;	Field observations, vegetation assessment as per Queensland Terrestrial Habitat Quality Assessment methodology (sites A &C). Field observations, vegetation assessment as per former BioCondition	Monitoring sites as defined, and listed at *Table 12*.

Monitoring	Attributes monitored	Frequency	Method	Location/s
		reported every 5 years	methodology (site B).	
Additional *Solanum* spp. monitoring (as per Queensland Herbarium advice)	• Extent of the Solanum stand and number of stems • Note any localised mechanical disturbance • Record the time period since the last fire, and its intensity • Canopy cover at the site • Ground cover at the site (native and exotic cover measured separately)	Year 1, Year 5 and then every 5 years to (and including) year 2030 reported every 5 years (including to the Queensland Herbarium)	*Solanum spp.* typically occur in stands, i.e., a population of stems occupying a contiguous area, and connected by underground rhizomes. Ideally the monitoring points should be placed at the edge of one or more of these stands. That way, expansion or contraction over time can be detected.	Monitoring sites B and C (*Solanum spp.* habitat only) as listed in *Table 12*.
Landholder Records				
Photo Points	Stocking rates, rates and timing	Reported annually for the first 5 years and then every 5 years to (and including) year 2030	[redacted] landholder representative will undertake inspections of the offset area to observe and record grass cover levels, weed occurrence and any evidence of pest animal incursion. These records are to be collated and reported every year for the first 5 years. Subsequently, they are to be included in the five yearly reports along with the Terrestrial Habitat Quality Assessment reports.	Monitoring sites listed at ***Table 12***
Grazing	Incidence and extent			Within Offset Area
Fire	Occurrence, control measures, timing and result of the control measures			
Weeds	Occurrence, control measures adopted, timing of the control measures and the result			
Pest animals	Stocking rates, rates and timing			

Table 12: Monitoring Sites

Monitoring Site Number	Related Quaternary Site Number	Centre Point Easting	Centre Point Northing	Bearing
1	22	[redacted]	[redacted]	90°
2	28	[redacted]	[redacted]	270°
	33 (observation site for long-eared bat habitat)	[redacted]	[redacted]	
4	39	[redacted]	[redacted]	90°
A		[redacted]	[redacted]	225°
B		[redacted]	[redacted]	240°
C		[redacted]	[redacted]	180

7. Reporting

[redacted] will prepare Offset Area monitoring reports and submit the reports to the administering authority every year for the first 4 years for the life of this plan and thereafter each 5 years for the life of this plan (i.e., until 2030). Ongoing monitoring is required to ensure the Management Plan achieves the outcomes identified.

The frequency of monitoring has been determined based on the remnant status and established regrowth within the area and the likely rate of improvement. As remnant and an established regrowth community the expected rate of change is likely to be moderate, with high opportunities for improvement and, with good management, a low risk of decline. Accordingly, monitoring frequency has been established on an initial yearly photo point monitoring cycle followed by a 5 year Terrestrial Habitat Quality Assessment monitoring cycle. (**Table 13**):

Table 13: Reporting Schedule

Offset Year	Report Details	Date to be submitted
1	Offset Area Annual Report including: • Outcomes of Year 1 monitoring programme defined in *Table 11*, including confirmation of the presence of the *Solanum spp.*, density and distribution within the offset areas • Photopoint and Landholder records	1st anniversary of offset being secured (2016)
2*	Offset Area Annual Report including Photopoint and Landholder records collated and reported to the administrating authority	2nd anniversary of offset being secured (2017)
3*	Offset Area Annual Report including Photopoint and Landholder records collated and reported to the administrating authority	3rd anniversary of offset being secured (2018)
4*	Offset Area Annual Report including Photopoint and Landholder records collated and reported to the administrating authority	4th anniversary of offset being secured (2019)
5*	Offset Area Report summarising all monitoring defined in *Table 11* for the first 5 years of the offset	5th anniversary of offset being secured (2020)
10*	Offset Area Report summarising all monitoring defined in *Table 11* for years 6 to 10 of the offset	10th anniversary of offset being secured (2025)
15*	Offset Area Report summarising all monitoring defined in *Table 11* for years 11 to 15 of the offset	15th anniversary of offset being secured (2030)

** Note: As outlined in Table 11 of this Offset Area Management Plan, additional monitoring and reporting effort for the Solanum spp. offsets may be required depending on the outcome of the Year 1 monitoring programme, which will be reported to ENP in the Year 1 Annual Report for approval prior to implementation.*

8. Consent

Administering authority

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

Name [redacted] Signature: [redacted] .....

Witness name:..... [redacted] Signature:..... [redacted] .....

Date..... 11/11/15 .....

Landholder

The landowner agrees:

1. Any 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 landowner acknowledges:

5. That before the State will agree to the release this Offset Area management plan the State must be satisfied that the objectives and activities contained in the Offset Area management plan have been achieved.

The landowner 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 [redacted] being the current owner/s 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:..... [redacted] Signature: [redacted] ....

Witness name: [redacted] Signature: [redacted] .....

Date..... 22/2/2016 .....

Name:..... Signature:.....

Witness name:..... Signature:.....

Date.....

Name:..... Signature:.....

Witness name:..... Signature:.....

Date.....

SIGNED by [redacted] to indicate their agreement with the Offset Area management plan.

Executed by [redacted] in accordance with section 127 of the *Corporations Act 2001* (Cth)

[redacted]

.....
~~Director~~/company secretary

[redacted]

.....
Name of ~~director~~/company secretary
(BLOCK LETTERS)

[redacted]

.....
Director

[redacted]

.....
Name of director
(BLOCK LETTERS)

Attachment 1: Baseline Data

[redacted] Property – Site Observations (Table 4.15 from Field Assessment Report)

Observation site	Easting (Zone 55 GDA94)	Northing (Zone 55 GDA94)	Vegetation description*	Comments
022	[redacted]	[redacted]	Brigalow regrowth 1-3m tall (avg. 2m) on moderate gilgai. Ground layer sparse in dips. Mostly buffel on higher areas (rims) and in small flat cleared areas. Leptochloa digitata in larger depression here on site. Enchylaena tomentosa, occasional small *Parthenium hysterophorus. Small open area has *Oxalis corniculata, Atalaya hemiglauca, Apophyllum anomalum, Portulaca oleracea, Eriachne sp., Terminalia oblongata, Evolvulus alsinoides, Capparis lasiantha, Glycine sp., Enteropogon sp., Sporobolus caroli, Citrus glauca, Solanum sp.(possibly S.johnsonianum).	Near SE corner of [redacted] Conservation Park.
023	[redacted]	[redacted]	As above - brigalow regrowth 1-3m tall (avg. 2m) on moderate gilgai. Patchy cover to 40%.	BioCondition site1. Site centre - 50m mark.
024	[redacted]	[redacted]	As above.	BioCondition site1. 0m mark.
025	[redacted]	[redacted]	As above.	BioCondition site1. 100m mark.
026	[redacted]	[redacted]	Brigalow regrowth to 3m (avg. 2m) 20% cover. Buffel grass 50% cover. Also Leptochloa digitata, Eriachne sp., Enteropogon acicularis, Sporobolus caroli. Note: loose head of Homopholis belsonii - possibly from adjacent conservation park. Enchylaena tomentosa, Atalaya hemiglauca, Apophyllum anomalum, Terminalia oblongata, Evolvulus alsinoides, Capparis lasiantha, Glycine sp., Citrus glauca, Solanum sp. (possibly S.johnsonianum) *Pennisetum ciliare, *Oxalis corniculatum, Parthenium hysterophorus.	Gentle drainage depression with pale sandy clay. Ex 11.3.1 or 11.4.9. Two possible Threatened species.

027	[redacted]	[redacted]	Patch of disturbed mapped remnant brigalow-belah about 16m tall with about 30% canopy cover, and 30% partly-overlapping sub-canopy cover. Large logs. Disturbed by grazing. T1-EDL (upper) 16-18m tall, 10% cover - Eucalyptus cambageana, Casuarina cristata. T2-Sub (mid) 8-12m tall, 50% cover - Acacia harpophylla, Brachychiton rupestris, Geijera salicifolia. S1 (tall shrub) 2-8m tall, 40% cover - Geijera parviflora, Citrus glauca, Alectryon diversifolius, Everistia vacciniifolia, Alectryon oleifolius, Amyema sp. S2 (lower shrub) 1-2m tall, 10% cover - Casuarina cristata, Citrus glauca, Acacia harpophylla, Carissa ovata, Lysiphyllum carronii, Terminalia oblongata, Apophyllum anomalum. G (ground) - Enteropogon acicularis, Sporobolus caroli, Capparis lasiantha, Apophyllum anomalum, Cissus opaca, Sida sp., Maireana microphylla, *Pennisetum ciliare, *Opuntia tomentosa.	BioCondition site2. Site centre - 50m mark.
028	[redacted]	[redacted]	As above.	BioCondition site2. 0m mark.
029	[redacted]	[redacted]	As above.	BioCondition site2. 100m mark.
030	[redacted]	[redacted]	Eastern edge of remnant patch of brigalow-belah with Eucalyptus cambageana. To east: extensive cleared area with no gilgai. Soil has top sandy layer, dominated by buffel grass. Note: ridge line several hundred metres west defines eastern edge of gilgai to west.	
031	[redacted]	[redacted]	Distinct sudden change from orange sandy-covered soil to east, and typical black soil with cracking and gilgai to west. Western area supports brigalow regrowth 1.5 - 4m tall.	
032	[redacted]	[redacted]	Typical sample of wedge of dryland vegetation in between anabranches of [redacted]. Tall open woodland of brigalow 18-20m tall, 10% cover, with variable height understorey to 10m tall (avg. 5m) consisting of brigalow, belah, Lysiphyllum hookeri, Eremophila mitchelli, Geijera parviflora, 1 Capparis arborea, Amyema sp. on brigalow, buffel grass, Enchylaena tomentosa.	Remnant RE 11.9.5. No gilgai.
033	[redacted]	[redacted]	One of several channels comprising western (or NW) branch of fork of creeks surrounding wedge of dryland vegetation (as per site 32). Tall brigalow, with Melaleuca bracteata and Eucalyptus coolabah. Ground layer and water impacted by cattle.	[redacted] NW anabranch. RE 11.3.1, with 11.3.37.

034	[redacted]	[redacted]	Further downstream - generally mostly E.coolabah along creek from site 33 to here, but with component of brigalow approximately 10%. Also some brigalow on floodplain on western side of creek, but too narrow to be of offset value (cleared to west), and mostly E.coolabah.	Traverse down western boundary of creek, mostly RE 11.3.37 and 11.3.3. Further survey needed to determine amount of brigalow 11.3.1.
035	[redacted]	[redacted]	Further downstream - E.coolabah, Melaleuca trichostachya. Terminalia oblongata up on terrace, with Brachychiton rupestris and brigalow.	Creek. RE 11.3.37 and 11.3.3.
036	[redacted]	[redacted]	Remnant brigalow-belah in good condition. T1 (upper) 12-14m tall, 30% cover - brigalow 15%, belah 15%. Most larger trees 15-20cm DBH, but all under BioCondition threshold of 32cm. T2 (mid) 7-10m tall, 20% cover - brigalow, belah, Citrus glauca, Flindersia dissosperma. S1 (shrub) 1.5-4m tall, 15% cover - Geijera parviflora, brigalow, belah. S2 (shrub) 0.5-1.5m tall, 30% cover - Paspalidium sp., Enchylaena tomentosa, Capparis lasiantha, Chenopodiaceae, Acanthaceae, *Opuntia tomentosa, Cissus opaca, Sida sp. Litter 30%, bare 30%, logs 10%.	Inspection of site record location for Solanum elachophyllum in [redacted] Conservation Park. No sign of target species due to dry conditions. RE 11.4.3.
037	[redacted]	[redacted]	Senna sp. collected TBI.	Also in [redacted] Conservation Park, near site 36.
038	[redacted]	[redacted]	Patch of disturbed mapped remnant brigalow-belah about 14m tall with about 10% canopy cover, and 70% partly-overlapping sub-canopy cover. Large logs. Disturbed by grazing. T1-EDL (upper) 12-16m (avg.14m), 10% cover - Casuarina cristata (dominant), Acacia harpophylla. T2-Sub (mid) 2-12m (avg.9m), 60% cover - Casuarina cristata, Acacia harpophylla, Lysiphyllum carronii, Alectryon diversifolius, Terminalia oblongata. S1 (shrub) 1-2m, 5% cover - Acacia harpophylla, Casuarina cristata, Geijera parviflora, Terminalia oblongata, Alectryon diversifolius, Carissa ovata. G (ground) Ancistrachne uncinulata, thin-leafed grass grazed (possibly Enteropogon acicularis), Cissus opaca, Jasminum didymum subsp. lineare, Enchylaena tomentosa, Capparis lasiantha, probably Sida sp., *Bryophyllum sp., *Opuntia tomentosa.	BioCondition site3. Site centre - 50m mark.
039	[redacted]	[redacted]	As above.	BioCondition site3. 0m mark.
040	[redacted]	[redacted]	As above.	BioCondition site3. 100m mark.

**naturalised (weed or exotic) species indicated by **

BioCondition Site no:	2	**Relevant quaternary site no, if applicable:**		27			
RE/landtype:	11.4.8	Bioregion:	BB	Property: Lot 5 RM135 [redacted]			
Date:		Photos:	N: #	E: #	S: #	W: #	
Landscape photos: #		Spot photos:	1:	2:	3:	4:	5:
Datum: WGS84/GDA94/specify if other:		Zone: 55		Transect bearing: E-W (270 deg)			
0m mark	[redacted]	[redacted]		100m mark: [redacted]			
50m mark	[redacted]	[redacted]					
General description: Woodland (disturbed an open in places) of *Acacia harpophylla* with *Eucalyptus cambageana* and *Casuarina cristata*. Moderate shrub layer and numerous naturally fallen logs.							
100m x 50m area:							
Eucalypt large tree DBH benchmark (cm):	40cm(draft)	Non-eucalypt large tree DBH benchmark (cm):		27cm(draft)			
Number of large eucalypt trees:	6	Number of large non-eucalypt trees:		7			
Total large trees:	13						
Tree canopy height (for EDL Ecologically Dominant Layer) (m):	15m	T1 10-18m, 10%					
Subcanopy height (if present) (m):	8m	T2 8-12m, 50%					
Emergent height (if present) (m):	-	S1 2-8m, 40%, S2 1-2m, 10%					
Proportion of dominant canopy species with evidence of recruitment (%):		50%	Casuarina only, no bleckbutt				
Total tree species richness:	9	Includes all tree species in 100m x 50m, not just EDL. Trees are single-stemmed and over 2m tall					
Tree species list:	[T1 EDL Eucalyptus cambageana, Casuarina cristata], [T2-Sub Acacia harpophylla, Brachychiton rupestris, Geijera salicifolia], [S] Geijera parviflora, Citrus glauca, Alectryon diversifolius, Eremaea vaccinifolia, Alectryon oleifolius]. (mistletoe not counted - Amyema sp.)						
50m x 10m area:							
Shrub species richness:	7	Defined as single-stemmed and below 2m tall, or multi-stemmed from base, or from below 20cm.					
Shrub species list:	[S2 Casuarina cristata, Citrus glauca, Acacia harpophylla, Carissa ovata, Lysiphyllum carronii, Terminalia oblongata, Apophyllum anomalum].						
Grass species richness:	2						
Grass species list:	Enteropogon acicularis (common), Sporobolus caroli (rare).						
Forbs and others (non-grass ground) species richness:	5						

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[redacted]

Forbs and other ground species:	Capparis lasiantha, Apophyllum anomalum, Cissus opaca, Sida sp., Mairesna microphylla.												
Non-native plant cover (%):	20%	Species: Pennisetum ciliare (common), Opuntia tomentosa (rare).											
50m x 20m area:													
Coarse woody debris (>10cm diameter, >0.5m long, measure to plot boundary). Total length (m):	145.5m												
71													
74.5													

Five 1m x 1m plots (ground cover %):						
Quadrat:	1	2	3	4	5	Mean
Native perennial "decreaser" grass:	n/r	n/r	n/r	n/r	n/r	n/r - see below
Native other grass cover:	1	1	1	0	0	0.6
Native forbs and other species:	1	5	0	0	0	1.2
Native shrubs (<1m tall):	0	5	0	0	70	15
Non-native grass:	0	20	2	10	10	8.4
Non-native forbs and shrubs:	0	0	0	0	0	0
Litter:	30	64	78	85	10	53.4
Rock:	0	0	0	0	0	0
Bare ground:	68	5	20	5	10	21.6
Cryptogams:	0	0	0	0	0	0
Total:	=100%	=100%	=100%	=100%	=100%	=100.2

100m transect:

Tree-canopy cover: (Tree or Group code: C=canopy, S=subcanopy, E=emergent)

Total % canopy:	34.5	Total % subcanopy:	31.8	Total % emergent:	0

Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total
S		2	S		3						
C		7	S		6.3						
S		4.5	C		9						
C		5.5	S		2						

[redacted]

C		3									
S		3									
S		4									
C		10									
S		7									

Shrub canopy cover: (indicate non-native with *)			
Total % native:	5	Total % non-native:	0

*	Distance (m)	Total	*	Distance (m)	Total	*	Distance (m)	Total	*	Distance (m)	Total
		2.5									
		2.5									

[redacted] Biodiversity Offsets Assessments Report_FINAL 16/12/2014 [redacted]

BioCondition Site no:	**3**	**Relevant quaternary site no. if applicable:**	**38**

RE/landtype:	11.4.3	Bioregion:	BB	Property: Lots 21 & 22 Plan AU37 ([redacted])			
Date: 10/10/14		Photos:	N: *	E: *	S: *	W: *	
Landscape photos: *		Spot photos:	1: *	2: *	3: *	4: *	5: *

Datum: WGS84/GDA94/specify if other:		Zone: 55	Transect bearing: W-E (90 deg)
0m mark	[redacted]	[redacted]	100m mark [redacted]
50m mark	[redacted]	[redacted]	

General description: Woodland of Acacia harpophylla and Casuarina cristata with moderate shrub layer of same, and sparse ground cover over mirror gilgai.

100m x 50m area:

Eucalypt large tree DBH benchmark (cm):	n/a	Non-eucalypt large tree DBH benchmark (cm):	32cm
Number of large eucalypt trees:	0	Number of large non-eucalypt trees:	0*

Total large trees:	0*	*Note: most large trees were non-eucalypt 10-15cm DBH.

Tree canopy height (for EDL Ecologically Dominant Layer) (m):	14m	T1 12-16m, 10%
Subcanopy height (if present) (m):	9m	T2 2-12m, 60%
Emergent height (if present) (m):	-	S1 1-2m, 5%

Proportion of dominant canopy species with evidence of recruitment (%):	100%	

Total tree species richness:	5	Includes all tree species in 100m x 50m, not just EDL. Trees are single-stemmed and over 2m tall.
Tree species list:	[T1-EDL Casuarina cristata (dominant), Acacia harpophylla], [T2-Sub Casuarina cristata, Acacia harpophylla, Lysiphyllum carronii, Alectryon diversifolius, Terminalia oblongata]	

50m x 10m area:

Shrub species richness:	6	Defined as single-stemmed and below 2m tall, or multi-stemmed from base, or from below 20cm.
Shrub species list:	Acacia harpophylla, Casuarina cristata, Gegera parviflora, Terminalia oblongata, Alectryon diversifolius, Carissa ovata.	
Grass species richness:	2	
Grass species list:	Aristrachne uncinulata, thin-leafed grass grazed (possibly Enteropogon acicularis).	
Forbs and others (non-grass ground) species richness:	5	
Forbs and other ground species:	Cissus opaca, Jasminum didymum subsp. lineare, Enchylaena tomentosa, Capparis lasiantha, probably Sida sp.	

[redacted]

Non-native plant cover (%):	10%	Species: Bryophyllum sp. (common), Opuntia tomentosa (rare).
50m x 20m area:		
Coarse woody debris (>10cm diameter, >0.5m long, measure to plot boundary). Total length (m):		

Five 1m x 1m plots (ground cover %):						
Quadrat:	1	2	3	4	5	Mean
Native perennial "decreaser" grass:	n/r	n/r	n/r	n/r	n/r	n/r - see below
Native other grass cover:	0	5	0	2	<1	1.4
Native forbs and other species:	0	0	0	0	0	0
Native shrubs (<1m tall):	0	0	0	0	0	0
Non-native grass:	0	0	0	0	0	0
Non-native forbs and shrubs:	0	0	2	2	<1	0.8
Litter:	65	90	75	90	89	81.8
Rock:	0	0	0	0	0	0
Bare ground:	30	5	8	5	10	11.6
~~Cryptogams~~ Logs (can add to litter):	5	0	15	1	0	4.2
Total:	=100%	=100%	=100%	=100%	=100%	=99.8

100m transect:

Tree canopy cover: (Tree or Group code: C=canopy, S=subcanopy, E=emergent)

Total % canopy:	7	Total % subcanopy:	68	Total % emergent:	0	

Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total	Tree or group (C, S or E)	Distance (m)	Total
S	0-2	2	S	71.5-77	5.5						
C	2-5	3	S	81.5-82	0.5						
S	4-19	15	S	94-97	3						
S	23-25	2	S	98-100	2						
S	29-34	5									

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S	36-41	5									
S	45-56	11									
C	59-63	4									
S	63-80	17									

Shrub canopy cover: (indicate non-native with *)

Total % native:	5	Total % non-native:	0

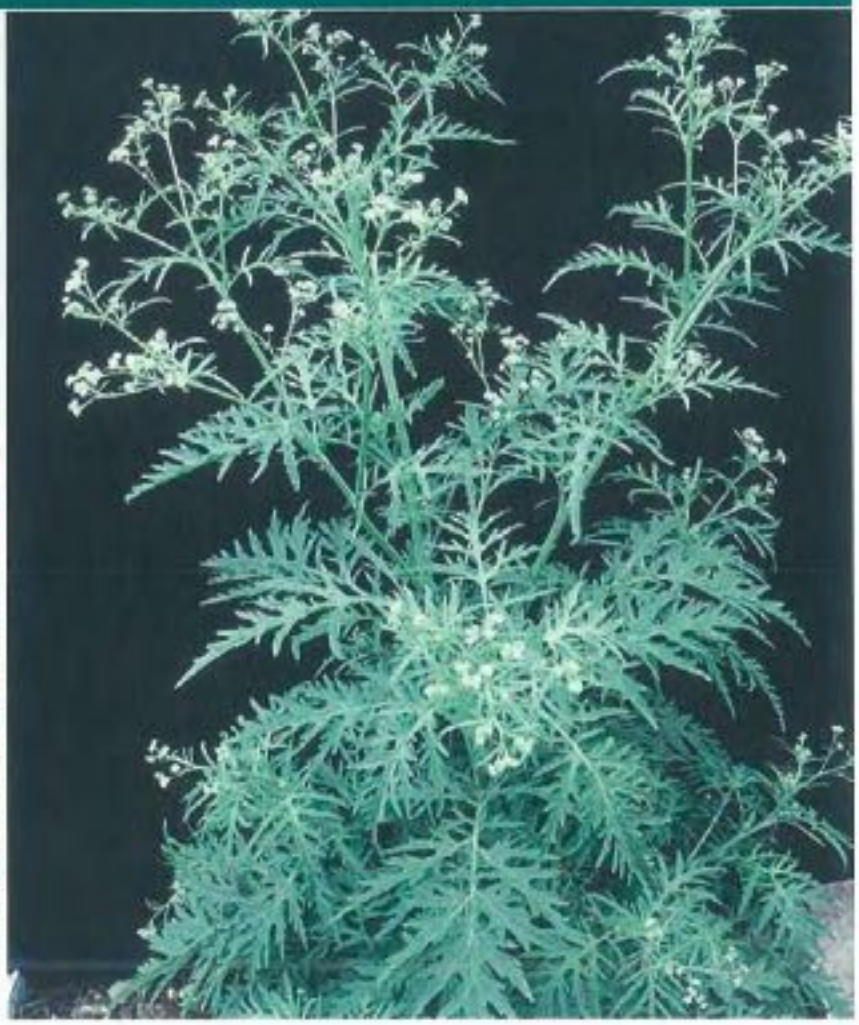
*	Distance (m)	Total	*	Distance (m)	Total	*	Distance (m)	Total	*	Distance (m)	Total
	2.5-3.5	1									
	9.5-10	0.5									
	12-14.5	2.5									
	26-26.5	0.5									
	34.5-35	0.5									

[redacted] [redacted]

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.

Queensland Government

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.

Carmenta 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	3.6–6 L/ha	Fields and fallow	Boom spray
max 3 kg/ha/yr	6 L/ha	Land—industrial, commercial, non-agricultural, roadside, right-of-way	Boom spray
atrazine 900 g/kg	2–3.3 kg/ha	Fields and fallow	Boom spray
max 3 kg/ha/yr	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 m²	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	Boom spray or spot spray
(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

[1]Use 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.

CS0944

Department of Agriculture, Fisheries and Forestry
Biosecurity Queensland

Fact sheet

DECLARED CLASS 1 AND 2 PEST PLANT

December 2014

Prickly pear

Opuntia, *Nopalea* and *Acanthocereus* spp.

The introduction and spread of prickly pear into Queensland and New South Wales is one of the greatest environmental invasions of modern times.

Prickly pear was introduced into pastoral districts in the 1840s. By 1900, over 4 million hectares in Queensland and New South Wales was infested by prickly pear. By 1925, the pest had invaded over 24 million hectares. Control costs were prohibitive and the only effective herbicide at the time was hazardous. This resulted in landholders abandoning large tracts of land.

Research for biological control agents commenced in 1912, and in 1914 cochineal insects were released to control one of the minor prickly pear species. Control of this minor prickly pear species by these introduced insects occurred within a few years.

The success of the cochineal insects led to renewed efforts against other types of prickly pear in the 1920s. These efforts resulted in the control of the major pest prickly pear by the moth *Cactoblastis cactorum*; by the mid-1930s, prickly pear was no longer a major problem.

Several prickly pear species have since remained as minor weeds.

Great state. Great opportunity.

Queensland Government

Declaration details

O. ficus-indica is not declared. *O. Stricta*, *O. aurantiaca*, *O. monacantha*, *O. tomentosa* and *O. streptacantha* species are Class 2 declared pest plants and all other species are declared Class 1 under Queensland legislation.

Description and general information

'Prickly pear' is a general term used to describe some plants of the Cactaceae family. The term includes species of *Opuntia*, *Nopalea* and *Acanthocereus*. All of these plants originate in the Americas. The term 'prickly pear' also relates to the fruit, which is often spiny and pear-shaped. Plants are normally leafless succulent shrubs. Stems are divided into segments (pads or joints) that are flat and often incorrectly called leaves.

Young shoots have true leaves resembling small fleshy scales that fall off as the shoot matures.

Flowers are large, normally seen during spring and can be yellow, orange, red, pink, purple or white depending on the species. Prickly pear fruits vary between species and can be red, purple, orange, yellow or green.

Areoles (spots with clusters of spines) are found on both the pads (joints, segments) and fruit. In addition to spines, areoles often have clusters of sharp bristles (glochids) and tufts of fibre ('wool'). Each areole contains a growing point that can produce roots or shoots.

Life cycle

Prickly pear species have several features that enable them to compete and become pests.

Prickly pear species are drought resistant because of their succulent nature, their lack of leaves and their thick, tough skins. These features result in plants that use the majority of their internal tissues for water storage and their outer parts to reduce water loss and damage by grazing and browsing animals. They can remain vigorous in hot, dry conditions that cause most other plants to lose vigour or even die. Some species develop underground bulbs that enable the plant to resist fire and mechanical damage.

Prickly pear species reproduce both sexually and asexually. Birds and other animals readily eat the many-seeded fruits and deposit seeds in their droppings. The seeds have hard seed coats that allow them to survive heat and lack of water. Asexual reproduction (cloning) of prickly pear occurs when pads (joints, segments) or fruits located on the ground take root and produce shoots. Animals and floods move broken pads long distances. These pads can survive long periods of drought before weather conditions allow them to set roots.

Habitat and distribution

Prickly pear species considered pests in Queensland are:

- Common pest pear — *Opuntia stricta* var. *stricta* (= *O. inermis*)
- Spiny pest pear — *Opuntia stricta* var. *dillenii* (= *O. stricta*)
- Tiger pear — *Opuntia aurantiaca*
- Drooping tree pear — *Opuntia vulgaris* (= *O. monacantha*)
- Velvety tree pear — *Opuntia tomentosa*
- Westwood pear — *Opuntia streptacantha*
- Devil's rope pear — *Opuntia imbricata*
- Coral cactus — *Opuntia cylindrica*
- Snake cactus — *Opuntia fulgida* = *O. imbricata*
- Sword pear — *Acanthocereus pentagonus*

Common pest pear (*Opuntia stricta* var. *stricta*)

This bushy, spreading plant grows up to 1.5 m high and forms large clumps. The stems are divided into oval, blue-green spineless pads 20 cm long and 10 cm wide. Areoles are in diagonal lines along the pads 2.5 cm to 5 cm apart and have a cushion of brown wool containing bristles but usually no spines. When spines occur they are stout, yellow and up to 4 cm long.

Common pest pear produces flowers that are 7.5 cm wide, bright lemon yellow and green at the base. The fruit is oval-shaped, has a deep cavity on one end and tapers at the other. It is purple, 6 cm long and 3 cm wide, with carmine-coloured (dark red) seeds and a fleshy pulp.

Common pest pear is found as small to large clumps of varying density. The clumps are usually broken up by the action of *Cactoblastis cactorum*. Common pest pear occurs throughout most of central and southern Queensland and is still spreading westwards. It is often found along beaches and on offshore islands.

Spiny pest pear (*Opuntia stricta* var. *dillenii*)

This succulent shrub grows 1–2 m high. The stems are hairless and bluish-green or dull green. The stems are divided into pads up to 30 cm long, 15 cm wide and 1–2 cm thick. The areoles have tufts of short and finely barbed bristles accompanied by one or two yellow spines between 2 cm and 4 cm long. Small scale-like leaves are found on areoles of immature pads.

Spiny pest pear produces 6–8 cm wide flowers that are lemon yellow with green or pink markings on the back. The fruit is pear-shaped and about 4–6 cm long with a red-purple skin. The areoles located on fruits have fine, barbed bristles. The red flesh of fruits contains rounded seeds that are yellow or pale brown.

While this prickly pear once formed large-scale dense infestations, it is now found as small clumps or as scattered plants. These clumps are usually broken by the action of *Cactoblastis cactorum*. It is found in eastern central Queensland, the Burnett district, the Darling Downs and south-eastern Queensland.

Tiger pear (*Opuntia aurantiaca*)

This succulent low shrub with underground tubers usually grows 30–60 cm high. The stems are divided into very spiny, slightly flattened pads that are 1–30 cm long and 1–5 cm wide. The stems are dark green to purple and red in colour. The areoles have 3–7 brown barbed spines up to 4 cm long surrounded by tufts of short, fine bristles. The pads detach easily and are transported on the skins of animals. Small and scale-like leaves are found on areoles of immature pads.

Tiger pear produces 6 cm wide yellow flowers. The rarely formed fruits are pear-shaped and about 2.5 cm long. When ripe, they are red with purple markings.

Dense tiger pear forms an impenetrable spiny groundcover and is prevalent in southern Queensland but extends into central Queensland.

Drooping tree pear (*Opuntia vulgaris*)

This erect succulent shrub with fibrous roots grows up to 5 m high but is usually 2–3 m high. The branches are divided into glossy light green pads up to 45 cm long, 15 cm wide and 1.5 cm thick. The dark grey trunk grows up to 25 cm in diameter. Drooping tree pear gets its name because the upper segments tend to droop. The areoles on the older pads have 1–5 sharp spines about 5 cm long.

Small, scale-like leaves are found on areoles of very young pads and are quickly shed as the pad grows. Drooping tree pear produces yellow flowers that are 6 cm wide and have red markings on the back. The fruit is pear-shaped and 4–7 cm long with a green skin. The flesh of the fruit is red and pulpy and contains round seeds that are yellow or pale brown. The fruits have areoles with tufts of fine, barbed bristles.

Dense thickets result when drooping tree pear is allowed to grow freely. Small scattered infestations occur in the south-east corner of Queensland and in coastal northern Queensland.

Velvety tree pear (*Opuntia tomentosa*)

This tree-like plant forms a central woody trunk over 40 cm wide and grows up to 5 m high. The stems are divided into oblong pads that are dull green and velvety to touch due to the dense covering of short fine hairs. The pads are 15–35 cm long, 8–12 cm wide and 1.5–2 cm thick.

Young plants have 2–4 white or pale yellow spines located in the areoles with one spine reaching a length of 2.5 cm. The areoles usually become spineless as the plant matures. A more spiny variety does exist and has more than 50 spines in each areole on the trunk.

The flowers are a deep orange. The fruit is egg-shaped, about 5 cm long and 3 cm wide, and dull red. The top of the fruit is saucer-shaped with circular lines that meet in the centre and give the fruit a shrivelled appearance. The fruit produces many seeds within a reddish pulp.

Velvety tree pear is found predominantly throughout the brigalow belt of Queensland and is still extending its range. It is occasionally found as dense shrubs, but more usually as small clumps of trees or as trees scattered over the landscape.

Westwood pear or Cardona pear (*Opuntia streptacantha*)

Westwood pear is a shrub-like or tree-like plant that forms clumps by branching from the base and is usually 2–4 m high. The stems are divided into almost circular dull green pads, 25–30 cm long and 15–20 cm wide. The areoles have white spines that vary in number and size when the plant matures.

Young pads have 2–5 white spines 1–2 cm long, accompanied by two hair-like spines 0.5 cm long in the lower part of the areole. Spines increase in number (up to 20) and size (5 cm long) in areoles along the trunk of the plant.

The flowers are yellow and fruits are barrel-shaped, 6 cm long and 5 cm wide with a flat top. The fruit has a purple skin and a rind that is 1 cm thick. Fruits contain red seeds buried in a dark red (carmine) pulp.

Westwood pear is found in eastern central Queensland as small clumps or as plants scattered over the landscape.

Devil's rope pear (*Opuntia imbricata*)

This open-branching shrub grows 1.5–3 m high. The stems are divided into hairless, dull green, cylindrical pads that vary up to 37 cm in length and are 3.5–5 cm thick. The pads have a series of short raised ridges that give them a twined, rope-like appearance. The areoles are found on these ridges and produce 3–11 pale yellow or white spines, with the longest being 2.5 cm long. Papery sheaths cover these spines.

The flowers are a dull, red-purple colour and found at the ends of pads. The yellow fruit resembles a small, 5 cm wide custard apple and has a spineless areole at the top.

Devil's rope pear occurs in Queensland as a small infestation at Gladfield.

3 **Prickly pear** *Opuntia, Nopalea* and *Austrocylindropuntia* spp.

Coral cactus (*Opuntia cylindrica*)

Coral cactus grows as a branching shrub 1–1.5 m high. The stems of coral cactus are divided into green cylinder-like pads that are fist-like and obtuse at their apex. Mature coral cactus pads widen, become distorted and wavy, and resemble a piece of coral. Areoles along the pads have a number of short white spines.

Coral cactus produces small (1–2 mm wide) scarlet flowers. The fruit is yellow-green and 2–5 cm wide.

Coral cactus has been located near Mount Isa, Longreach, Wyandra, Eulo and Hungerford but its potential spread includes all of far western Queensland.

Snake cactus (*Opuntia fulgida* × *O. imbricata*)

This open-branching shrub grows 1–2 m high. The stems are divided into hairless, dull green, cylindrical pads that vary up to 20 cm in length and are 3.5–5 cm thick. The pads have a series of short raised ridges that give them a twined rope-like appearance. The areoles are found on the bottom of these ridges and produce 5–10 pale yellow to brown spines, with the longest being 3 cm long.

The flowers are light red to dark rose and commonly 5–7 cm wide. Snake cactus produces fruit that is yellow and 2–5 cm wide.

Snake cactus has been located near Longreach but its potential spread includes all of north-western Queensland.

Sword pear (*Acanthocereus pentagonus*)

This elongated branching shrub grows in clumps up to 4 m high. The stems are erect, up to 1.5 m long, 3–8 cm wide and divided into many joints. Sword pear stems are three-angled, four-angled or five-angled and resemble star-picket posts. The areoles are found on the edges of the joints and produce many white spines 1–4 cm long.

The flowers are white, funnel-shaped and 14–20 cm long. The flowers open at night between spring and summer. Sword pear produces bright red sphere-shaped fruits that are 5 cm in diameter. The fruit has a red pulp and black seeds.

Sword pear occurs in the Gogango area west of Rockhampton.

Control

Biological control

Investigations into biological control agents against prickly pear began in 1912. Over 150 insect species were studied throughout the world, with 52 species selected for transport to Queensland. Following intensive host specificity testing, 18 insects and one mite were released in Queensland. Nine insects and the mite remain established in Queensland. These species are:

- *Cactoblastis cactorum*, a stem-boring moth
- *Dactylopius ceylonicus*, a cochineal mealy bug
- *Dactylopius opuntiae*, a cochineal mealy bug
- *Dactylopius confusus*, a cochineal mealy bug
- *Dactylopius tomentosus*, a cochineal mealy bug
- *Dactylopius austrinus*, a cochineal mealy bug
- *Chelinidea tabulata*, a cell-sucking bug
- *Tucumania tapiacola*, a stem-boring moth
- *Archlagocheirus funestus*, a stem-boring beetle
- *Tetranychus opuntiae*, prickly pear red spider mite.

These biological control agents continue to keep several prickly pear species under control. It is important to remember not all the agents attack all species.

The most successful of these agents were the moth *Cactoblastis cactorum* and five cochineal mealy bugs – *Dactylopius ceylonicus*, *D. opuntiae*, *D. confusus*, *D. tomentosus* and *D. austrinus*. The other agents are still around but not in sufficient numbers to provide control.

Cactoblastis cactorum (cactoblastis moth)

Larvae of this moth were introduced from Argentina in 1925. Cactoblastis proved to be the most effective agent against the common and spiny pest pears, destroying massive infestations in Australia. Larvae keeps these two pest pears controlled to an acceptable level most of the time, although it is less effective in some coastal and far western areas.

The larvae collectively eat out the contents of the pads, leaving empty pad skins and piles of mushy droppings. The orange and black larvae are occasionally observed on the outsides of pads. Cactoblastis also attacks most types of prickly pear but is not effective against them.

Dactylopius spp. (cochineal insects)

All female cochineal insects are small, sessile mealy bugs that spend their adult lives permanently attached to their host plants sucking plant juices. They are covered by a fine, white, waxy secretion and when crushed yield a carmine colouring. The adult males are small, free-flying insects that do not feed.

Dactylopius ceylonicus (monacantha cochineal, Argentine cochineal)

This South American mealy bug was released in 1914 and 1915 to control drooping tree pear. It destroyed the dense infestations existing at that time. It is specific to drooping tree pear and today remains the only effective biological control agent for drooping tree pear. This insect needs to be distributed manually.

***Dactylopius opuntiae* (prickly pear cochineal)**

This mealy bug was introduced from Mexico and southern United States between 1920 and 1922. It is effective against common pest pear, spiny pest pear, velvety tree pear and Westwood pear and remains the main biological control agent against velvety tree pear and Westwood pear. This insect spreads slowly in nature and can be assisted manually.

***Dactylopius confusus* (prickly pear cochineal)**

This mealy bug was introduced from Florida and released in 1933 against spiny pest pear. It remains effective against spiny pest pear in central Queensland but spreads slowly. This insect can be spread manually.

***Dactylopius tomentosus* (devil's rope pear cochineal)**

This mealy bug was introduced from southern United States in 1925 and 1926. It is effective against devil's rope pear but works slowly.

Dactylopius austrinus (tiger pear cochineal)

This mealy bug was introduced from Argentina in 1932. It is specific to and effective against tiger pear. It rapidly reduces tiger pear populations but dies out in a paddock after the destruction of tiger pear. It needs to be reintroduced after tiger pear regrows.

***Chelinidea tabulata* (prickly pear bug)**

This plant-sucking bug was introduced from Texas in 1921. It was effective against dense common pest pear before *Cactoblastis cactorum* was but is now relatively ineffective. This insect also attacks most other prickly pears. The adult is a pale brown bug up to 20 mm long that leaves characteristic round bleached spots on the surface of the cactus.

***Tucumania tapiacola* (prickly pear moth-borer)**

This moth was introduced from Argentina in 1934 against tiger pear. Its solitary larvae feed internally and eat out tiger pear pads with limited effect. It has been observed attacking common pest pear and harrisia cactus.

***Archlagocheirus funestus* (tree pear beetle)**

This stem-boring beetle was introduced from Mexico in 1935. It was effective against velvety tree pear and Westwood pear but has become rare since the dense stands of these prickly pears have gone.

***Tetranychus opuntiae* (prickly pear spider mite)**

This mite was introduced from southern United States and Mexico in 1922. It was effective against common pest pear but is now rare and difficult to find. It causes distinctive scar tissue formation around areoles.

Distributing biological control agents

Cactoblastis

Cactoblastis can be spread manually by distributing eggs or larvae. Cactoblastis moths lay chains of eggs (eggsticks) on prickly pear pads from January to February and from September to November. The eggsticks are distinguished from spines by their curved appearance.

1. Collect the fragile eggsticks carefully.
2. Glue single eggsticks to small pieces of paper using a starch-based adhesive.
3. Pin the egg papers to prickly pear pads. (Eggs take up to one month to hatch.)
4. Collect pads or plants in which larvae are obviously still active.
5. At a release site place all the collected plant material in a small part of the infestation.
6. Subsequent generations of moths will disperse through the infestation.
7. Follow up the biological control with either herbicide or mechanical treatment.

Cochineals

Because several cochineal insects affect some prickly pears and not others, it is essential to know what prickly pear you wish to control.

1. Identify your prickly pear type.
2. Find the same prickly pear type which is being attacked by a cochineal.
3. Collect pads of the prickly pear with the insects.
4. Place affected pads against unaffected prickly pears at the release site.
5. Follow up the biological control with either herbicide or mechanical treatment.

Tiger pear cochineal

Tiger pear cochineal is easy to multiply quickly after collection.

1. Carefully collect a reasonable quantity of unaffected tiger pear in a container (box or bucket).
2. Place a few pieces of cochineal-affected tiger pear into the same container.
3. Cover the container with a cloth and store under cover for a few weeks.
4. Check the cactus occasionally.
5. When most of the tiger pear in the container has cochineal, it is ready to distribute.
6. At the release site place affected pads against unaffected prickly pears.
7. Follow up the biological control with either herbicide or mechanical treatment.

Note: It is best to multiply tiger pear cochineal before release.

5 **Prickly pear** *Opuntia*, *Nopalea* and *Austrocylindropuntia* spp.

Mechanical control

Mechanical control using machinery is difficult because prickly pear pads can easily re-establish. A hot fire is an effective control method for dense prickly pear infestations. Before burning, consult Biosecurity Queensland to see if this practice is suitable for your pasture and land management practices.

Herbicide control

Herbicide options available for the control of prickly pears in Queensland are shown in Table 1.

Landholders and contractors should check if the property is in a hazardous area as defined in the *Agricultural Chemicals Distribution Control Act 1966* prior to spraying.

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 the control of prickly pears

Pest name	Situation	Herbicide	Rate	Method
Common prickly pear	Agricultural land—non-crop	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	
	Forests—timber production	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (300 g/L) + picloram (300 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
			3 L/100 L or 1 L/75 L diesel	Foliar
	Land—commercial/industrial (public)	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (300 g/L) + picloram (300 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
			3 L/100 L or 1 L/75 L diesel	Foliar
	Land—non-agricultural	Triclopyr (300 g/L) + picloram (300 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
	Land—rights of way	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (300 g/L) + picloram (300 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
			3 L/100 L or 1 L/75 L diesel	Foliar
	Pastures	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (300 g/L) + picloram (300 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
			3 L/100 L or 1 L/75 L diesel	Foliar
Coral cactus	Agricultural non-crop areas, fence lines and forestry	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump Apply as an overall spray, wetting all areas of the plant to ground level
	Commercial/industrial areas, rights-of-way and pastures	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel See permit PER13812 (expires 30 November 2017)	Basal bark/cut stump

Continued

Pest name	Situation	Herbicide	Rate	Method
Tiger pear	Agricultural land—non-crop	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	
	Forests—timber production	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
			3 L/100 L or 1 L/75 L diesel	Foliar
	Land—commercial/ industrial/public	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
			3 L/100 L or 1 L/75 L diesel	Foliar
	Land—non-agricultural	Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
	Land—rights of way	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
			3 L/100 L or 1 L/75 L diesel	Foliar
	Pastures	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
			3 L/100 L or 1 L/75 L diesel	Foliar
Drooping tree pear	Agricultural land—non-crop	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (600 g/L)	0.8 L/60 L diesel	
	Forests—timber production	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (300 g/L) + picloram (100 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	0.8 L/60 L diesel	Basal bark/cut stump
			1 L/75 L diesel	Foliar
	Land—around buildings	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
	Land—commercial/ industrial/public	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
		Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (300 g/L) + picloram (100 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	0.8 L/60 L diesel	Basal bark/cut stump
			1 L/75 L diesel	Foliar
	Land—non-agricultural	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
		Triclopyr (300 g/L) + picloram (100 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	0.8 L/60 L diesel	Basal bark/cut stump
	Land—rights of way	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	Basal bark/cut stump
		Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	
		Triclopyr (300 g/L) + picloram (100 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	0.8 L/60 L diesel	Basal bark/cut stump
			1 L/75 L diesel	Foliar

Continued

1 **Prickly pear** *Opuntia, Nopalea and Acanthocereus* spp.

Pest name	Situation	Herbicide	Rate	Method
Drooping pear	Pastures	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (300 g/L) + picloram (100 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	0.8 L/60 L diesel	Basal bark/cut stump
			1 L/75 L diesel	Foliar
Velvety tree pear	Agricultural land—non-crop	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
	Forests—timber production	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
	Land—around buildings	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
Velvety tree pear	Land—commercial/industrial/public	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
		Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
	Land—non-agricultural	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
	Land—rights of way	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
		Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
	Pastures	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
Spiny pest pear Westwood pear Devil's rope pear Snake cactus	Agricultural land—non-crop Forests—timber production Land—commercial/industrial/public Land—rights of way Pastures	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump

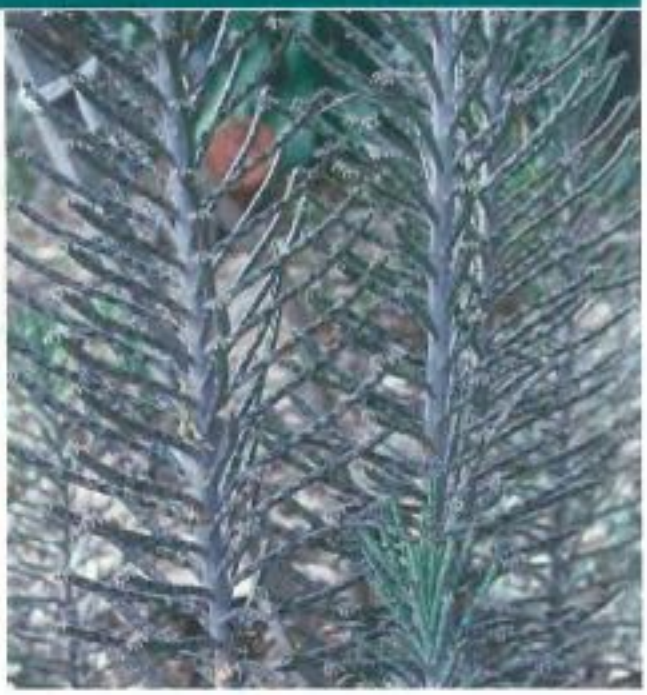
This fact sheet is developed with funding support from the Land Protection Fund.

Department of Agriculture, Fisheries and Forestry
Biosecurity Queensland

Fact sheet
DECLARED CLASS 2 PEST PLANT

Mother-of-millions

Bryophyllum delagoense (syn. *B. tubiflorum*, *Kalanchoe delagoensis*), *Bryophyllum* × *houghtonii* (syn. *B. daigremontianum* × *B. delagoense*, *Kalanchoe* × *houghtonii*)



Mother-of-millions are native to Madagascar and are escaped ornamental plants. Five species are commonly naturalised in Queensland. It is well adapted to dry areas because of its succulent features.

As the name suggests, one plant can reproduce a new generation from masses of embryoids (plantlets) that are formed on the leaf edges. This makes these plants hard to eradicate and follow up controls are essential.

These plants, especially their flowers, are poisonous to stock and occasionally cause a significant number of cattle deaths. When cattle are under stress or in unusual conditions they are more likely to eat plants that they would not normally eat. Shifting cattle to new paddocks, moving stock through infested rubbish dumps and wastelands, and reduction of availability of feed due to flood or drought can all contribute to cattle eating mother-of-millions and being poisoned. The plant flowers from May to October (during the drier months of the year) and the scarcity of feed at this time may cause cattle to consume lethal amounts of mother-of-millions.

Poisoned cattle show signs of dullness, loss of appetite, diarrhoea and heart failure. Some cattle may drool saliva or dribble urine. There are two responses to poisoning:

1. acute—where cattle die within a day
2. chronic—where cattle may take up to five days to die.

Some cattle may make a slow recovery if insufficient plant material was eaten.

Poisoned cattle must be treated within 24 hours of consuming the plant. The treatment is intense and needs to be given by a veterinarian, or under their direction, because of the drugs and materials used. The treatment is costly—$70 or more for one adult cow, plus veterinary fees.

Declaration details

Bryophyllum delagoense syn. *B. tubiflorum*, *Kalanchoe delagoensis* and the hybrid *Bryophyllum* × *houghtonii* syn. *B. daigremontianum* × *delagoense*, *Kalanchoe* × *houghtonii* are declared Class 2 plants under the *Land Protection (Pest and Stock Route Management) Act 2002*.

Great state. Great opportunity.

Queensland Government

A Class 2 pest is one that has already spread over substantial areas of Queensland, but its impact is so serious that there is a need to try and control it and avoid further spread onto properties that are still free of the pest. By law, all landholders must try to keep their land free of Class 2 pests and it is an offence to keep or sell these pests without a permit. A local government may serve a notice upon a landholder requiring control of declared pests.

Description and general information

Mother-of-millions are erect, smooth, fleshy succulent plants growing to 1 m or more in height.

All species form tall flower spikes in winter with clusters of bell-shaped flowers. Each species has a distinctive leaf shape, but all produce small plantlets along the edges of the leaves. These plantlets drop readily, develop roots and establish quickly to form a new colony.

Bryophyllum delagoense syn. *B. tubiflorum* and *Kalanchoe delagoensis* (common mother-of-millions, mission bells, Christmas bells) has grey-brown, fleshy, tubular like leaves with up to seven projections at the tip of each leaf. The flowers are orange-red and occur in a cluster at the top of a single stem. Seeds can germinate for some years.

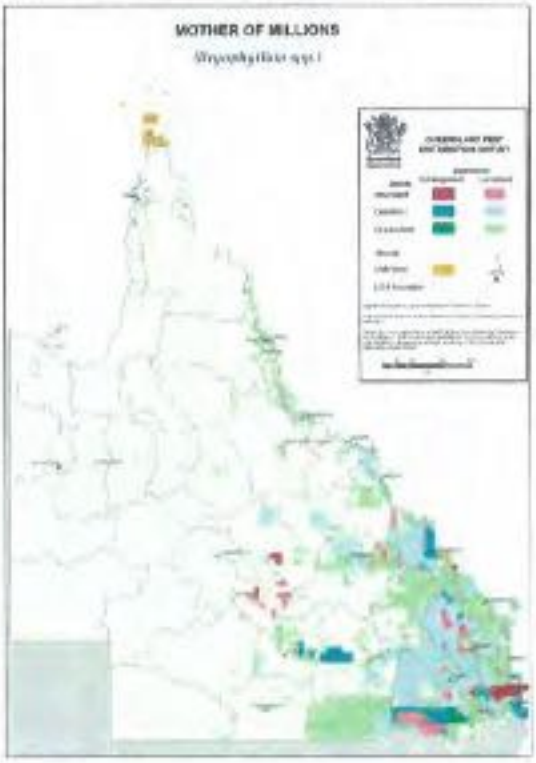
Bryophyllum × *houghtonii* syn. *B. daigremontianum* × *B. delagoense*, *Kalanchoe* × *houghtonii* (hybrid or crossbred mother-of-millions) has similar flowers arranged in a branched cluster at the top of the stem. Its leaves are boat shaped with thick stalks and notches along the edges of the leaves.

A third species, *Bryophyllum pinnatum* (resurrection plant, live-leaf), is also problematic but is not a declared pest plant. This plant has yellow-green, oval, fleshy leaflets with wavy edges and up to five leaflets per leaf. Its flowers are yellowish-green, often tinged with pink, and occur in loose clusters on stalks growing at intervals along the upper portion of the stem.

Habitat and distribution

These popular garden plants have escaped cultivation and spread in various areas of Queensland. They have become a problem in pasture lands in the central highlands around Clermont, Emerald and Dingo, and the Burnett, Moreton and Darling Downs scrub regions. The plants establish well in leaf litter or other debris on shallow soils in shady woodlands, and often grow on roadsides, along fence lines and around old rubbish dumps. They can spread from these areas, especially in flood, and establish if pastures are run down. They are adapted to dry conditions and can survive long periods of drought.

Map 1. Distribution of mother-of-millions in Queensland



Prevention

The best form of weed control is prevention. Always treat weed new infestations when small—do not allow weeds to establish. Weed control is not cheap, but it is cheaper to do it now rather than next year, or the year after. Proper planning ensures better value for each dollar spent.

Permanent control of mother-of-millions infested areas is best ensured by establishing more desirable plants in that location to compete successfully with future mother-of-millions seedlings and plantlets. This is best achieved through soil preparation, replanting, fertilising and using the area more productively.

Ensure scattered infestations and small dumping areas on properties are regularly checked and cleaned up. Day-to-day hygiene management will help prevent establishment of these weeds.

Co-operative control upstream and downstream of problem areas will help prevent re-infestation from other areas.

To prevent poisoning, keep stock (especially hungry stock) away from infested areas until the plants are controlled.

2 **Mother-of-millions** *Bryophyllum* spp.

Control

Lock at weed problems carefully. Decide whether to contain the weed to stop new infestations developing while reducing existing weeds. Determine what weed control is required by legislation. Determine how weed control fits into your property management. What can be done to restore and prevent re-establishment?

The best approach is usually to combine different methods. Control may include chemical, mechanical, fire and biological methods combined with land management changes. The control methods chosen should suit the specific weed and particular situation.

Fire

When suitable (e.g. after grading firebreaks), burn infestations and the accompanying debris on which mother-of-millions plants thrive. This is the most economical form of control, encourages grass competition and lessens the problem for following years, requiring only spot spraying with selective herbicides.

Biological control

The South African citrus thrips is present in Queensland and is quite widespread through the south of the state. The thrip damages the outer tissue of the mother-of-millions plant and also lays its eggs under the outer tissue. Where high populations of thrips exist, the number of viable plantlets and flowers forming on mother-of-millions is reduced.

The thrips populations vary from year to year, according to mother-of-millions populations and climate. The South African citrus thrips should not be seen as a long term control strategy—only a control option to complement other techniques such as herbicide treatment and burning.

Mechanical control

For small areas, pull up plants by hand and burn on a wood heap. Alternatively, bag the plants and dump them in a bin, the contents of which are buried at council refuse tips rather than being recycled into mulch.

Herbicide control

Before using any herbicide always read the label carefully. All herbicides must be applied strictly in accordance with the directions on the label. Where the addition of a wetting agent is recommended, always use a commercial wetting agent or surfactant.

Mother-of-millions may be controlled with herbicides at any time of the year, but infestations are easiest to see in winter when the plants are in flower. Treating infestations at this time of year also has the benefit of preventing new seeds from developing on common mother-of-millions.

Table 1 details the herbicides registered for mother-of-millions control.

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).

South African citrus thrips adult

South African citrus thrips damage to mother-of-millions

Table 1. Herbicides registered for the control of mother-of-millions

Situation	Herbicide	Rate	Comments[1]
Pastures, non-crop land	2,4-D acid (AF 300)	7 L/1000 L water per ha 70 ml/10 L water	Overall spray handgun Overall spray knapsack
Pastures, rights of way, non-crop land, forests, non-agricultural land, commercial/industrial areas	picloram + triclopyr (e.g. Grass-ap, Grazon DS, Picker)	50 ml/10 L water	Overall spray knapsack Apply at flowering
	fluroxypyr	600 ml/100 L water + surfactant	Apply to seedlings and young plants before flowering
	picloram + triclopyr + aminopyralid (e.g. Grazon Extra)	50 ml/10 L water	Add 100% concentrate non-ionic surfactant (e.g. BS 1000) at 100 ml/100 L water Apply at flowering

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

Note: 1. Thorough, even coverage of leaves and plantlets is necessary.

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

Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Status: All
Records: All
Date: Since 1980
Latitude: [redacted]
Longitude [redacted]
Distance: 10
Email: [redacted]
Date submitted: Monday 15 Dec 2014 11:31:02
Date extracted: Monday 15 Dec 2014 11:40:26

The number of records retrieved = 88

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
animals	birds	Acanthizidae	*Acanthiza nana*	yellow thornbill		C		2
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		1
animals	birds	Anatidae	*Chenonetta jubata*	Australian wood duck		C		1
animals	birds	Anatidae	*Cygnus atratus*	black swan		C		1
animals	birds	Anatidae	*Anas superciliosa*	Pacific black duck		C		1
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		1
animals	birds	Artamidae	*Cracticus tibicen*	Australian magpie		C		5
animals	birds	Artamidae	*Artamus personatus*	masked woodswallow		C		1
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		1
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		1
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		3
animals	birds	Cacatuidae	*Eolophus roseicapillus*	galah		C		1
animals	birds	Cacatuidae	*Nymphicus hollandicus*	cockatiel		C		3
animals	birds	Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike		C		1
animals	birds	Climacteridae	*Climacteris picumnus*	brown treecreeper		C		2
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		3
animals	birds	Columbidae	*Geopelia humeralis*	bar-shouldered dove		C		1
animals	birds	Columbidae	*Geopelia striata*	peaceful dove		C		2
animals	birds	Corvidae	*Corvus coronoides*	Australian raven		C		1
animals	birds	Corvidae	*Corvus sp.*					2
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		5
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		2
animals	birds	Falconidae	*Falco cenchroides*	Nankeen kestrel		C		1
animals	birds	Falconidae	*Falco berigora*	brown falcon		C		1
animals	birds	Maluridae	*Malurus lamberti*	variegated fairy-wren		C		3
animals	birds	Maluridae	*Malurus cyaneus*	superb fairy-wren		C		4
animals	birds	Megaluridae	*Megalurus timoriensis*	tawny grassbird		C		1
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		2
animals	birds	Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater		C		3
animals	birds	Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater		C		1
animals	birds	Meliphagidae	*Manorina melanocephala*	noisy miner		C		2
animals	birds	Meliphagidae	*Meliphaga lewinii*	Lewin's honeyeater		C		1
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		1
animals	birds	Meliphagidae	*Gavicalis virescens*	singing honeyeater		C		1
animals	birds	Monarchidae	*Myiagra rubecula*	leaden flycatcher		C		1
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		4
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		2
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		2
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		1
animals	birds	Phalacrocoracidae	*Microcarbo melanoleucos*	little pied cormorant		C		1
animals	birds	Phasianidae	*Coturnix ypsilophora*	brown quail		C		1
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		1
animals	birds	Psittacidae	*Trichoglossus haematodus moluccanus*	rainbow lorikeet		C		1
animals	birds	Ptilonorhynchidae	*Ptilonorhynchus maculatus*	spotted bowerbird		C		1
animals	birds	Rhipiduridae	*Rhipidura albiscapa*	grey fantail		C		2
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		4

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Threskiornithidae	*Platalea regia*	royal spoonbill		C		1
animals	birds	Threskiornithidae	*Platalea flavipes*	yellow-billed spoonbill		C		1
fungi	sac fungi	Parmeliaceae	*Parmotrema praesorediosum*			C		2/2
plants	higher dicots	Aizoaceae	*Tetragonia tetragonoides*	New Zealand spinach		C		1/1
plants	higher dicots	Amaranthaceae	*Alternanthera*			C		1/1
plants	higher dicots	Amaranthaceae	*Alternanthera denticulata*	lesser joyweed		C		1/1
plants	higher dicots	Apiaceae	*Centella asiatica*			C		1/1
plants	higher dicots	Asteraceae	*Centipeda minima subsp. minima*			C		2/2
plants	higher dicots	Asteraceae	*Parthenium hysterophorus*	parthenium weed	Y			1/1
plants	higher dicots	Asteraceae	*Gnaphalium polycaulon*		Y			1/1
plants	higher dicots	Asteraceae	*Xanthium occidentale*		Y			1/1
plants	higher dicots	Asteraceae	*Aster subulatus*	wild aster	Y			1/1
plants	higher dicots	Asteraceae	*Soliva anthemifolia*	dwarf jo jo weed	Y			1/1
plants	higher dicots	Boraginaceae	*Heliotropium indicum*		Y			1/1
plants	higher dicots	Brassicaceae	*Rorippa eustylis*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Senna barclayana*			C		1/1
plants	higher dicots	Chenopodiaceae	*Einadia nutans subsp. linifolia*			C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena tetracuspis*	brigalow burr		C		1/1
plants	higher dicots	Chenopodiaceae	*Einadia polygonoides*	knotweed goosefoot		C		1/1
plants	higher dicots	Chenopodiaceae	*Atriplex semibaccata*	creeping saltbush		C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia hyssopifolia*		Y			1/1
plants	higher dicots	Fabaceae	*Glycine tabacina*	glycine pea		C		1/1
plants	higher dicots	Fabaceae	*Desmodium varians*	slender tick trefoil		C		1/1
plants	higher dicots	Fabaceae	*Tephrosia leptoclada*			C		1/1
plants	higher dicots	Fabaceae	*Sesbania cannabina var. cannabina*			C		1/1
plants	higher dicots	Lamiaceae	*Basilicum polystachyon*			C		1/1
plants	higher dicots	Onagraceae	*Ludwigia peploides subsp. montevidensis*			C		1/1
plants	higher dicots	Sclanaceae	*Solanum elachophyllum*			E		1/1
plants	higher dicots	Verbenaceae	*Glandularia aristigera*		Y			1/1
plants	higher dicots	Verbenaceae	*Stachytarpheta jamaicensis*	Jamaica snakeweed	Y			1/1
plants	lower dicots	Papaveraceae	*Argemone mexicana*	prickly poppy	Y			1/1
plants	monocots	Alismataceae	*Damasonium minus*	starfruit		C		1/1
plants	monocots	Alismataceae	*Caldesia oligococca*			C		1/1
plants	monocots	Cyperaceae	*Cyperus pygmaeus*	dwarf sedge		C		2/2
plants	monocots	Cyperaceae	*Fimbristylis aestivalis*			C		1/1
plants	monocots	Juncaginaceae	*Cycnogeton dubius*			C		1/1
plants	monocots	Najadaceae	*Najas tenuifolia*	water nymph		C		1/1
plants	monocots	Poaceae	*Chloris gayana*	rhodes grass	Y			1/1
plants	monocots	Poaceae	*Walwhalleya subxerophila*			C		1/1
plants	monocots	Poaceae	*Eragrostis trichophora*		Y			1/1
plants	monocots	Poaceae	*Sporobolus elongatus*			C		1/1
plants	monocots	Poaceae	*Astrebla squarrosa*	bull mitchell grass		C		1/1

DES

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

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 ( ).

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).

ords – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).
a number is output as 9999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon
a number is output as 999 if it equals or exceeds this value

Department of Environment and Resource Management

Land Manager's Monitoring Guide

Ground cover indicator

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

Queensland Government

Prepared by:

Environment and Resource Sciences

Department of Environment and Resource Management

August 2010

Contents

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).

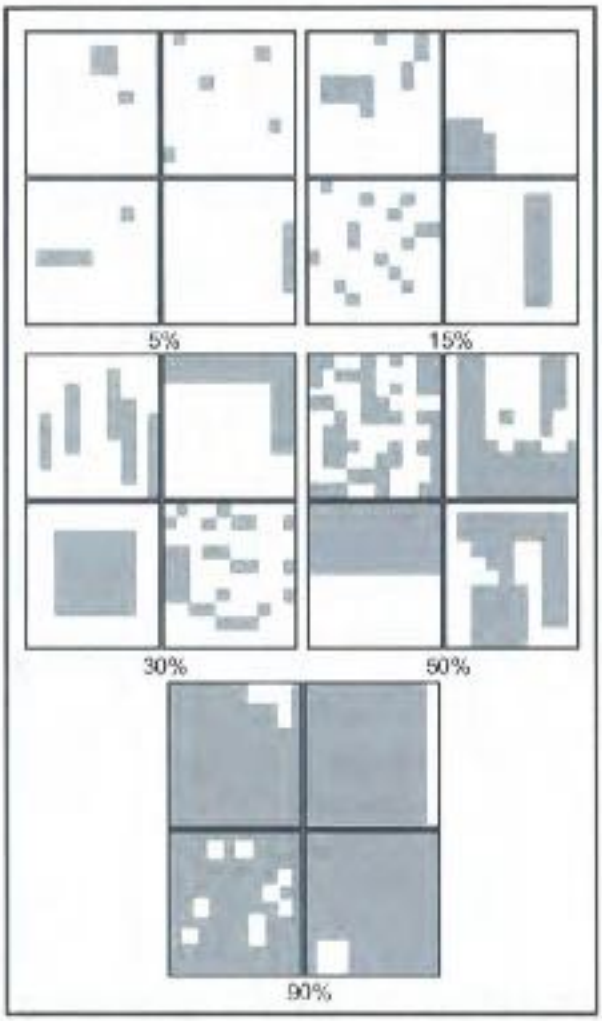


Figure 2: Examples of ground cover patterns as they appear in a quadrat for 5%, 15%, 30%, 50% and 90% cover (Department of Natural Resources 1997)

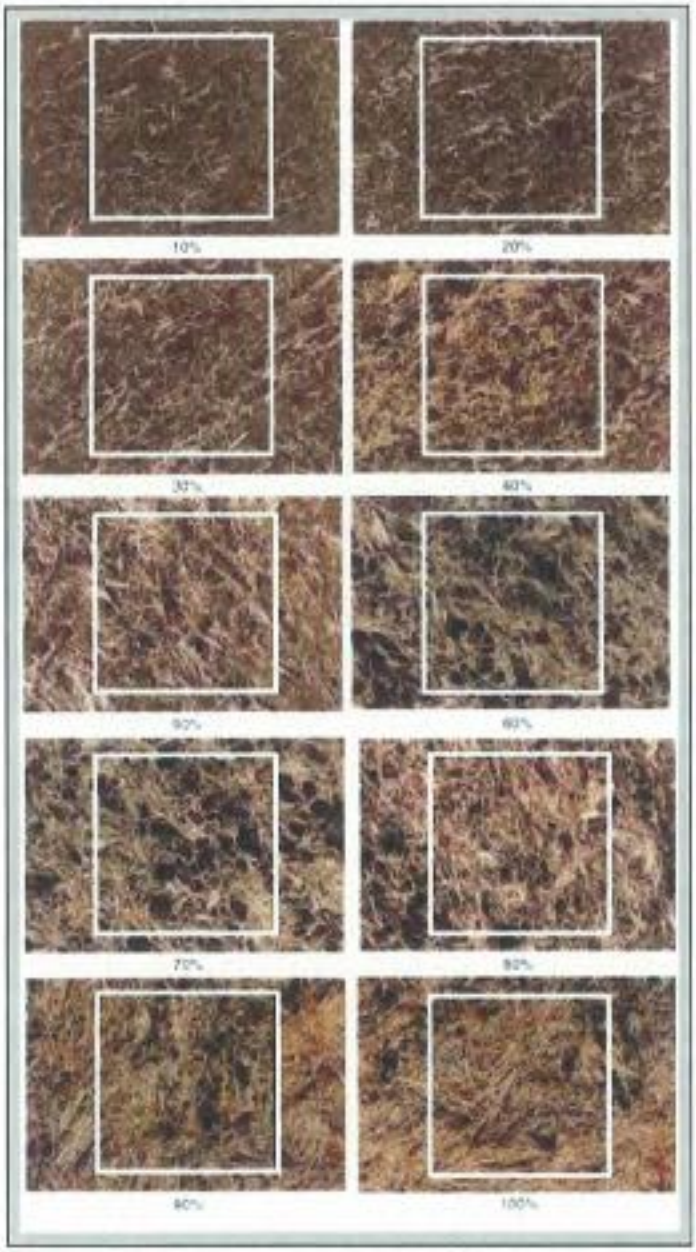


Figure 3: Photographs of wheat stubble cover levels in 10% increments (Molloy 1988)

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, Eastern 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 lead 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.

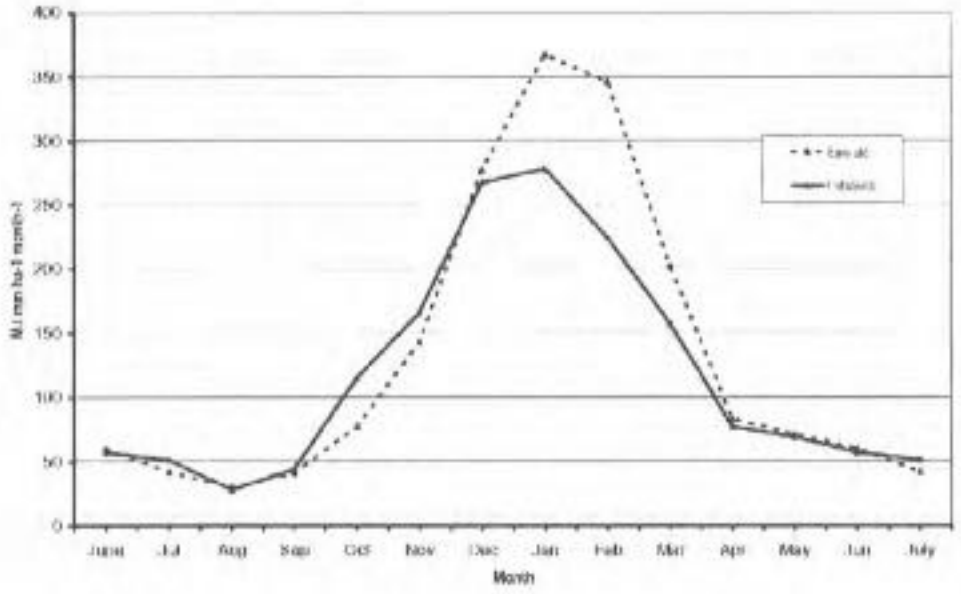


Figure 4: Average monthly rainfall erosivity values for Emerald and Pittsworth

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.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>.

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).

A Queensland Department of Environment and Resource Management state wide ground cover monitoring program reports annually on percentage of ground cover in Queensland based on Landsat imagery starting in 1988. This low cost imagery enables a more dynamic monitoring of ground cover by remote sensing and opens up new opportunities for monitoring and time series analysis of up to 20 images per year. Recent research by the Queensland Department of Environment and Resource Management (as at 2010) indicates that ground cover may soon be able to be monitored remotely and at low cost with the ability to distinguish between bare ground, green vegetation and dry (or non-green) vegetation cover.

The use of photopoints is recommended to support any system of assessing ground cover.

Use of photopoints – photographic records

It is preferable that a photographic record is kept for all ground cover monitoring sites. A sequence of photos taken annually from exactly the same location in a paddock can record changes in ground cover, woody plant populations and feed availability (Figure 1). They show the long-term effects of management as well as short-term changes caused by seasonal conditions and the effects of grazing management.

Photos should be taken on a clear day between 9 am and 3 pm. You will always get a better photo by having the sun behind your back. To do this you need to be facing south (in the Southern Hemisphere!). Photos can be taken from two angles: the 'trayback' and the 'landscape'.

The 'trayback' photo

This photo angle will best illustrate ground conditions and the amount of feed available in a pasture. A step ladder could be used as an alternative to a vehicle. The vehicle trayback is set up at the post from which the photo is being taken (Figure 5). Facing south, focus the middle of the viewfinder on the base of the sighter post.

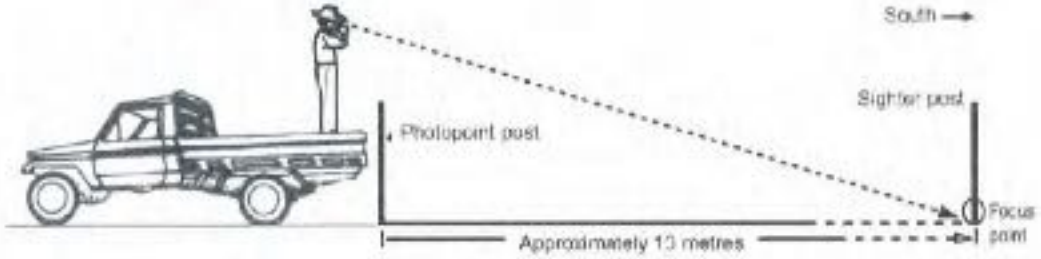


Figure 5: Taking the 'trayback' photo (Department of Natural Resources 1997)

The landscape photo

This photo angle will best illustrate the general condition of the site showing major changes in shrub and tree populations. Stand next to the photopoint post as in Figure 6. Position the top of the sighter post in the middle of the viewfinder and focus on infinity.

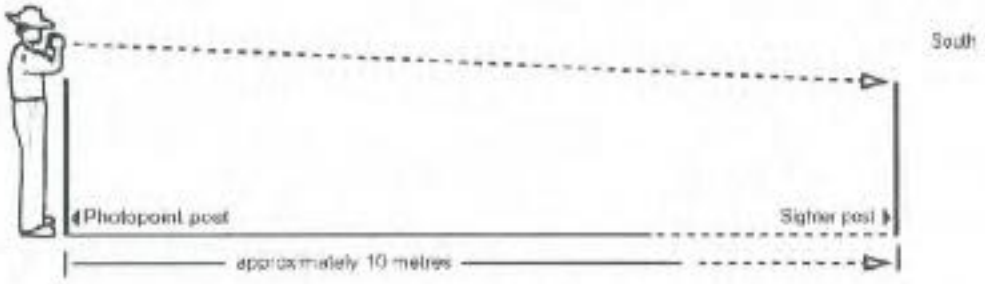


Figure 6: Taking the landscape photo (Department of Natural Resources 1997)

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 my 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.

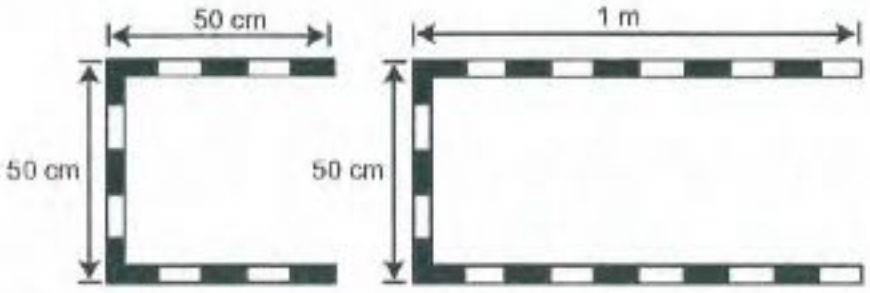


Figure 7: Two types of quadrats used for measuring ground cover

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 point 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.

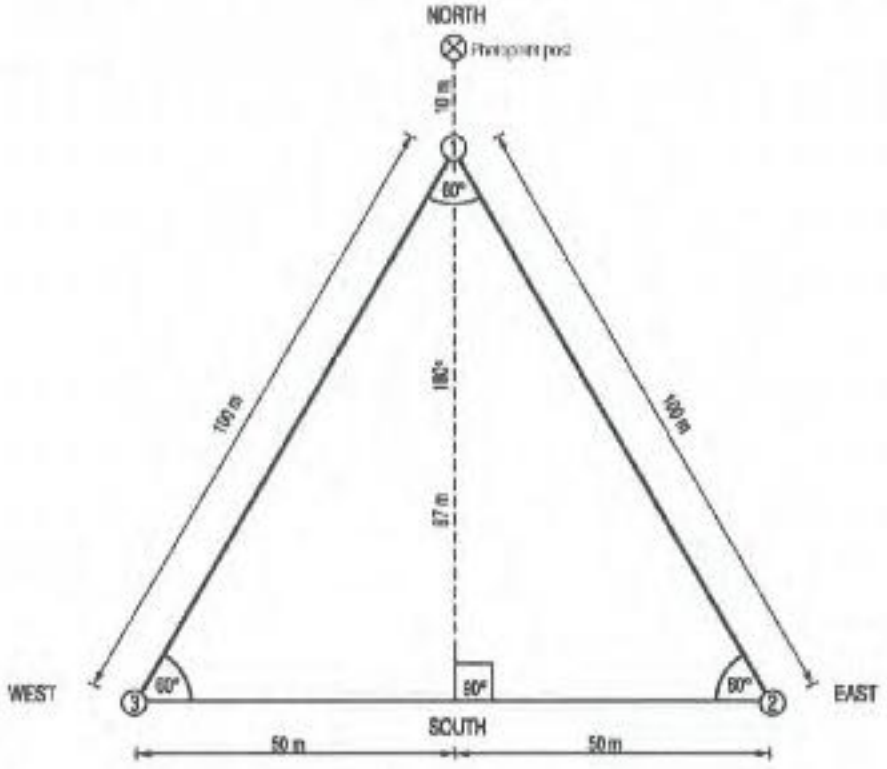


Figure 8: Approximate dimensions for a monitoring triangle

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 mulch. 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 at 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.

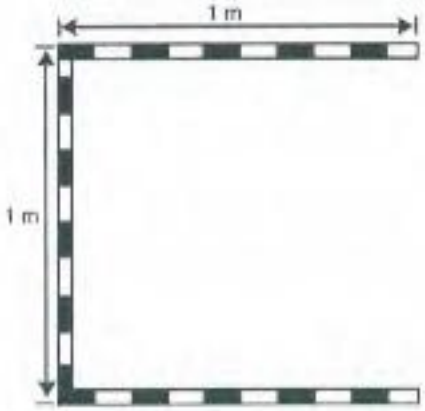


Figure 9: Quadrat recommended for use in measuring ground cover for BioCondition assessment

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.

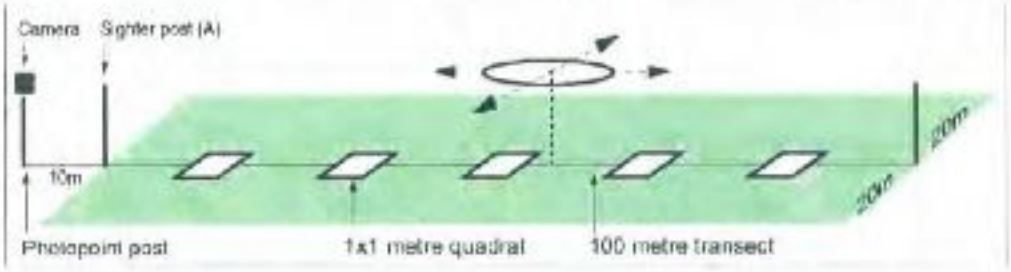


Figure 10: Standard monitoring site for BioCondition Assessment

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.

Maintaining 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).

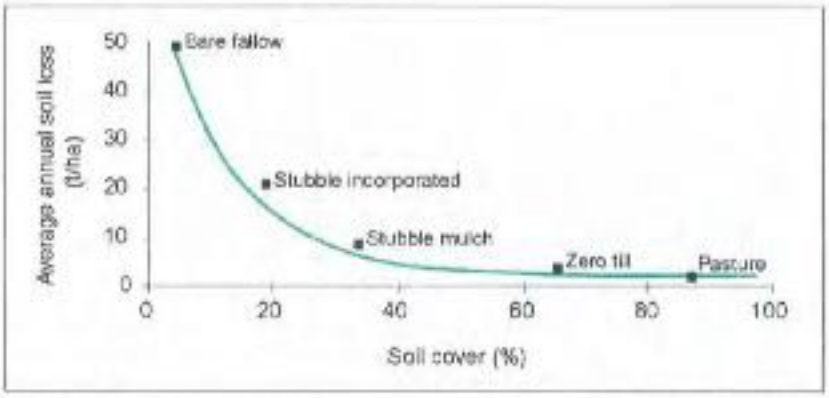


Figure 11: Annual average soil loss (1978–92) vs. cover for contour bay catchments on the eastern Darling Downs (Freebairn 2004)

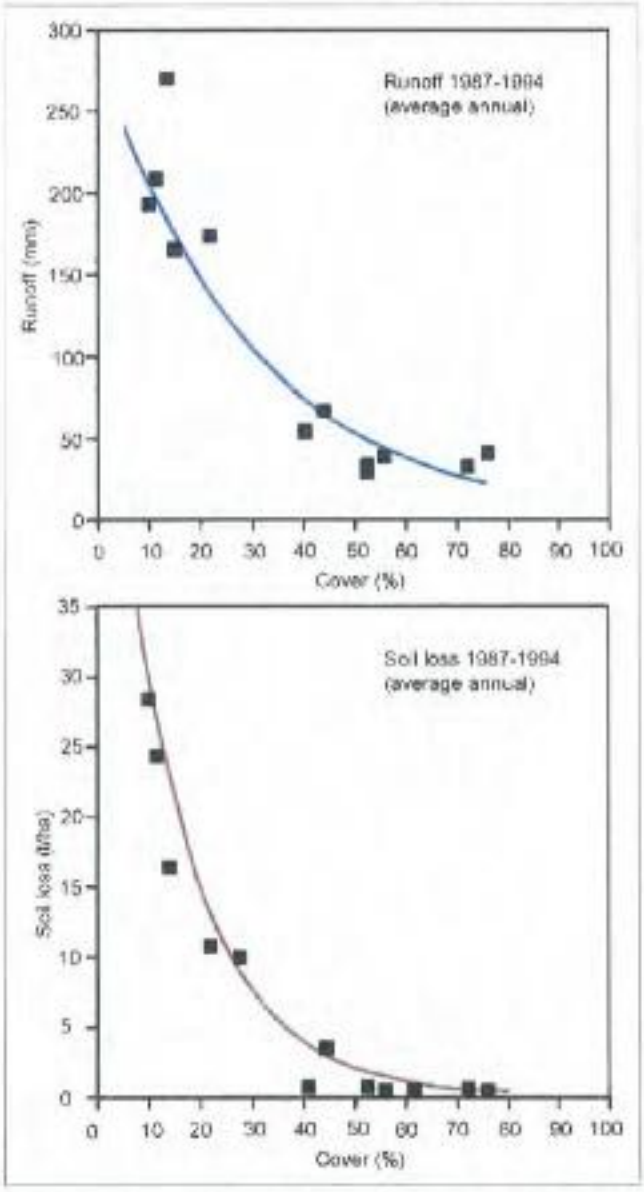


Figure 12: Average annual runoff and soil loss (1987–94) vs. ground cover for native pasture in Central Queensland (Mark Silburn, Queensland Department of Natural Resources and Water, pers. comm. 2005)

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.

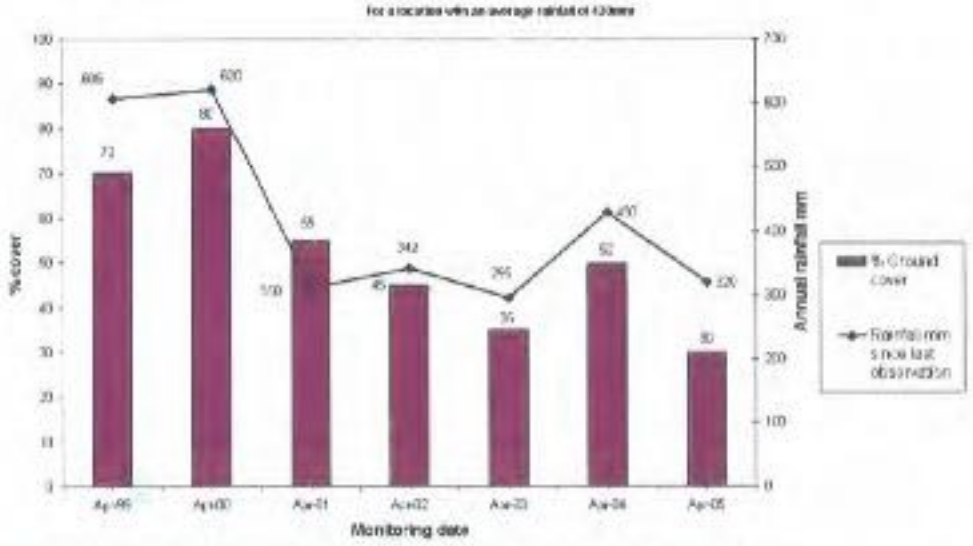


Figure 13: Rainfall and changes in pasture ground cover from 1999 to 2005

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

protection from erosion as well as providing organic matter to improve the water-holding capacity of the soil. Cover may also be provided by using a surface mulch of plant residue from crops such as pineapples and bananas while in many tree crops a grass sod is recommended beneath the trees.

Urban areas

In an established urban environment, adequate ground cover should be provided by appropriate landscaping. Vulnerable areas will be land that has been disturbed while it is undergoing development and areas subject to high rates of pedestrian traffic on land that has not been given adequate protection (e.g. school grounds often have bare areas where high rates of runoff and erosion may occur).

A range of specialised products including hydromulching and geotextiles can be used to provide surface cover and to manage runoff on development sites. Disturbed land in urban areas is sometimes protected by fast-growing vegetation such as millet (summer growing) or oats (winter growing). These plants provide protection while the soil is in a loose and friable condition. When these annual crops mature, the remaining stubble will continue to provide some protection and by this time the soil will have consolidated and be less prone to erosion.

Protected areas

Private landholders can assist with maintaining biodiversity by providing a nature refuge on their property with assistance provided by the Queensland Department of Environment and Resource Management. A nature refuge is established via a voluntary conservation agreement between a landholder and the Queensland Government. A nature refuge is a category of protected area under the *Nature Conservation Act 1992*.

Each agreement is tailored to suit the management needs of the particular area and the needs of the landholder. In most cases, the agreement allows for the ecologically sustainable use of natural resources to continue. A nature refuge can cover part or all of a property protecting wildlife and wildlife habitat and emphasising the conservation of biodiversity as an important part of property management.

Other information sources

Books

Boulter, SL, Wilson, BA, Westrup, J, Anderson, ER, Turner, EJ, and Scanlan, JC (Editors) 2000, *Native vegetation management in Queensland – Background science and values*, Queensland Department of Natural Resources.

Longway, DJ and Handley, NL 2005, *Landscape function analysis – Procedures for monitoring and assessing landscapes, with special reference to minesites and rangelands*, CSIRO Sustainable Ecosystems.

CD-ROMs

Department of Primary Industries 2003, *Pasture Photo Standards CD*, Queensland Department of Primary Industries, as available from the Queensland Government Bookshop <https://www.bookshop.qld.gov.au/> - Search for 'Pasture photo standards'.

PrimeNotes CD ROM Version 18 produced in May 2005 by the Queensland Department of Primary Industries and Fisheries contains over 5000 fact sheets about issues related to natural resource management and agricultural production. Fourteen agencies throughout Australia contributed information to the CD. This publication is available from some libraries.

Fact sheets

The Queensland Department of Environment and Resource Management has several fact sheets that are related to this topic:

- Soil limitation to water entry – understanding restrictive soil layers (L40)
- Erosion control in cropping land (L13)
- Erosion in school grounds (L42)
- Erosion control in grazing lands (L91)
- Managing for drought in grazing lands (L90)
- Identifying and monitoring salt-affected areas (L53)
- Catchments and water quality (C2)

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 DNRQ970102, 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 Q192009, 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.		*e.g. Ground cover at "specified property"*
Name of the land manager or business responsible for the dataset.		
Brief assessment of reliability of the information in the dataset.		*Record which method you have decided to use, e.g. Level 1, 2a or 2b monitoring plus brief description of the method*
Brief history of the source and processing steps used to produce the dataset.		*Record which method you have decided to use, e.g. Level 1, 2a or 2b monitoring plus brief description of the method*
Maintenance and update frequency of the dataset.		
What location or area does the data relate to.		*Provide property or other location details and/or GPS Eastings and Northings*

The Land Manager's Monitoring Guide

Indicator: Ground cover

Level 1 field recording sheet - visual observations

Date							Recorder
	Observation number					Average	
Paddock name	1	2	3	4	5	% cover	Comments

Indicator: Ground cover

Level 1 example field recording sheet - visual observations

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

Indicator: Ground cover

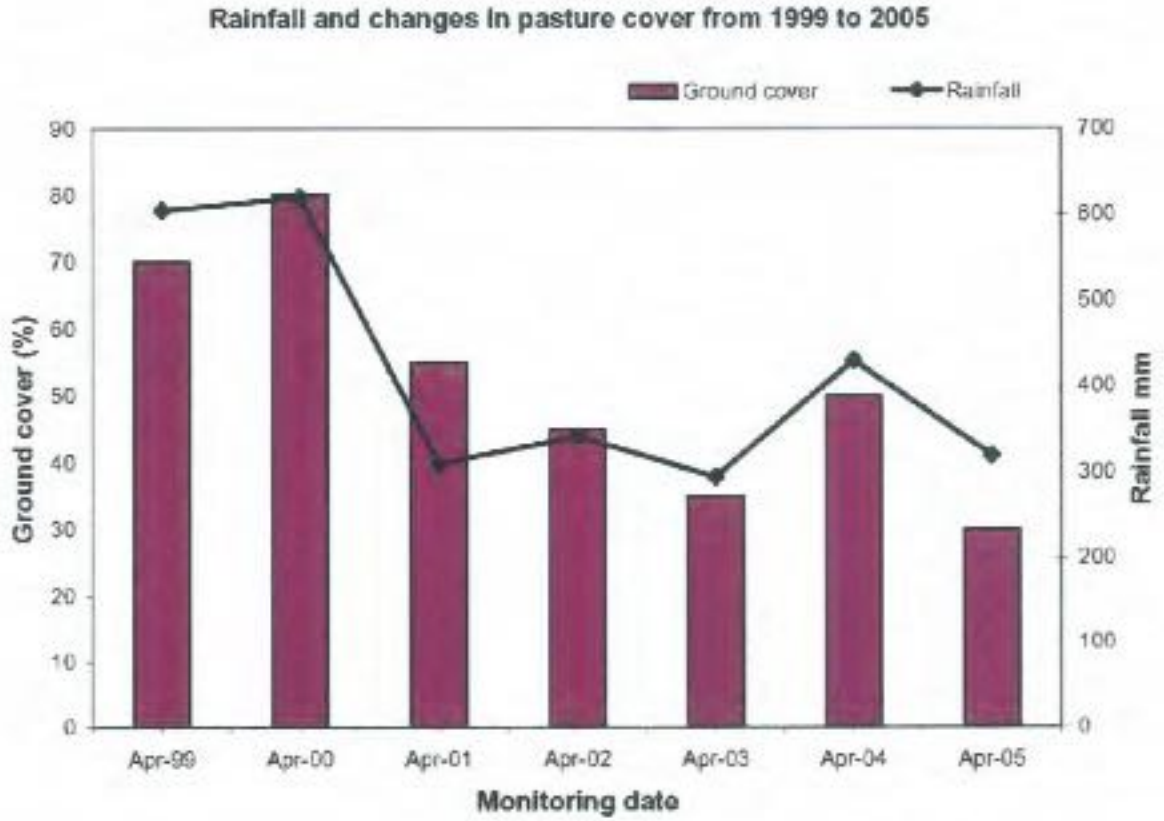
Level 1 field spreadsheet - pastures

Paddock name				
Site name number				
GPS reading				Additional data
Date	**Ground cover (%)**	**Recording person**	**Comments (seasonal conditions, grazing pressure)**	Rainfall mm since last observation

Indicator: Ground cover

Level 1 example field spreadsheet - pastures

Paddock name		Tank paddock		
Site name number				Additional data
Date	**Ground cover (%)**	**Recording person**	**Comments (seasonal conditions, grazing pressure)**	Rainfall mm since last observation
Apr-99	70	Jane W		605
Apr-00	80	Jane W		620
Apr-01	55	Jane W		310
Apr-02	45	Jane W		342
Apr-03	35	Jane W		295
Apr-04	50	Jane W		430
Apr-05	30	Jane W		320



For a location with an average rainfall of 430mm

The Land Manager's Monitoring Guide

Indicator: Ground cover

Attachment 3: Terrestrial Habitat Quality Assessment Tool outputs

Private Access Road – Impact Site – Terrestrial Habitat Quality Calculations *

Habitat Quality attributes	Impact area - assessment unit number		** Note: RE 11.9.5 used as a benchmark due to the lack of an 11.4.8 benchmark.*
	1 0.5ha regrowth 11.4.8	2 11.8ha cleared area	Comments
1. Recruitment of woody perennial species	5	0	The regrowth area had 3 woody species being recruited although the recruitment is spasmodic and fragmented.
2. Native plant species richness			
- Trees	5	0	The benchmark lists as a richness of 2 species, with 3 being present on the impact site hence a score of 3. The cleared area had only very fragmented recruitment of Brigalow that was <2m in height hence a score of 0
- Shrubs	3	0	10 shrub *spp.* are recorded in the benchmark with the impact site having a recruitment of 4 in the tall shrub layer thus a score of 3 is allocated. The cleared areas lacked any consistent shrub layer and thus received a score of 0.
- Grasses	3	0	The ground layer was dominated by introduced *spp.* with only 3 native *spp.* present at the impact site compared to a richness of 10 in the benchmark site thus a score of 3. The cleared area is dominated by Buffel grass and thus a score of 0 is attributed.
- Forbs	0	0	No forbs were noted in either the regrowth or cleared areas and hence a score of 0 for both is recorded.
3. Tree canopy height	3	0	The T1 layer in the regrowth area has a mean height of 10m as compared to the benchmark height of 25m hence a score of 3. There was no tree canopy recorded in the

Habitat Quality attributes	Impact area - assessment unit number		* Note: RE 11.9.5 used as a benchmark due to the lack of an 11.4.8 benchmark.
	1 0.5ha regrowth 11.4.8	2 11.8ha cleared area	Comments
			cleared area and so a score of 0 is allocated.
4. Tree canopy cover	5	0	The regrowth area had an average cover of 30% versus the benchmark of 59% therefore achieving a score of 5. There was no tree canopy recorded in the cleared area and so a score of 0 is allocated.
5. Shrub canopy cover	5	0	The S1 layer recorded a cover of 5-25% in the regrowth area whereas the benchmark has a cover of 11% giving a score of 5. No shrub layer is recorded in the cleared area giving a score of 0.
6. Native perennial grass cover	3	0	Ground-cover is dominated by Buffel grass although there are intermittent areas of native grasses present. Given the small 0.5ha area, and the lack of Buffel in the gilgai areas, a conservative score of 3 has been allocated as the benchmark only achieves a score of 4% for native grasscover. The cleared areas receive a score of 0 given the total dominance of Buffel grass.
7. Organic litter	0	0	There is no record of organic litter being present in either of the assessment units and hence a score of 0 is attributed.
8. Large trees	0	0	There are no large trees present on the site so a score of 0 is given to the impact site in its entirety.
9. Coarse woody debris	2	0	There is some photographic evidence of a small amount of coarse woody debris present in the regrowth area versus a benchmark of 16m in the benchmark site. A conservative score of 2 has been attributed to the regrowth area and 0 to the cleared area.
10. Weed cover	3	0	AS the site is dominated by Buffel grass and the regrowth area also contains Green Panic grasses, the

Habitat Quality attributes	Impact area - assessment unit number		* Note: RE 11.9.5 used as a benchmark due to the lack of an 11.4.8 benchmark.
	1 0.5ha regrowth 11.4.8	2 11.8ha cleared area	Comments
			site was allocated a score of 3 being 25-50% non-native plant cover. The cleared area receives a score of 0 given the dominance of Buffel grass >50% cover.
11. Size of patch (fragmented)	0	0	The impact site receives a score of 0 as the regrowth area is only 0.5ha in size and the cleared area has no remnant vegetation or High Value Regrowth present.
12. Connectedness (fragmented)	0	0	There is no connectivity to remnant vegetation.
13. Context (fragmented)	0	0	There is less than 10% vegetation within a 1km buffer of the impact site hence a score of 0.
14. Distance from water (intact)	*N/A - Only scored for intact subregions*		
15. Ecological corridors	*0*	*0*	The site is not within either a regional or state corridor.
16. Threats to species			These attributes are relative to Fauna Habitat and as such are not used in this instance being an offset for protected Flora under the NC Act.
17. Quality and availability of food and foraging habitat			
18. Quality and availability of shelter			
19. Species mobility capacity			
20. Role of site location to overall population			

Habitat Quality attributes	Impact area - assessment unit number		* Note: RE 11.9.5 used as a benchmark due to the lack of an 11.4.8 benchmark.
	1 0.5ha regrowth 11.4.8	2 11.8ha cleared area	Comments
Habitat Quality Score (measured)	32	0	Calculated from the input scores above
Habitat Quality Score (max)	80	80	Maximum score achievable for a vegetation community in a fragmented subregion
Area (ha)	0.5	11.8	Impact area as per the Appendix E - *TLO and Private Access Road NC Act Impact Management Plan dated September 2014.*

** Note: RE 11.9.5 used as a benchmark due to the lack of an 11.4.8 benchmark.*

Private Access Road – Offset Site – Terrestrial Habitat Quality Calculations

Habitat Quality attributes	Impact area - assessment unit number 1 11.4.9	Comments
1. Recruitment of woody perennial species	3	A score of 3 is attributed as brigalow is present which the dominant canopy species. The benchmark has a score of 2 species and hence a score of 3 is attributed to the offset site
2. Native plant species richness		
- Trees	2.5	1 shrub species is recorded as being present with the benchmark having a score of 10 thus a score of 2.5 being <25% of the benchmark
- Shrubs	5	4 grass species are present on the offset site with the benchmark recording 4 hence a score of 5 is given for this attribute
- Grasses	5	9 forbs were recorded being present versus a 9 being present on the benchmark hence a score of 5

Habitat Quality attributes	Impact area - assessment unit number	
	1 11.4.9	Comments
- Forbs	0	There are no trees present in Site 1 with an EDL of 2m whereas the benchmark achieves a median canopy height of 25m. As the offset site canopy height is less than 25% of the benchmark height, a score of 0 is allocated.
3. Tree canopy height	0	There is no tree canopy cover whereas the benchmark has a canopy cover of 59%
4. Tree canopy cover	3	The site achieves a shrub canopy cover of 40% although this is patchy. The benchmark sub canopy cover is 48% so a score of 3 is achieved
5. Shrub canopy cover	5	Native grass cover at the offset site is recorded as 5% whereas the benchmark has a native grass cover of 4% and a score of 5 is therefore attributed
6. Native perennial grass cover	5	With a recorded 40% organic litter cover a the offset site compared to 66% at the benchmark a score of 5 is attributed to this attribute
7. Organic litter	0	No large trees are present at the offset site. The benchmark has a count of 30 large Eucalypt Trees and 98 large non-eucalypt trees/ha
8. Large trees	0	No coarse woody debris is recorded at the offset site
9. Coarse woody debris	5	Non native grasses made up 22.6% of the offset site as compared to 0% at the benchmark site giving a score therefore of 5 being between 5-25% non-native plant cover
10. Weed cover	7	The patch is 40.2ha in area and directly adjoins a further 108ha of remnant comprising [redacted] and a further 36ha Conservation Park – thus a score of 7 is achieved
11. Size of patch (fragmented)	5	A score of 5 is attributed as more than 75% of the patch is connected to remnant vegetation
12. Connectedness (fragmented)	4	Between 30% and 75% of the area within 1km of the patch is remnant vegetation and hence a score of 4 is allocated
13. Context (fragmented)	3	A score of 3 is attributed as Brigalow is present which the dominant canopy species. The benchmark has a score of 2 species and hence a score of 3 is attributed to the offset site
14. Distance from water (intact)	*NA – only calculated for an intact landscape*	
15. Ecological corridors	6	The entire patch is within a regional and state corridor and therefore achieves a score of 6.

Habitat Quality attributes	Impact area - assessment unit number	
	1 11.4.9	Comments
16. Threats to species	*These attributes are relative to Fauna Habitat and as such are not used in this instance being an offset for protected Flora under the NC Act.*	
17. Quality and availability of food and foraging habitat		
18. Quality and availability of shelter		
19. Species mobility capacity		
20. Role of site location to overall population		
Habitat Quality Score (measured)	58.5	Calculated from the input scores above and derived from the Bio-condition scoresheet for Site 1 – Appendix A-2, *Potential Biodiversity Offsets Baralaba North Project and Associated Infrastructure December 2014*
Habitat Quality Score (max)	80	Maximum score achievable for a vegetation community in a fragmented subregion
Area (ha)	49.2	Offset area calculated and illustrated in *Figure 7*.

Schedule 1b ([redacted] – OAMP)

Please refer to pdf file supplied separately.

Department of **Natural Resources and Mines**

[redacted]

EPBC 2013/7036
Baralaba North Continued Operations Project (BNCOP)

Offset Area Management Plan
“[redacted]”

May 2015

Contents

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,* or the *Environment Protection & Biodiversity Conservation Act 1999.*

The plan template is composed of 4 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 impacted on the clearing 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 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 landowner and the delegate

Part 3 - Attachments

1. Baseline data

    (a) Ecological equivalence assessment of the Offset Area
    (b) Weed and pest species
    (c) Flora and fauna present on the Offset Area or adjacent to Offset Area
    (d) Monitoring data:

    - GPS points
    - Photo monitoring
    - Flora quadrats

2. Land Manager's Monitoring Guide

Parts 1, 2 and 3 must be completed to fulfil the management plan requirements.

1. Summary Information

1.1. Departmental Reference Details

Departmental Reference Details for application that triggers offset	
Departmental Reference Number and Case Name: EPBC 2013/7036 Offset reference number (if applicable):	
Tenure: Freehold	Primary Local Government Area: Banana Shire Council

Offset Triggers and Values	
Offset Trigger	**Values requiring to be offset**
☐ Regional Vegetation Management Code ☐ Part P ☐ Part S ☐ Part Xa ☐ Part Xb ☐ Material Change of Use / Reconfiguration of a lot Policies (Table F1) ☒ *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* ☐ *Nature Conservation Act 1992 (Qld)/Environmental Offsets Act 2014 (Qld)*	☒ EPBC MNES ☐ Assessable vegetation adjacent to a wetland, significant wetland ☐ Assessable vegetation adjacent to a watercourse ☐ Connectivity ☐ Endangered regional ecosystem ☐ Of concern regional ecosystem ☐ Threshold regional ecosystem ☐ Critically limited regional ecosystem ☐ Essential habitat ☐ Essential habitat for koalas in SEQ ☐ Values within a highly vegetated bioregion ☐ Protected Plant under the *Nature Conservation Act 1992*

1.2. Offset Area Details

Landholder Details	
Register Owner/s on Title: [redacted]	
Lessee:	Trustee:
Business/Company name: [redacted]	
ABN/ACN: [redacted]	
Phone number: [redacted]	Mobile phone:
Facsimile number: [redacted]	Contact person (if required): [redacted]
Email: [redacted]	
Postal Address: | [redacted]	

Property Details	
Property name: [redacted]	
Real property description (lot on Plan/s): Lot 22 AU37	
Tenure: Freehold	Primary Local Government Area: [redacted]
Planning Scheme Zone: Rural	Property area (ha): 720.34 Offset Area (ha): 420.0
Landzone / geology	Landzone - 7 - Cainozoic duricrusts formed on a variety of rock types, usually forming mesas or scarps. Includes exposed ferruginous, siliceous or mottled horizons and associated talus and colluvium, and remnants of these features, for example low stony rises on downs.
Soils	Soils are usually shallow Rudosols and Tenosols, with minor Sodosols and Chromosols on associated pediments, and shallow Kandosols on plateau margins and larger mesas
Pre-clear regional ecosystem (V.)	11.7.4/11.7.7/11.7.5/11.7.2
Existing vegetation	Remnant REs - 11.7.4/11.7.7/11.7.5/11.7.2
Estimated age of vegetation	>25 years

Is there a PMAV currently over all or part of the property, Please detail	No

Legally Binding Mechanism

☒ Voluntary Declaration (*Vegetation Management Act 1999*) ☐ Covenant (*Land Act 1994*/ *Land Title Act 1994*)

Reference Number: Reference Number:

☐ Nature Refuge (*Nature Conservation Act 1992*) ☐ Other

Reference Number: Reference Number:

Registered Interests on the Property:

1. EASEMENT IN GROSS No 715771947 15/05/2014 at 15:04 burdening the land [redacted] over EASEMENT CR ON SP265436
2. EASEMENT IN GROSS No 716063165 08/10/2014 at 15:45 burdening the land A[redacted] over EASEMENT CX ON SP261962

1.3. Description of MNES clearing and offset values

The following table (**Table 1**) identifies the MNES impacted on under the *Environmental Protection and Biodiversity Conservation Act 1999* – in the BNCOP clearing area for which an offset is provided with this Offset Area.

Table 1: Summary BNCOP Clearing and this Offset area – *Environmental Protection and Biodiversity Conservation Act 1999*

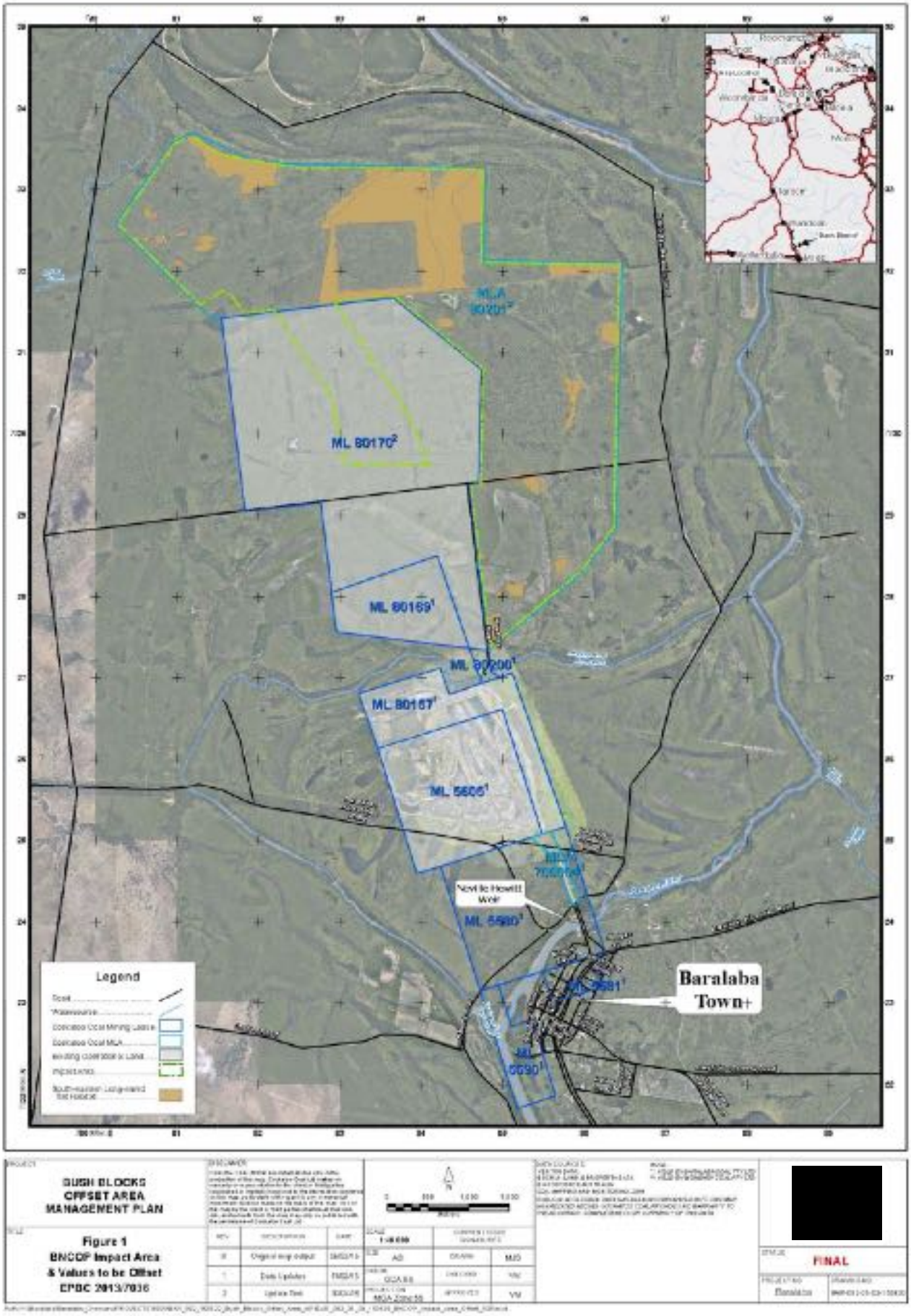
Protected Matter	Status	Impact area (ha)	Impact Area Habitat Quality Score	Offset Area (ha)	Offset Area Start Habitat Quality Score	Offset Property
Threatened Species						
Nyctophilus corbeni South-eastern long-eared bat	Vulnerable	277	5	420	8	[redacted] **Note** – additional 108ha located on "[redacted]" property Lot 9 BH194

Table 2: Impact Site EPBC Calculator input scores

Attribute	Value	Rationale/Assumption
Impact Area	277 ha	The calls of the South-eastern long-eared bat, which are recorded with an Anabat detector, cannot be distinguished from calls of other *Nyctophilus spp*. that are also potentially present in the area. Calls of a *Nyctophilus spp*. were recorded at five locations throughout the BNCOP area by [redacted] in April and October 2013. [redacted] described that the calls are more likely to be from a common long-eared bat species since the common long-eared bat species were caught in harp traps and the closest record of the South-eastern long-eared bat is approximately 130 km to the south-east of the BNCOP area. However, it remains a possibility that the South-eastern long-eared bat is present (and some of the calls may be of the South-eastern long-eared bat). If the South-eastern long-eared bat is present in the area, foraging habitat would be removed through the clearance of woodland and open forest (277 ha) and some breeding habitat where there are hollow-bearing trees. No habitat within the BNCOP locality has been identified as important or critical habitat for the South-eastern long-eared bat in any recovery plans or listed on the EPBC Act Register of Critical Habitat maintained by the Minister of the Environment under the EPBC Act (DotE, 2014d). Past disturbance and clearance has resulted in reduced abundance of tree hollows across the BNCOP area and regrowth vegetation is common. Hollow-bearing trees are more abundant outside of the BNCOP area along the Dawson River and Dawson River anabranch as the vegetation is typically older. The habitat in the BNCOP area may also be suboptimal for the South-eastern long-eared bat due to the high levels of fragmentation. Habitat fragmentation is considered a potential threat to the South-eastern long-eared bat because the species displays a preference for larger areas of intact habitat (DotE, 2014d).
Quality	5/10 (rounded up from 4.7)	**Site Condition = 2.7** The majority of the BNCOP area has been degraded through various rural land uses, particularly grazing, clearing and associated management practices. Extant vegetation is generally limited to the Dawson River and its associated tributaries and a broad overflow floodplain linking the Dawson River floodplain with that of Saline Creek, along fence lines, small wetlands, and road reserves. These areas are impacted by a variety of disturbances include exploration, historical clearing, grazing and weed invasion. The largest patch of vegetation in the BNCOP Additional Footprint is the Eucalypt open forest (VCs 6a, 7, 8a and 8b), but it has been cleared in the past and subsequently regrown. The structural complexity of this vegetation is relatively good with multiple vegetation layers, fallen woody debris and leaf litter. This habitat consists of a moderately intact canopy layer (40% cover) of medium to large trees (19 m high and 25-40 cm DBH), a low abundance of hollow-bearing trees (1 per ha), a distinct mid-storey and shrub layer (11% cover). However the condition of VC 8a is poor and weed cover is high (average 88% cover). This habitat type has a highly simplified structure with a low but moderately intact canopy layer (9 m high and 39% cover) of small to medium sized trees (15-25 cm DBH), and a sparse shrub layer (5% cover). The external connectivity of the habitats is relatively low, except for habitat along watercourses and the overflow floodplain linking the Dawson River and Saline Creek. Nevertheless the distribution and configuration of such disconnected patches when considered together provide flyways for some birds and bats. The South-eastern long-eared bat habitat that will be impacted by the BNCOP Project was given a 'Site Condition' score of '2.7', based on the above factors. This component of the habitat quality assessment was allocated a weighting of 40%, as outlined above. **Site Context = 2.0**

		Although several small patches of habitat were identified in patches of less than 10 ha there was little to no connectivity to larger patches of remnant habitat. The majority of suitable habitat was identified along the northern boundary of the BNCOP and was either remnant and/or contiguous with vast tracks of remnant vegetation to the north of the BNCOP site. This habitat is currently threatened by existing land uses and occurs in a fragmented agricultural landscape. There is limited connectivity to large intact remnant areas, except for the large area of remnant in the far north of the BNCOP as mentioned above. All areas of habitat on site will be removed by the Project. The South-eastern long-eared bat habitat that will be impacted by the BNCOP Project was given a 'Site Context' score of '2.0', based on the above factors. This component of the habitat quality assessment was allocated a weighting of 40%, as outlined above. **Species stocking rate = 0** The species was not positively identified as occurring within the BNCOP area. The anabat calls are far more likely to be from the more common *Nyctophilus* species that occur in the area. The South-eastern long-eared bat habitat that will be impacted by the BNCOP Project was given a 'Species stocking rate' score of '0', based on the above factors. This component of the habitat quality assessment was allocated a weighting of 20%, as outlined above.

Figure 1: Location of MNES within the BNCOP Clearing Area



BUSH BLOCKS OFFSET AREA MANAGEMENT PLAN

Figure 1
BNCOP Impact Area & Values to be Offset
EPBC 2013/7036

FINAL

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 2030. It is recognised that the timeframes are subject to natural conditions and unexpected events, and the risks identified in section 4, Risk Analysis.

The management area objectives and outcomes for the Offset Area are for the ***Nyctophilus corbeni* South-eastern long-eared bat** as listed in the EPBC Act.

2.1.1 Management area objectives

To protect and enhance the condition of the habitat values for the threatened species *Nyctophilus corbeni*, (South-eastern long-eared bat) previously listed as *Nyctophilus timoriensis* in the ***Action Plan for Australian Bats*** (ISBN 0 642 2546 363).

A legally binding mechanism, in the form of a Voluntary Declaration under the *Vegetation Management Act 1999* will protect and manage this vegetation in conjunction with this management plan to meet the offset requirements of the Approval Conditions EPBC 2013/7036 for the Baralaba North Continued Operations Project (BNCOP). The offset area will be actively managed until 30 June 2030.

2.1.2 Offset Area Outcomes

(a) **Site Condition**: The offset management area is managed to improve the habitat condition through appropriate restoration and management actions as detailed in **Table 6**. These actions include the exclusion of any forestry and/or timber harvesting operations therefore allowing the regeneration of large hollow bearing trees, natural regeneration of canopy and sub canopy species, 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) The scores in **Table 3** align with the scores recorded as the baseline at the monitoring and reporting locations as detailed in section 6 of this management plan

(c) **Site Context**: the Offset Area is managed to enable the natural regeneration process of the habitat along the riparian zone of [redacted] (Stream Order 4) and associated adjacent forage areas. The use of the creek as part of the offset will therefore enhance connectivity to the 232,500ha Barakula State Forest which is 4.8km to the east and connected to the offset site via Tin Hut Creek. This habitat regeneration and enhancement will be achieved by the Management Actions detailed in **Table 6**.

(d) **Species Stocking Rate**:
Not positively identified on-site, but 100 (including one female with two young) microbats from five species were captured. This included 33 *Nyctophilus sp*.

Table 3: Offset Area EPBC Calculator Input (start) and offset area future quality (outcome) scores

Offset Calculator Step	Score attributed	Comments
Step 8 – Time horizon	20 years	Time over which loss is averted. The value selected for time over which loss is averted was the maximum of 20 years for the offset site.
Time until ecological benefit	10 years	Ecologist advice indicates that the ecological benefit predicated following the implementation of the management actions will be achieved by year 10 of the offset.
Step 9 – Start area and quality	420 ha Score - 8	The South-eastern long-eared bat was not positively identified on-site, but 100 (including one female with two young) microbats from five species were captured. This included 33 *Nyctophilus spp*.; 9 *N. geoffroyi* and 24 *N. gouldi* (inc. 2 young). Diverse range of foraging habitats for this species are supported across the whole site, including tall treed canopy layer, tall shrub layer, low shrub layer and ground cover

Offset Calculator Step	Score attributed	Comments
		including native grasses and leaf litter layer. The site supported structurally diverse and abundant treed, tall canopy layer with decorticating bark and tree hollows resources considered abundant, to provide suitable roosting/breeding resources. The shrub layers were equally diverse and abundant. The ground and leaf litter layer were diverse, yet patchy, which is common in the local area. Breeding habitat resources, i.e., tree hollows, supported on-site for the species. For these reasons, a 'Start Quality' score of '8' has been given for the south-eastern long-eared bat habitat present on the site.
Step 10 – Future area and quality without offset Risk of loss (%) Without Offset	 378.0 ha Score - 5 10%	Historically, the site has been selectively logged for timber resources. With the exception of the broadscale clearing of the LNG pipeline corridors on-site, there has been little disturbance to the remaining vegetation on-site and consequently, the habitat values supported on-site have improved over time since the cessation of logging activities. In addition, there is limited cattle grazing on-site which has had some impact on the values supported, primarily associated with the decline in the structure, nature and extent of the low shrub, ground and leaf litter layers supported. Without the offset, it is likely that the values of the site will decline over time if cattle grazing pressure continues/increases and/or a wildfire occurs across the site. Both these impacting processes have the potential to significantly impact on the values of the site. The property management practices are currently limited in this regard, and are likely to be maintained as such, therefore a "Future Quality without Offset" score of 5 has been given.
Step 11 – Future area and quality with offset Risk of loss (%)With Offset	 378 ha Score - 9 10%	This Offset Delivery Plan outlines a number of planned management actions that will be implemented to enable the quality of the habitat on site for the South-eastern long-eared bat to improve. For example, the specific actions include the exclusion of heavy cattle grazing from the defined offset area on the [redacted] property which can impact the understory vegetation community, with the exception of controlled grazing for fuel reduction purposes as required. Further, the exclusion of forestry operations or native timber harvesting across the offset area and exclusion of intense, frequent fire (which can reduce the number of tree bearing hollows as well as cause mortality) with the exception of low intensity burns undertaken at a period of not less than 20 years interval, will assist in improving habitat quality for the species by controlling weed cover and maintaining woody vegetation. These actions align with mitigating the 'Threatening Processes' as listed in the Queensland Department of the Environment and Heritage Protection advice for the species, and the EPBC Act Listing Advice, being: • Habitat loss and fragmentation – refer management actions in Table 14 • Fires that destroy roosting sites and foraging habitat – refer fire management actions in Table 14 • Forestry activities – refer forestry operations management actions in Table 14 • Overgrazing – refer grazing management actions in Table 14 • Predation by feral species – refer pest (pest animals) management actions in Table 14 • Competition for tree hollows – refer management actions in Table 14 • Exposure to agrichemicals – refer pest (weeds)

Offset Calculator Step	Score attributed	Comments
		management actions in Table 14 Habitat improvements will primarily include an increase in the structural diversity, abundance and availability of foraging habitats supported on-site. Therefore the predicted "Future Quality with Offset" score of '9' has been applied within the calculator based upon the effective implementation of a management plan that includes these key strategies.
Step 12 – Start quality and future quality without offset	 Score - 8 Score - 5	See commentary in Step 9 and 10 respectively
Step 13 – Future quality (with offset)	 Score - 9	See commentary Step 11
Step 14 – Calculating adjusted gain using confidence in result (%) Confidence in Result	 315ha 6.75% 75%	
Step 15 – Net present value (adjusted hectares)	111.16%	
Step 16 – Percentage of impact offset	80.26% **Note** – additional 20.06% located on Lot 9 BH194	

2.2 Detailed Offset Area Mapping

The following figures demonstrate the Offset Areas within the region being the Location Map (**Figure 2**) and the EPBC Offset Area for the South-eastern long-eared bat (**Figure 3**). This offset map includes surrounding values such as the Barakula State Forest and the offset's monitoring points (**Figure 4**).

Figure 2: Offset Location Map

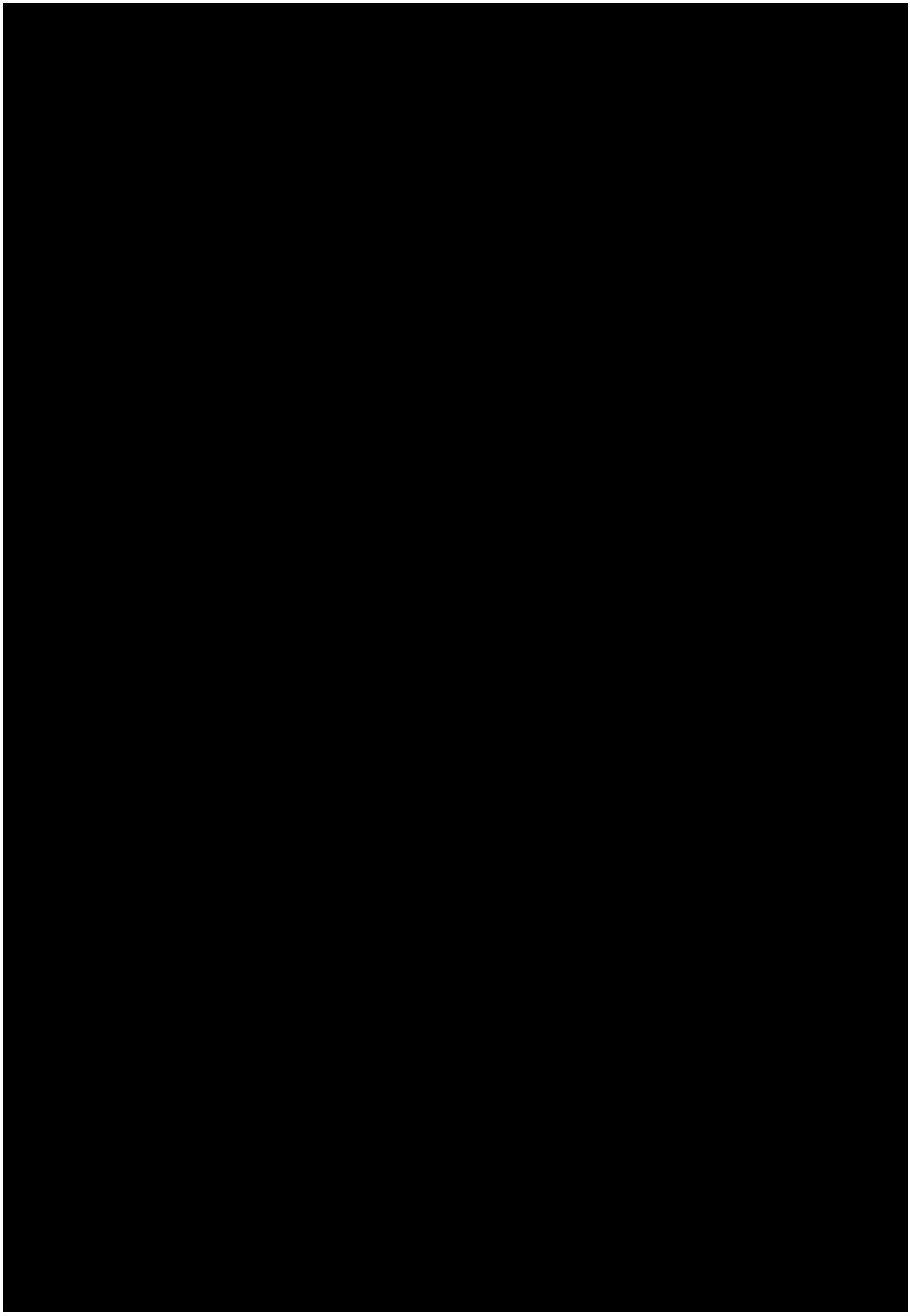


Figure 3: EPBC South-eastern long-eared bat Offset Area Map – "[redacted]"

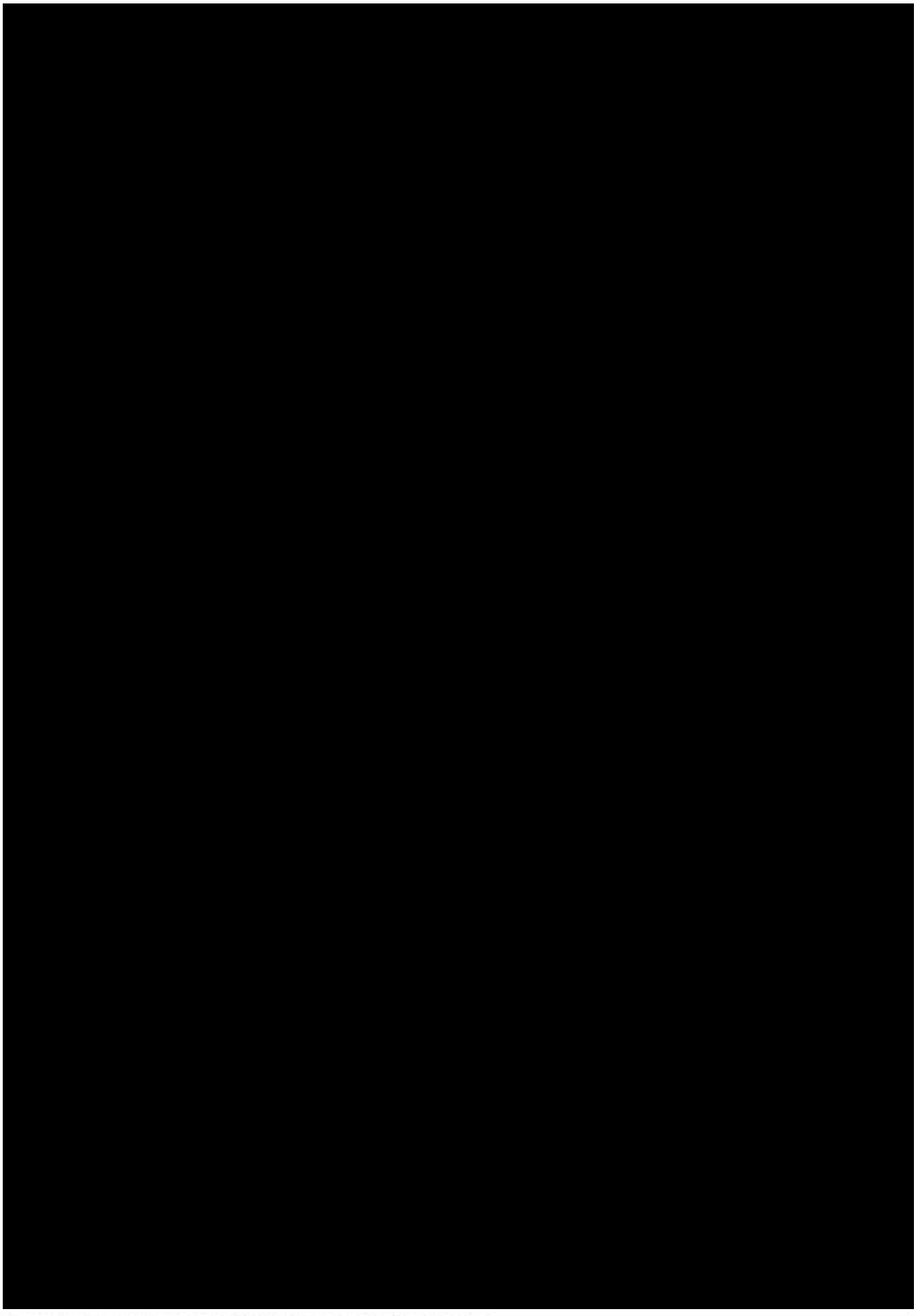
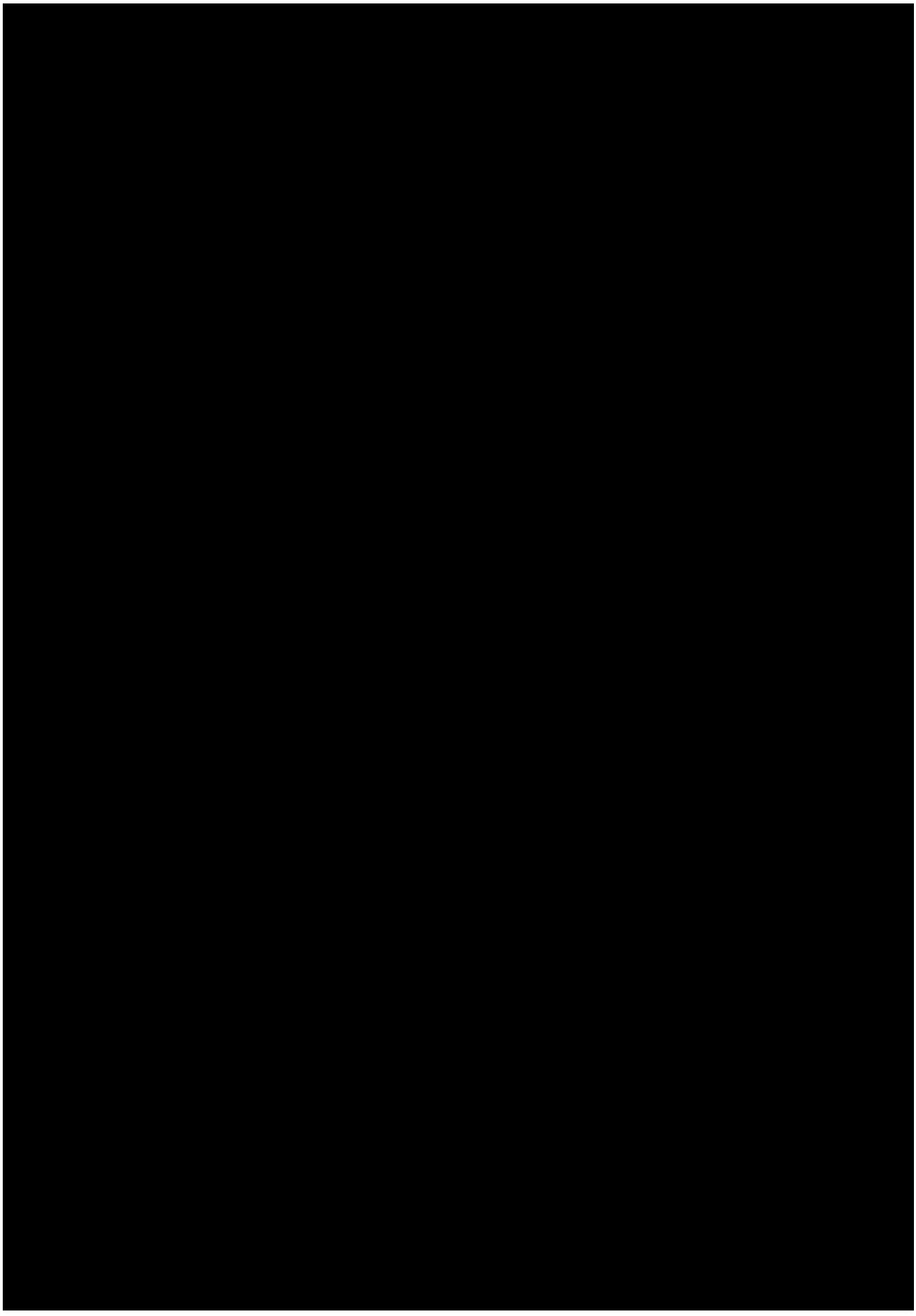


Figure 4: Survey Site Locations – [redacted]



3. Restrictions imposed on the use of the Offset Area[i]

The restrictions in **Table 4** are to be implemented within the Offset Area.

Table 4: Offset Area Restrictions

Restriction	Details
Vegetation clearing	1. Vegetation clearing on the Offset Area is restricted to: 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. Where vegetation clearing is sought for any other purpose, the landowner must contact the relevant department administering the *Vegetation Management Act 1999*. 2. Vegetation clearing is restricted to the use of non-mechanical means. 3. Native forest practice (harvesting of timber for forestry purposes) **is not** allowed under this Offset Area management plan. **Note:** Any vegetation clearing must be undertaken in accordance with: • 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 *Nature Conservation Act 1992.*
Grazing	1. Grazing of domestic livestock will occur on the Offset Area under the following arrangements: a) for fuel reduction purposes only; and b) noting that there are no set stocking rates or times throughout the year where stock are to be permitted to graze. The Landowner, at their discretion, is to graze stock at rates and times necessary to reduce the fuel load in the Offset Area without lowering the native grass cover to below 15% (REDD benchmark %) at the end of the dry season. The ground cover is to be determined as per **Attachment 2: *Land Manager's Monitoring Guide***.
Fire	1. Fire is to be, where possible, excluded from the Offset Area except for low intensity burns by undertaken in a mosaic pattern by: a) maintaining firebreaks relative to the Offset Area; b) using a low intensity fire >20 year interval c) co-locating firebreaks with existing roads and fence lines on the property where possible; and d) not using fire as a tool for regrowth management in the Offset Area.
Other	**Pest Animal Management** Minimise the introduction of pest animals and control of existing populations of pest animals within the Offset Area in accordance with the *Land Protection (Pest and Stock Route Management) Act 2002*. **Weeds** 1. Keep the introduction; establishment and spread of non-native weeds including Declared Pest Plants listed under the L*and Protection (Pest and Stock Route Management) Act 2002* 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 *Land Protection (Pest and Stock Route Management) Act 2002* to ensure that the non-native weeds do not cover more than 10% of the Offset Area. e.g., Tree Pear. 3. Minimise the spread of any non-native pasture species within the Offset Area in accordance with **Table 6: Management Actions**. **Note:** existing weed control efforts on this property are effective (i.e. the current levels of weed infestation are low). 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.

[i] Restrictions may relate to achieving the management area objectives and outcomes e.g. mapped remnant status, or are a means of managing threatening processes for identified flora and fauna species, or are simply best practice management.

4. Analysis of Risks to Achieving Management Objectives and Outcomes

The following risk assessment in **Table 5** has considered:

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

Table 5: Risk Analysis

Number	Risk	Level of Risk (Extreme, High, Moderate or Low)	Proposed Actions to Minimise Risk	Proposed Remedial Actions if Risk Occurs
1	Fire	**High** Due to the small populations of South-eastern long-eared bat, fires pose a major threat to the species. They not only directly kill the animal, but also destroy roosting sites.	Maintaining firebreaks at appropriate widths to enable fires on adjoining properties to be prevented from impacting on the offset area. Manage fuel loads through controlled grazing. *Force Majeure* events are acknowledged being separate from general fire use practices. Fire control lines to be checked annually for condition and adequacy.	Fire to be excluded wherever possible from the offset area with low intensity fires >20year intervals. **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.
2	Forestry	**High** The South-eastern long-eared bat is known to roost in deadwood or hollow trunks/branches. Standard forestry and Native Timber Harvesting practices remove such items from the environment and are hence considered a potential threat.	Forestry and Native Timber Harvesting are **excluded** from the offset area Signs at entrance points to the property with regards that it is an offset area and that any harvesting of timber is prohibited	No clearing of native trees are to occur within the offset area **Remedial action**: Reassess access protocols for any lessees etc., signage and general access.
3	Grazing	**Low** The South-eastern long-eared bat is believed to forage on low ground and shrubs. High density grazing around such regions destroys shrubs and limits the regeneration of the habitat. The natural condition of this vegetation community has a low grass cover (15%) and hence any grazing undertaken is at low stocking rates and for short periods of time	The 420ha offset area is grazed in a conservative manner during the dry season for fuel reduction purposes with a minimum of 15% grass cover to be present at the end of the dry season. Boundary fencing to be checked annually and maintained in a stock proof condition	Grazing is determined by the amount of dry matter available and is used conservatively for that necessary for fuel reduction purposes only **Remedial action**: Any entry points due to fencing breaks etc. to be repaired to a stock proof condition within a 30 day period
4	Erosion	**Low**	Maintaining grass cover at a minimum of 15% at the end of the dry season. This will ensure groundcover is even higher (due to the presence of fallen woody	**Remedial action**: Further reduction of grazing levels and checking on the cause of any point source erosion (such as illegal vehicle access) and rectifying access

Number	Risk	Level of Risk (Extreme, High, Moderate or Low)	Proposed Actions to Minimise Risk	Proposed Remedial Actions if Risk Occurs
			debris, organic matter etc.) thus minimising the risk of sheet erosion.	if this is the cause.
5	Drought	**Low** The risk incurred by drought would be an increase in the likelihood of fire due to the dry conditions and accumulated fuel loads.	Maintain fire control lines as detailed above and manage grazing levels according to the amount of dry matter available for grazing.	**Remedial action**: Allow Offset Area to recover post drought/fire, particularly through the control of weeds. Maintain a minimum of 15% grass cover at the end of the dry season.

5. Management actions

The following (**Table 6**) identifies the actions which will be undertaken for the Offset Area, by whom, when and more specific information relating to the action.

Table 6: 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
Forestry Operations, Native Timber Harvesting and general Vegetation clearing	Vegetation clearing on the Offset Area is restricted to: a) that necessary for the removal of non-native weeds or declared pests; b) establishing and maintaining fencing around the boundary of the declared area; c) establishing and maintaining fire breaks; and d) ensure public safety Vegetation clearing for any other purpose **is not** permitted within the offset area.	Only in those areas subject to non-native weed control, fire control lines and boundary fences.	As required and identified in the Annual inspections of the boundary fence and collocated fire control lines.	Landowner or suitable qualified person appointed by the Landowner.	No evidence of recent forestry or timber harvesting activities is evident during term of the offset management plan. Any illegal clearing to be identified by the monitoring and reporting program.	Any evidence of clearing apart from weeds is to be noted in the Annual Landholder reports. If evidence of recent timber harvesting is noted during inspections, the landholder is to reassess access protocols for any lessees etc., signage and general access.
Fire	Fire is to be, excluded from the Offset Area except for low intensity ecological burns by: a) Maintaining firebreaks relative to the Offset Area; b) Using a low intensity fire >20 years interval; and c) Firebreaks are to be co-located with existing roads and fence lines on the property where possible. **Note:** Fire is not to be used as a tool for regrowth management on the Offset Area.	Throughout the Offset Area.	Fire Control lines as required but at an interval of at least each 2 years with annual inspections to identify the need for maintenance of the fire control lines. Low intensity fire at >20 years interval.	Landowner or suitable qualified person appointed by the Landowner.	No evidence of fire is observed during the term of the offset management plan, except for prescribed mosaic burns. Any incidence of wild fire or illegal burning (Force Majeure) is to be identified during annual inspections and documented within the monitoring and reporting program.	Any occurrence of fire in the Offset Area is to be noted in the Annual Landholder reports. **Corrective 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. Fire and grazing excluded until ground level cover has increased to the benchmark level of 15%.
Grazing	Stock will be grazed in the Offset Area for fuel reduction purposes only. There is no set stocking rates or times throughout the year where stock is to be permitted to graze.	Throughout the Offset Area. Repair fence at Observation Point 46 Easting –	As required. Fence repair by December 2016.	Landowner	The Landowner, at their discretion, is to graze stock, at rates and times necessary to reduce the fuel load in the Offset	Photo point and quaternary site assessment results of grass cover and groundcover to be incorporated into the Annual Landholder Reports and the Compliance reports to [redacted] and 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
		[redacted], Northing - [redacted]. This site is located at a Grid on [redacted] and has a gate. There is no east-west fence to the east of the grid.			Area without lowering the grass cover to below 15% at the end of the dry season.	regulator/s. **Corrective action**: grazing excluded until grass cover has increased to the Qld Herbarium Benchmark of 15% for this vegetation community.
Other	**Pest Animal Management** Minimise the introduction of pest animals and control of existing populations of pest animals (wild pigs) within the Offset Area in accordance with the *Land Protection (Pest and Stock Route Management) Act 2002*.	Throughout the Offset Area.	As required.	Landowner or suitable qualified person appointed by the Landowner.	Incidents and control measures to be noted in the Annual Landholders Reports. Anecdotal evidence collected yearly and included in the Monitoring and Reporting to the Regulator.	**Corrective action**: if an increase in pig numbers is observed, the landholder will implement a pest animal management program to control the feral animal population.
	Weeds 1. Keep the introduction, establishment and spread of non-native weeds including Declared Pest Plants listed under the *Land Protection (Pest and Stock Route Management) Act 2002* to less than 10% weed cover over the Offset Area. 2. Control existing infestations of non-native weeds including Declared Pest Plants under the *Land Protection (Pest and Stock Route Management) Act 2002* to ensure that the non-native weeds cover less than 10% of the Offset Area. e.g., Tree Pear.	Throughout the Offset Area.	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.	Landowner or suitable qualified person appointed by the Landowner	Observations during routine property inspections, Photo point and quaternary site assessment results of grass cover and groundcover to be incorporated into the Annual Landholder Reports and the Compliance reports to [redacted] and the regulator.	**Corrective action**: There is potential for the cleared gas pipeline routes to be a significant source of weed infestation and these areas should be monitored after rain events and the respective companies contacted to undertake control actions if weed infestations increase. The level of weed infestation is low in the observed areas and spot spraying of small outbreaks observed during routine property inspections should suffice.

6. Monitoring Requirements[ii]

Monitoring of the Offset Area will occur in accordance with **Table 7**:

Table 7: Offset Area monitoring

Monitoring	Attributes monitored	Frequency	Method	Location/s
Baseline monitoring		At commencement of Plan (year 0)	Field observations, vegetation assessment as per Qld Herbarium quaternary site assessment methodology.	Observation sites listed at **Table 8.**
Ecological condition, habitat assessment	Recruitment of woody perennial species	At commencement (year 0) and then every 5 years to year 2030.	Field observations, and vegetation assessment as per Queensland Herbarium quaternary site assessment methodology	Observation sites listed at **Table 8.**
	Native plant species richness	At commencement (year 0) and then every 5 years to year 2030.		Observation sites listed at **Table 8.**
	Native perennial grass cover	At commencement (year 0) and then every 5 years to year 2030.		Observation sites listed at **Table 8.**
	Weed cover	At commencement (year 0) and then every 5 years to year 2030.		Observation sites listed at **Table 8.**
Photo Points	Visual appearance of offset	Annually for first 5 years, then every 5 years along with 'ecological condition, habitat assessment' monitoring; reported annually for the first 5 years and then every 5 years to (and including) year 2030.	Photographs of offset area taken at defined locations for medium to long-term comparison	Observation sites listed in the Management Plans.
Grazing	Stocking rates, rates and timing	Reported annually for the first 5 years and then every 5 years to (and including) year 2030.	[redacted]/landholder representative will undertake inspections of the offset area to observe and record grass cover levels, weed occurrence and any evidence of pest animal incursion. These records are to be collated and reported every year for the first 5 years. Subsequently, they are to be included in the five yearly reports along with the quaternary site assessment reports.	Within Offset Area
Fire	Incidence and extent	As required; reported annually for the first 5 years and then every 5 years to (and including) year 2030.		
Weeds	Occurrence, control measures, timing and result of the control measures	Reported annually for the first 5 years and then every 5 years to (and including) year 2030.		
Pest animals	Occurrence, control measures adopted, timing of the control measures and the result	Reported annually for the first 5 years and then every 5 years to (and including) year 2030.		

[ii] The objectives and outcomes should link with the monitoring requirements identified in section 6. Monitoring requirements.

Table 8: Observation Sites

Observation Site Number	Easting (Zone 56# GDA94)	Northing (Zone 56# GDA94)	Comments
45	[redacted]	[redacted]	RE 11.5.1
46	[redacted]	[redacted]	Grid on [redacted] and gate. No east-west fence to the east of the grid.
47	[redacted]	[redacted]	NW corner of the property
48	[redacted]	[redacted]	Gate on boundary for access track running east-west.

7. Reporting

[redacted], its successors or assigns, will prepare Offset Area monitoring reports and submit the reports to the administering authority every year for the first 5 years for the life of this plan and thereafter each 5 years for the life of this plan (i.e., until 2030).

Ongoing monitoring is required to ensure the Management Plan achieves the outcomes identified.

The frequency of monitoring has been determined based on the tree age being more than 25 years and identified as being of remnant status on a Regulated Vegetation Map as per the *Vegetation Management Act 1999* within the offset area and the likely rate of site condition change (improvement). As a remnant vegetation community the expected rate of change is likely to be moderate, with high opportunities for improvement and, with good management, a low risk of decline. Accordingly, monitoring frequency has been established on an initial yearly photo point monitoring cycle followed by a 5-year monitoring cycle for vegetation condition assessment, using the Qld Herbarium quaternary site methodology (**Table 9**).

Table 9: Reporting Schedule

Offset Year	Report Details	Date to be Submitted
1	Offset Area Annual Report including Photopoint and Landholder records collated and reported to the administrating authority	30 June 2016
2	Offset Area Annual Report including Photopoint and Landholder records collated and reported to the administrating authority	30 June 2017
3	Offset Area Annual Report including Photopoint and Landholder records collated and reported to the administrating authority	30 June 2018
4	Offset Area Annual Report including Photopoint and Landholder records collated and reported to the administrating authority	30 June 2019
5	Quaternary Site Assessment to accompany the Offset Area Report format to cover the intervening 5 years.	30 June 2020
10	Quaternary Site Assessment to accompany the Offset Area Report format to cover the intervening 5 years.	30 June 2025
15	Quaternary Site Assessment to accompany the Offset Area Report format to cover the intervening 5 years.	30 June 2030

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 landowner agrees:

1. Any 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 landowner acknowledges:

5. That before the State will agree to the release this Offset Area management plan the State must be satisfied that the objectives and activities contained in the Offset Area management plan have been achieved.

The landowner 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 Surat Coal Pty Ltd ACN 010678869

being the current owner/s 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 [redacted] Signature: [redacted]

Witness name [redacted] Signature: [redacted]

Date 11 August 2015

Name: [redacted] Signature [redacted]

Witness name: [redacted]

Signature: [redacted]

Date 10/08/15

Name:

Signature:

Witness name:

Signature:

Date

Attachment 1: Baseline Data

Quaternary sites [redacted]"

Observation site	Easting (Zone 56# GDA94)	Northing (Zone 56# GDA94)	Vegetation description*	Comments
41	[redacted]	[redacted]	Tall open forest of Eucalyptus crebra 20-25m tall, with dense lower layer of Callitris glaucophylla to 16m tall.	NE corner of [redacted] and [redacted]. RE 11.5.1.
42	[redacted]	[redacted]	Drainage depression. As above for site 41, but also with Eucalyptus chloroclada.	Minor drainage depression, but no channel.
43	[redacted]	[redacted]	As above for site 42, but with channel in drainage depression.	Minor drainage depression with channel.
44	[redacted]	[redacted]	Another drainage depression. As for site 42.	Drainage depression.
45	[redacted]	[redacted]	As for site 41, but also with Melaleuca decora.	Probably a slightly wetter area.
46	[redacted]	[redacted]	Eucalyptus crebra, Angophora leiocarpa, Callitris glaucophylla.	Grid on [redacted], and gate to Lot. No east- west fence east of grid, but there is one to the west.
47	[redacted]	[redacted]	Eucalyptus crebra, Callitris glaucophylla, Corymbia sp. (probably C.watsoniana).	NW corner of Lot. Good access along both boundaries and along pipeline easement running ESE.
48	[redacted]	[redacted]	As for site 41.	Gate. Minor track access to east.
49	[redacted]	[redacted]	Eucalyptus crebra, Callitris glaucophylla, Eucalyptus populnea.	Gate on [redacted]. Minor track access to north between Lot 21 & Lot 22. RE 11.5.1 with minor 11.5.1a.
50	[redacted]	[redacted]	Eucalyptus crebra, Callitris glaucophylla, Allocasuarina luehmannii. Shrub layer of Acacia spp.	
51	[redacted]	[redacted]	Mainly Eucalyptus crebra, Allocasuarina luehmannii.	Start of fork into two gas pipeline easements to NNW.

Observation site	Easting (Zone 56# GDA94)	Northing (Zone 56# GDA94)	Vegetation description*	Comments
52	[redacted]	[redacted]	Eucalyptus crebra, Corymbia sp. (probably C.watsoniana), Acacia spp., minor Callitris glaucophylla.	Drainage depression, but no channel.
53	[redacted]	[redacted]	Semi-advanced regrowth, or possibly stunted, Eucalyptus sp. (probably E.tenuipes), Callitris glaucophylla, Acacia spp., Corymbia sp. (probably C.watsoniana), Eucalyptus crebra.	
54	[redacted]	[redacted]	Shrubland of Acacia aprepta for last 100m of road. 1 large Eucalyptus populnea in corner of Lot 21 but no others.	East end of [redacted], with gate SE to [redacted]. Also gate to NE property. No track to Lot 21 but fenceline is cleared.

** naturalised (weed or exotic) species indicated by **

 # note that this site [redacted] is further east than the other two sites [redacted] and is in MGA Zone 56 (and not 55).

Department of Agriculture, Fisheries and Forestry
Biosecurity Queensland

Fact sheet

DECLARED CLASS 1 AND 2 PEST PLANT

December 2014

Prickly pear

Opuntia, *Nopalea* and *Acanthocereus* spp.

The introduction and spread of prickly pear into Queensland and New South Wales is one of the greatest environmental invasions of modern times.

Prickly pear was introduced into pastoral districts in the 1840s. By 1900, over 4 million hectares in Queensland and New South Wales was infested by prickly pear. By 1925, the pest had invaded over 24 million hectares. Control costs were prohibitive and the only affective herbicide at the time was hazardous. This resulted in landholders abandoning large tracts of land.

Research for biological control agents commenced in 1912, and in 1914 cochineal insects were released to control one of the minor prickly pear species. Control of this minor prickly pear species by these introduced insects occurred within a few years.

The success of the cochineal insects led to renewed efforts against other types of prickly pear in the 1920s. These efforts resulted in the control of the major past prickly pear by the moth *Cactoblastis cactorum*; by the mid-1930s, prickly pear was no longer a major problem.

Several prickly pear species have since remained as minor weeds.

Great state. Great opportunity.

Queensland Government

Declaration details

O. ficus-indica is not declared. *O. Stricta, O. aurantiaca, O. monacantha, O. tomentosa* and *O. streptacantha* species are Class 2 declared pest plants and all other species are declared Class 1 under Queensland legislation.

Description and general information

'Prickly pear' is a general term used to describe some plants of the Cactaceae family. The term includes species of *Opuntia, Nopalea* and *Acanthocereus*. All of these plants originate in the Americas. The term 'prickly pear' also relates to the fruit, which is often spiny and pear-shaped. Plants are normally leafless succulent shrubs. Stems are divided into segments (pads or joints) that are flat and often incorrectly called leaves.

Young shoots have true leaves resembling small fleshy scales that fall off as the shoot matures.

Flowers are large, normally seen during spring and can be yellow, orange, red, pink, purple or white depending on the species. Prickly pear fruits vary between species and can be red, purple, orange, yellow or green.

Areoles (spots with clusters of spines) are found on both the pads (joints, segments) and fruit. In addition to spines, areoles often have clusters of sharp bristles (glochids) and tufts of fibre ('wool'). Each areole contains a growing point that can produce roots or shoots.

Life cycle

Prickly pear species have several features that enable them to compete and become pests.

Prickly pear species are drought resistant because of their succulent nature, their lack of leaves and their thick, tough skins. These features result in plants that use the majority of their internal tissues for water storage and their outer parts to reduce water loss and damage by grazing and browsing animals. They can remain vigorous in hot, dry conditions that cause most other plants to lose vigour or even die. Some species develop underground bulbs that enable the plant to resist fire and mechanical damage.

Prickly pear species reproduce both sexually and asexually. Birds and other animals readily eat the many-seeded fruits and deposit seeds in their droppings. The seeds have hard seed coats that allow them to survive heat and lack of water. Asexual reproduction (cloning) of prickly pear occurs when pads (joints, segments) or fruits located on the ground take root and produce shoots. Animals and floods move broken pads long distances. These pads can survive long periods of drought before weather conditions allow them to set roots.

Habitat and distribution

Prickly pear species considered pests in Queensland are:

- Common pest pear — *Opuntia stricta* var. *stricta* (= *O. inermis*)
- Spiny pest pear — *Opuntia stricta* var. *dillenii* (= *O. stricta*)
- Tiger pear — *Opuntia aurantiaca*
- Drooping tree pear — *Opuntia vulgaris* (= *O. monacantha*)
- Velvety tree pear — *Opuntia tomentosa*
- Westwood pear — *Opuntia streptacantha*
- Devil's rope pear — *Opuntia imbricata*
- Coral cactus — *Opuntia cylindrica*
- Snake cactus — *Opuntia fulgida* × *O. imbricate*
- Sword pear — *Acanthocereus pentagonus*

Common pest pear (*Opuntia stricta* var. *stricta*)

This bushy, spreading plant grows up to 1.5 m high and forms large clumps. The stems are divided into oval, blue-green spineless pads 20 cm long and 10 cm wide. Areoles are in diagonal lines along the pads 2.5 cm to 5 cm apart and have a cushion of brown wool containing bristles but usually no spines. When spines occur they are stout, yellow and up to 4 cm long.

Common pest pear produces flowers that are 7.5 cm wide, bright lemon yellow and green at the base. The fruit is oval-shaped, has a deep cavity on one end and tapers at the other. It is purple, 6 cm long and 3 cm wide, with carmine-coloured (dark red) seeds and a fleshy pulp.

Common pest pear is found as small to large clumps of varying density. The clumps are usually broken up by the action of *Cactoblastis cactorum*. Common pest pear occurs throughout most of central and southern Queensland and is still spreading westwards. It is often found along beaches and on offshore islands.

Spiny pest pear (*Opuntia stricta* var. *dillenii*)

This succulent shrub grows 1–2 m high. The stems are hairless and bluish-green or dull green. The stems are divided into pads up to 30 cm long, 15 cm wide and 1–2 cm thick. The areoles have tufts of short and finely barbed bristles accompanied by one or two yellow spines between 2 cm and 4 cm long. Small scale-like leaves are found on areoles of immature pads.

Spiny pest pear produces 6–8 cm wide flowers that are lemon yellow with green or pink markings on the back. The fruit is pear-shaped and about 4–6 cm long with a red-purple skin. The areoles located on fruits have fine, barbed bristles. The red flesh of fruits contains rounded seeds that are yellow or pale brown.

While this prickly pear once formed large-scale dense infestations, it is now found as small clumps or as scattered plants. These clumps are usually broken by the action of *Cactoblastis cactorum*. It is found in eastern central Queensland, the Burnett district, the Darling Downs and south-eastern Queensland.

Tiger pear (*Opuntia aurantiaca*)

This succulent low shrub with underground tubers usually grows 30–60 cm high. The stems are divided into very spiny, slightly flattened pads that are 1–30 cm long and 1–5 cm wide. The stems are dark green to purple and red in colour. The areoles have 3–7 brown barbed spines up to 4 cm long surrounded by tufts of short, fine bristles. The pads detach easily and are transported on the skins of animals. Small and scale-like leaves are found on areoles of immature pads.

Tiger pear produces 6 cm wide yellow flowers. The rarely formed fruits are pear-shaped and about 2.5 cm long. When ripe, they are red with purple markings.

Dense tiger pear forms an impenetrable spiny groundcover and is prevalent in southern Queensland but extends into central Queensland.

Drooping tree pear (*Opuntia vulgaris*)

This erect succulent shrub with fibrous roots grows up to 5 m high but is usually 2–3 m high. The branches are divided into glossy light green pads up to 45 cm long, 15 cm wide and 1.5 cm thick. The dark grey trunk grows up to 25 cm in diameter. Drooping tree pear gets its name because the upper segments tend to droop. The areoles on the older pads have 1–5 sharp spines about 5 cm long.

Small, scale-like leaves are found on areoles of very young pads and are quickly shed as the pad grows. Drooping tree pear produces yellow flowers that are 6 cm wide and have red markings on the back. The fruit is pear-shaped and 4–7 cm long with a green skin. The flesh of the fruit is red and pulpy and contains round seeds that are yellow or pale brown. The fruits have areoles with tufts of fine, barbed bristles.

Dense thickets result when drooping tree pear is allowed to grow freely. Small scattered infestations occur in the south-east corner of Queensland and in coastal northern Queensland.

Velvety tree pear (*Opuntia tomentosa*)

This tree-like plant forms a central woody trunk over 40 cm wide and grows up to 5 m high. The stems are divided into oblong pads that are dull green and velvety to touch due to the dense covering of short fine hairs. The pads are 15–35 cm long, 8–12 cm wide and 1.5–2 cm thick.

Young plants have 2–4 white or pale yellow spines located in the areoles with one spine reaching a length of 2.5 cm. The areoles usually become spineless as the plant matures. A more spiny variety does exist and has more than 50 spines in each areole on the trunk.

The flowers are a deep orange. The fruit is egg-shaped, about 5 cm long and 3 cm wide, and dull red. The top of the fruit is saucer-shaped with circular lines that meet in the centre and give the fruit a shrivelled appearance. The fruit produces many seeds within a reddish pulp.

Velvety tree pear is found predominantly throughout the brigalow belt of Queensland and is still extending its range. It is occasionally found as dense shrubs, but more usually as small clumps of trees or as trees scattered over the landscape.

Westwood pear or Cardona pear (*Opuntia streptacantha*)

Westwood pear is a shrub-like or tree-like plant that forms clumps by branching from the base and is usually 2–4 m high. The stems are divided into almost circular dull green pads, 25–30 cm long and 15–20 cm wide. The areoles have white spines that vary in number and size when the plant matures.

Young pads have 2–5 white spines 1–2 cm long, accompanied by two hair like spines 0.5 cm long in the lower part of the areole. Spines increase in number (up to 20) and size (5 cm long) in areoles along the trunk of the plant.

The flowers are yellow and fruits are barrel-shaped, 6 cm long and 5 cm wide with a flat top. The fruit has a purple skin and a rind that is 1 cm thick. Fruits contain red seeds buried in a dark red (carmine) pulp.

Westwood pear is found in eastern central Queensland as small clumps or as plants scattered over the landscape.

Devil's rope pear (*Opuntia imbricata*)

This open-branching shrub grows 1.5–3 m high. The stems are divided into hairless, dull green, cylindrical pads that vary up to 37 cm in length and are 3.5–5 cm thick. The pads have a series of short raised ridges that give them a twined, rope-like appearance. The areoles are found on these ridges and produce 3–11 pale yellow or white spines, with the longest being 2.5 cm long. Papery sheaths cover these spines.

The flowers are a dull, red-purple colour and found at the ends of pads. The yellow fruit resembles a small, 5 cm wide custard apple and has a spineless areole at the top.

Devil's rope pear occurs in Queensland as a small infestation at Gladfield.

Coral cactus (*Opuntia cylindrica*)

Coral cactus grows as a branching shrub 1–1.5 m high. The stems of coral cactus are divided into green cylinder-like pads that are fist-like and obtuse at their apex. Mature coral cactus pads widen, become distorted and wavy, and resemble a piece of coral. Areoles along the pads have a number of short white spines.

Coral cactus produces small (1–2 mm wide) scarlet flowers. The fruit is yellow green and 2–5 cm wide.

Coral cactus has been located near Mount Isa, Longreach, Wyandra, Eulo and Hungerford but its potential spread includes all of far western Queensland.

Snake cactus (*Opuntia fulgida* × *O. imbricata*)

This open-branching shrub grows 1–2 m high. The stems are divided into hairless, dull green, cylindrical pads that vary up to 20 cm in length and are 3.5–5 cm thick. The pads have a series of short raised ridges that give them a twined rope-like appearance. The areoles are found on the bottom of these ridges and produce 5–10 pale yellow to brown spines, with the longest being 3 cm long.

The flowers are light red to dark rose and commonly 5–7 cm wide. Snake cactus produces fruit that is yellow and 2–5 cm wide.

Snake cactus has been located near Longreach but its potential spread includes all of north-western Queensland.

Sword pear (*Acanthocereus pentagonus*)

This elongated branching shrub grows in clumps up to 4 m high. The stems are erect, up to 1.5 m long, 3–8 cm wide and divided into many joints. Sword pear stems are three-angled, four-angled or five-angled and resemble star-picket posts. The areoles are found on the edges of the joints and produce many white spines 1–4 cm long.

The flowers are white, funnel-shaped and 14–20 cm long. The flowers open at night between spring and summer. Sword pear produces bright red sphere-shaped fruits that are 5 cm in diameter. The fruit has a red pulp and black seeds.

Sword pear occurs in the Gogango area west of Rockhampton.

Control

Biological control

Investigations into biological control agents against prickly pear began in 1912. Over 150 insect species were studied throughout the world, with 52 species selected for transport to Queensland. Following intensive host specificity testing, 18 insects and one mite were released in Queensland. Nine insects and the mite remain established in Queensland. These species are:

- *Cactoblastis cactorum*, a stem-boring moth
- *Dactylopius ceylonicus*, a cochineal mealy bug
- *Dactylopius opuntiae*, a cochineal mealy bug
- *Dactylopius confusus*, a cochineal mealy bug
- *Dactylopius tomentosus*, a cochineal mealy bug
- *Dactylopius austrinus*, a cochineal mealy bug
- *Chelinidea tabulata*, a cell-sucking bug
- *Tucumania tapiacola*, a stem-boring moth
- *Archlagocheirus funestus*, a stem-boring beetle
- *Tetranychus opuntiae*, prickly pear red spider mite.

These biological control agents continue to keep several prickly pear species under control. It is important to remember not all the agents attack all species.

The most successful of these agents were the moth *Cactoblastis cactorum* and five cochineal mealy bugs—*Dactylopius ceylonicus*, *D. opuntiae*, *D. confusus*, *D. tomentosus* and *D. austrinus*. The other agents are still around but not in sufficient numbers to provide control.

Cactoblastis cactorum (cactoblastis moth)

Larvae of this moth were introduced from Argentina in 1925. Cactoblastis proved to be the most effective agent against the common and spiny pest pears, destroying massive infestations in Australia. Larvae keeps these two pest pears controlled to an acceptable level most of the time, although it is less effective in some coastal and far western areas.

The larvae collectively eat out the contents of the pads, leaving empty pad skins and piles of mushy droppings. The orange and black larvae are occasionally observed on the outsides of pads. Cactoblastis also attacks most types of prickly pear but is not effective against them.

Dactylopius spp. (cochineal insects)

All female cochineal insects are small, sessile mealy bugs that spend their adult lives permanently attached to their host plants sucking plant juices. They are covered by a fine, white, waxy secretion and when crushed yield a carmine colouring. The adult males are small, free-flying insects that do not feed.

Dactylopius ceylonicus (monacantha cochineal, Argentine cochineal)

This South American mealy bug was released in 1914 and 1915 to control drooping tree pear. It destroyed the dense infestations existing at that time. It is specific to drooping tree pear and today remains the only effective biological control agent for drooping tree pear. This insect needs to be distributed manually.

***Dactylopius opuntiae* (prickly pear cochineal)**

This mealy bug was introduced from Mexico and southern United States between 1920 and 1922. It is effective against common pest pear, spiny pest pear, velvety tree pear and Westwood pear and remains the main biological control agent against velvety tree pear and Westwood pear. This insect spreads slowly in nature and can be assisted manually.

***Dactylopius confusus* (prickly pear cochineal)**

This mealy bug was introduced from Florida and released in 1933 against spiny pest pear. It remains effective against spiny pest pear in central Queensland but spreads slowly. This insect can be spread manually.

***Dactylopius tomentosus* (devil's rope pear cochineal)**

This mealy bug was introduced from southern United States in 1925 and 1926. It is effective against devil's rope pear but works slowly.

***Dactylopius austrinus* (tiger pear cochineal)**

This mealy bug was introduced from Argentina in 1932. It is specific to and effective against tiger pear. It rapidly reduces tiger pear populations but dies out in a paddock after the destruction of tiger pear. It needs to be reintroduced after tiger pear regrows.

***Chelinidea tabulata* (prickly pear bug)**

This plant-sucking bug was introduced from Texas in 1921. It was effective against dense common pest pear before *Cactoblastis cactorum* was but is now relatively ineffective. This insect also attacks most other prickly pears. The adult is a pale brown bug up to 20 mm long that leaves characteristic round bleached spots on the surface of the cactus.

***Tucumania tapiacola* (prickly pear moth-borer)**

This moth was introduced from Argentina in 1934 against tiger pear. Its solitary larvae feed internally and eat out tiger pear pads with limited effect. It has been observed attacking common pest pear and harrisia cactus.

***Archlagocheirus funestus* (tree pear beetle)**

This stem-boring beetle was introduced from Mexico in 1935. It was effective against velvety tree pear and Westwood pear but has become rare since the dense stands of these prickly pears have gone.

***Tetranychus opuntiae* (prickly pear spider mite)**

This mite was introduced from southern United States and Mexico in 1922. It was effective against common pest pear but is now rare and difficult to find. It causes distinctive scar tissue formation around areoles.

Distributing biological control agents

Cactoblastis

Cactoblastis can be spread manually by distributing eggs or larvae. Cactoblastis moths lay chains of eggs (eggsticks) on prickly pear pads from January to February and from September to November. The eggsticks are distinguished from spines by their curved appearance.

1. Collect the fragile eggsticks carefully.
2. Glue single eggsticks to small pieces of paper using a starch-based adhesive.
3. Pin the egg papers to prickly pear pads. (Eggs take up to one month to hatch.)
4. Collect pads or plants in which larvae are obviously still active.
5. At a release site place all the collected plant material in a small part of the infestation.
6. Subsequent generations of moths will disperse through the infestation.
7. Follow up the biological control with either herbicide or mechanical treatment.

Cochineals

Because several cochineal insects affect some prickly pears and not others, it is essential to know what prickly pear you wish to control.

1. Identify your prickly pear type.
2. Find the same prickly pear type which is being attacked by a cochineal.
3. Collect pads of the prickly pear with the insects.
4. Place affected pads against unaffected prickly pears at the release site.
5. Follow up the biological control with either herbicide or mechanical treatment.

Tiger pear cochineal

Tiger pear cochineal is easy to multiply quickly after collection.

1. Carefully collect a reasonable quantity of unaffected tiger pear in a container (box or bucket).
2. Place a few pieces of cochineal-affected tiger pear into the same container.
3. Cover the container with a cloth and store under cover for a few weeks.
4. Check the cactus occasionally.
5. When most of the tiger pear in the container has cochineal, it is ready to distribute.
6. At the release site place affected pads against unaffected prickly pears.
7. Follow up the biological control with either herbicide or mechanical treatment.

Note: It is best to multiply tiger pear cochineal before release.

Pest name	Situation	Herbicide	Rate	Method
Tiger pear	Agricultural land—non-crop	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	
	Forests—timber production	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
			3 L/100 L or 1 L/75 L diesel	Foliar
	Land—commercial/ industrial/public	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
			3 L/100 L or 1 L/75 L diesel	Foliar
	Land—non-agricultural	Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
	Land—rights of way	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
			3 L/100 L or 1 L/75 L diesel	Foliar
	Pastures	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (600 g/L)	3 L/100 L or 0.8 L/60 L diesel	Basal bark/cut stump
			3 L/100 L or 1 L/75 L diesel	Foliar
Drooping tree pear	Agricultural land—non-crop	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (600 g/L)	0.8 L/60 L diesel	
	Forests—timber production	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (300 g/L) + picloram (100 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	0.8 L/60 L diesel	Basal bark/cut stump
			1 L/75 L diesel	Foliar
	Land—around buildings	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
	Land—commercial/ industrial/public	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
		Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (300 g/L) + picloram (100 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	0.8 L/60 L diesel	Basal bark/cut stump
			1 L/75 L diesel	Foliar
	Land—non-agricultural	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
		Triclopyr (300 g/L) + picloram (100 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	0.8 L/60 L diesel	Basal bark/cut stump
	Land—rights of way	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	Basal bark/cut stump
		Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	
		Triclopyr (300 g/L) + picloram (100 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	0.8 L/60 L diesel	Basal bark/cut stump
			1 L/75 L diesel	Foliar

Continued

7 **Prickly pear** *Opuntia*, *Nopalea* and *Acanthocereus* spp.

Pest name	Situation	Herbicide	Rate	Method
Drooping pear	Pastures	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
		Triclopyr (300 g/L) + picloram (100 g/L)	0.5 L/100 L	
		Triclopyr (600 g/L)	0.8 L/60 L diesel	Basal bark/cut stump
			1 L/75 L diesel	Foliar
Velvety tree pear	Agricultural land—non-crop	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
	Forests—timber production	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
	Land—around buildings	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
Velvety tree pear	Land—commercial/ industrial/public	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
		Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
	Land—non-agricultural	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
	Land—rights of way	Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)	1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)	
		Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
	Pastures	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump
Spiny pest pear Westwood pear Devil's rope pear Snake cactus	Agricultural land—non-crop Forests—timber production Land—commercial/ industrial/public Land—rights of way Pastures	Triclopyr (240 g/L) + picloram (120 g/L)	1 L/60 L diesel	Basal bark/cut stump

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

Wildlife Online Report

Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Status: All
Records: All
Date: All
Latitude: [redacted]
Longitude: [redacted]
Distance: 5
Email: [redacted]
Date submitted: Friday 27 Feb 2015 09:05:19
Date extracted: Friday 27 Feb 2015 09:10:02

The number of records retrieved = 21

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
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		1
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		1
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		1
animals	birds	Cacatuidae	*Eolophus roseicapillus*	galah		C		1
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		1
animals	birds	Meliphagidae	*Nesoptilotis leucotis*	white-eared honeyeater		C		2
animals	birds	Meliphagidae	*Caligavis chrysops*	yellow-faced honeyeater		C		1
animals	birds	Meliphagidae	*Manorina melanocephala*	noisy miner		C		1
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		1
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		1
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		1
animals	birds	Pardalotidae	*Pardalotus punctatus*	spotted pardalote		C		1
animals	birds	Petroicidae	*Eopsaltria australis*	eastern yellow robin		C		1
animals	reptiles	Varanidae	*Varanus panoptes*	yellow-spotted monitor		C		1
plants	higher dicots	Asteraceae	*Olearia ramulosa*			C		1/1
plants	higher dicots	Haloragaceae	*Gonocarpus urceolatus*			C		1/1
plants	higher dicots	Lamiaceae	*Westringia cheelii*			C		1/1
plants	higher dicots	Myrtaceae	*Micromyrtus gracilis*			C		1/1
plants	higher dicots	Rhamnaceae	*Cryptandra ciliata*			NT		1/1
plants	monocots	Poaceae	*Aristida jerichoensis*			C		1/1
plants	monocots	Poaceae	*Schizachyrium fragile*	firegrass		C		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

Toward | Queensland Government

Prepared by:

Environment and Resource Sciences

Department of Environment and Resource Management

August 2010

Contents

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.

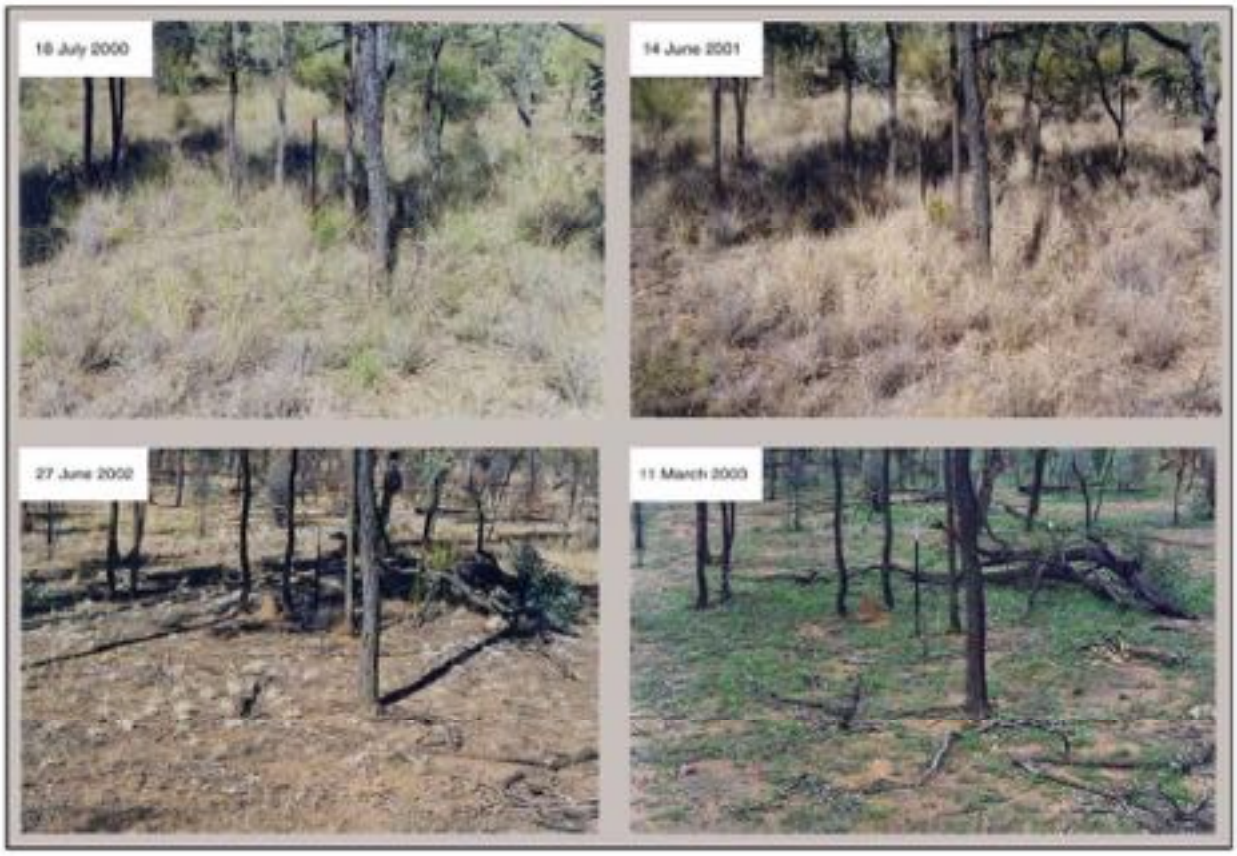


Figure 1: Photographs comparing ground cover at the same point over a three year span

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).

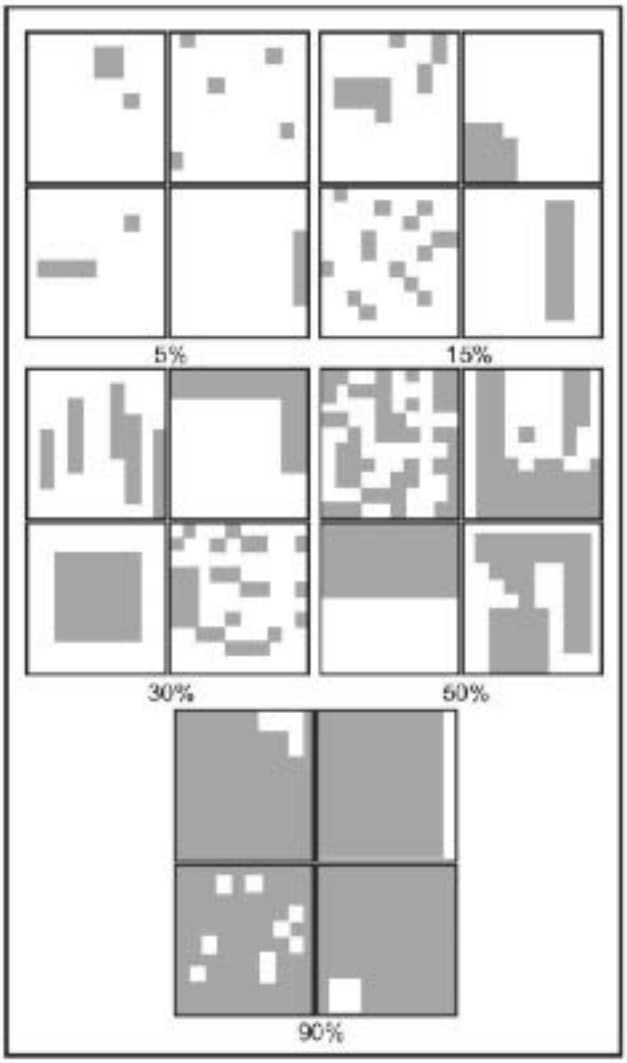


Figure 2: Examples of ground cover patterns as they appear in a quadrat for 5%, 15%, 30%, 50% and 90% cover (Department of Natural Resources 1997)

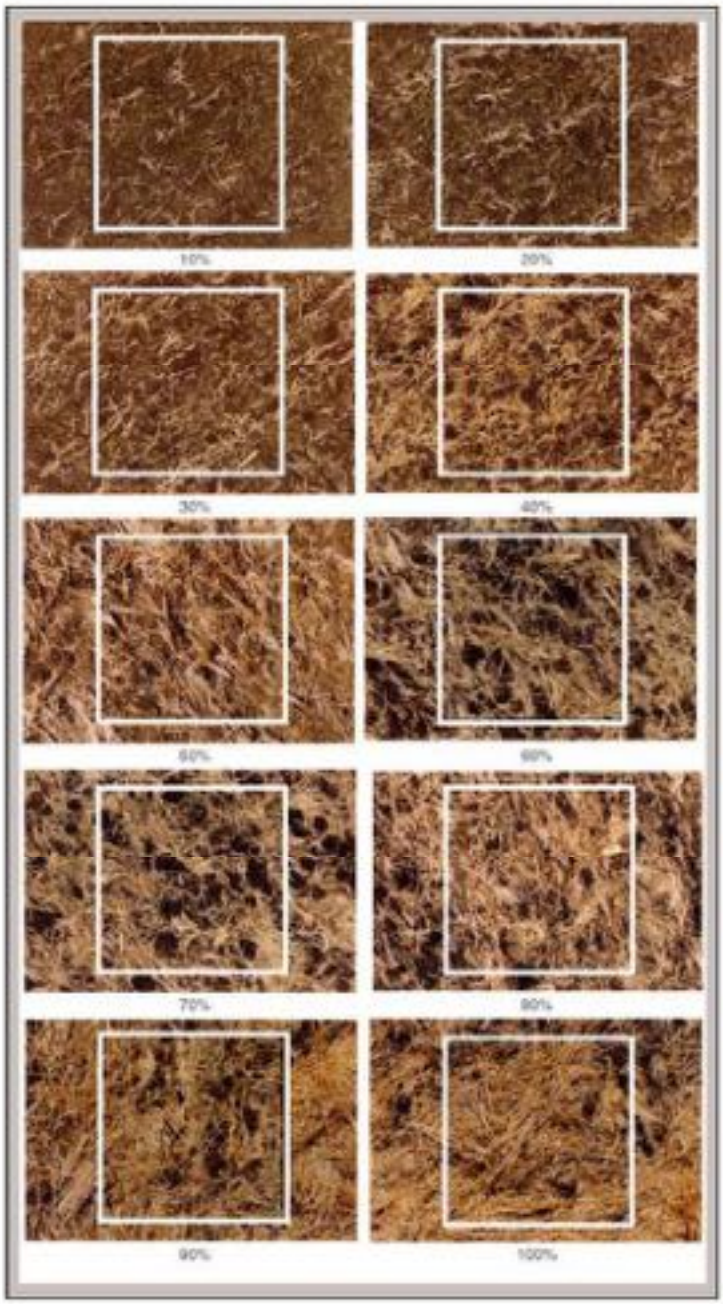


Figure 3: Photographs of wheat stubble cover levels in 10% increments (Molloy 1988)

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.

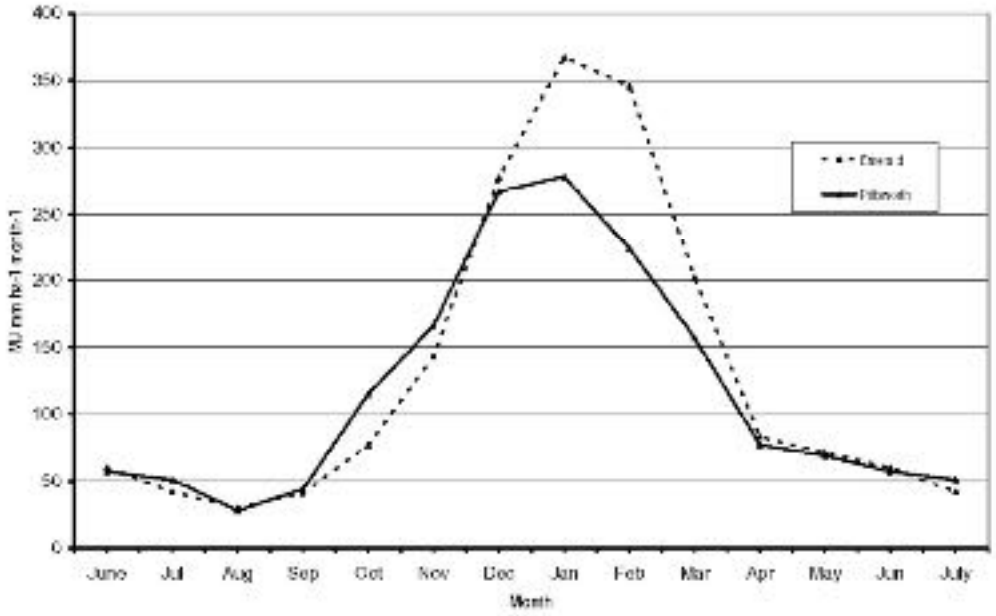


Figure 4: Average monthly rainfall erosivity values for Emerald and Pittsworth

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.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>.

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).

A Queensland Department of Environment and Resource Management state wide ground cover monitoring program reports annually on percentage of ground cover in Queensland based on Landsat imagery starting in 1988. This low cost imagery enables a more dynamic monitoring of ground cover by remote sensing and opens up new opportunities for monitoring and time series analysis of up to 20 images per year. Recent research by the Queensland Department of Environment and Resource Management (as at 2010) indicates that ground cover may soon be able to be monitored remotely and at low cost with the ability to distinguish between bare ground, green vegetation and dry (or non-green) vegetation cover.

The use of photopoints is recommended to support any system of assessing ground cover.

Use of photopoints – photographic records

It is preferable that a photographic record is kept for all ground cover monitoring sites. A sequence of photos taken annually from exactly the same location in a paddock can record changes in ground cover, woody plant populations and feed availability (Figure 1). They show the long-term effects of management as well as short-term changes caused by seasonal conditions and the effects of grazing management.

Photos should be taken on a clear day between 9 am and 3 pm. You will always get a better photo by having the sun behind your back. To do this you need to be facing south (in the Southern Hemisphere!). Photos can be taken from two angles: the 'trayback' and the 'landscape'.

The 'trayback' photo

This photo angle will best illustrate ground condition and the amount of feed available in a pasture. A step ladder could be used as an alternative to a vehicle. The vehicle trayback is set up at the post from which the photo is being taken (Figure 5). Facing south, focus the middle of the viewfinder on the base of the sighter post.

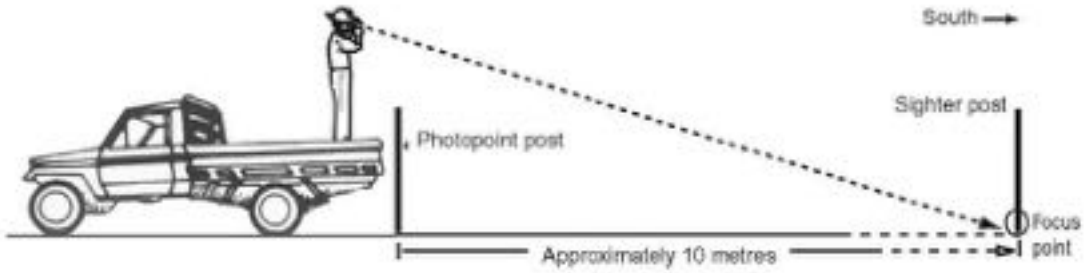


Figure 5: Taking the 'trayback' photo (Department of Natural Resources 1997)

The landscape photo

This photo angle will best illustrate the general condition of the site showing major changes in shrub and tree populations. Stand next to the photopoint post as in Figure 6. Position the top of the sighter post in the middle of the viewfinder and focus on infinity.

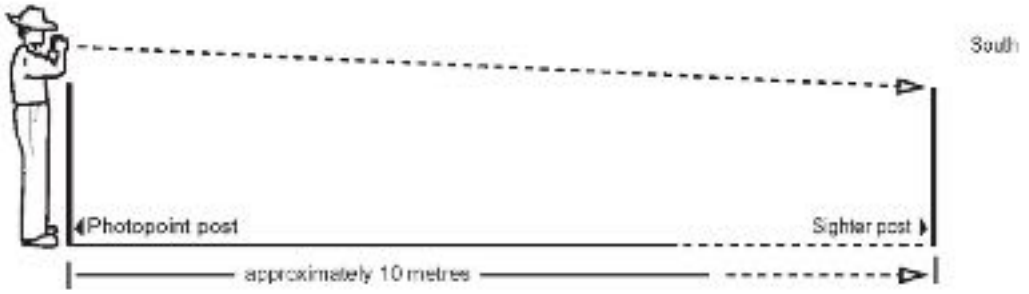


Figure 6: Taking the landscape photo (Department of Natural Resources 1997)

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 my 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.

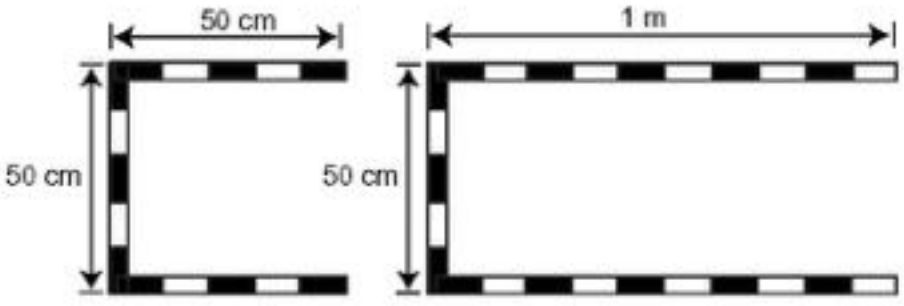


Figure 7: Two types of quadrats used for measuring ground cover

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 point 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.

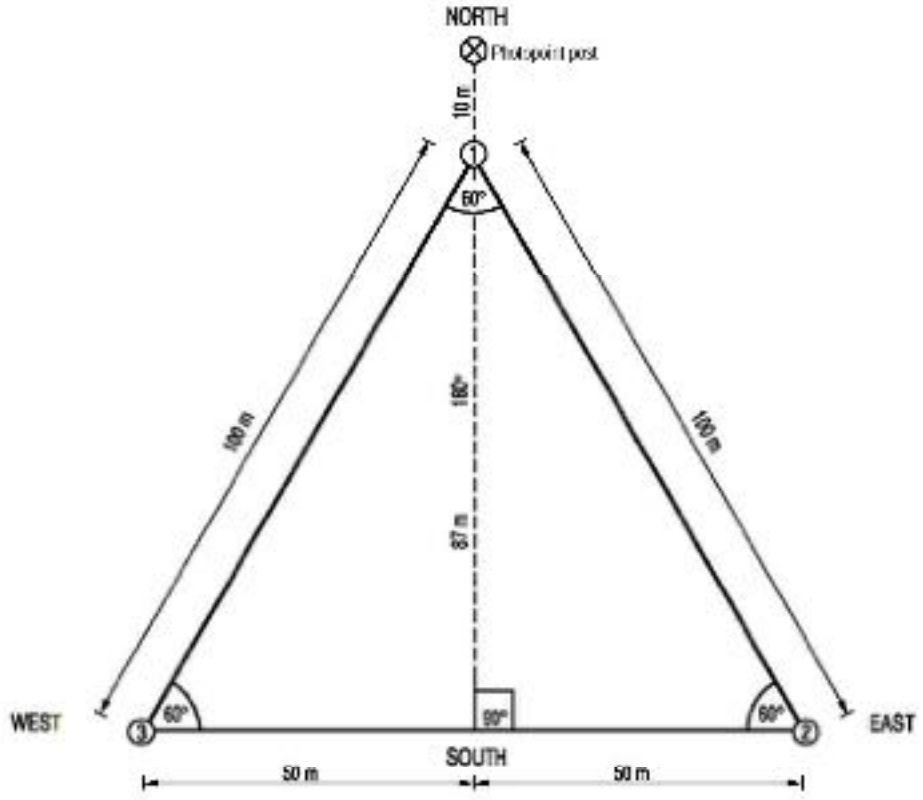


Figure 8: Approximate dimensions for a monitoring triangle

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 'moves' 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 photos.

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.

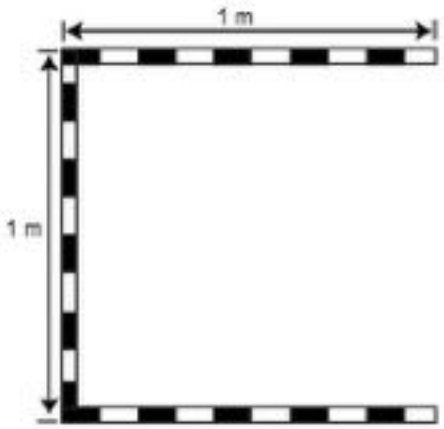


Figure 9: Quadrat recommended for use in measuring ground cover for BioCondition assessment

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.

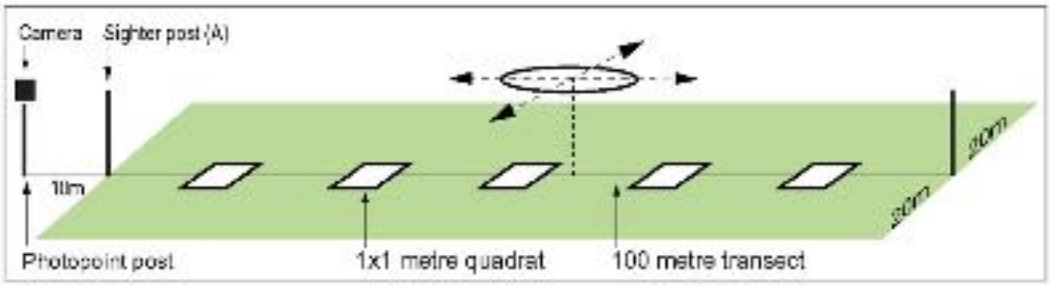


Figure 10: Standard monitoring site for BioCondition Assessment

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 galloping 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).

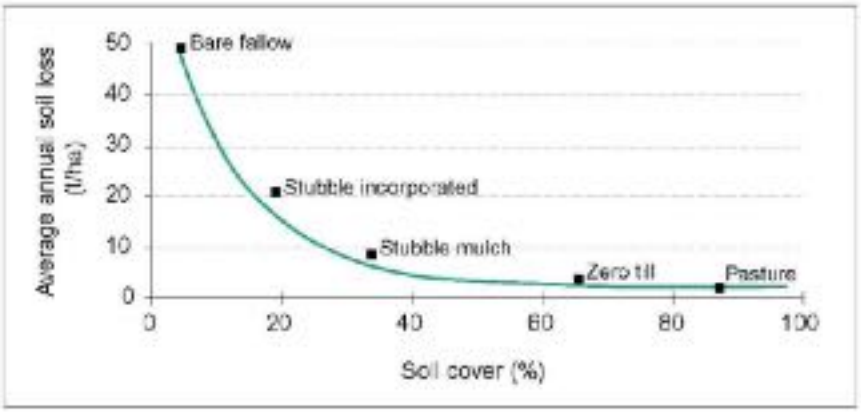


Figure 11: Annual average soil loss (1978–92) vs. cover for contour bay catchments on the eastern Darling Downs (Freebairn 2004)

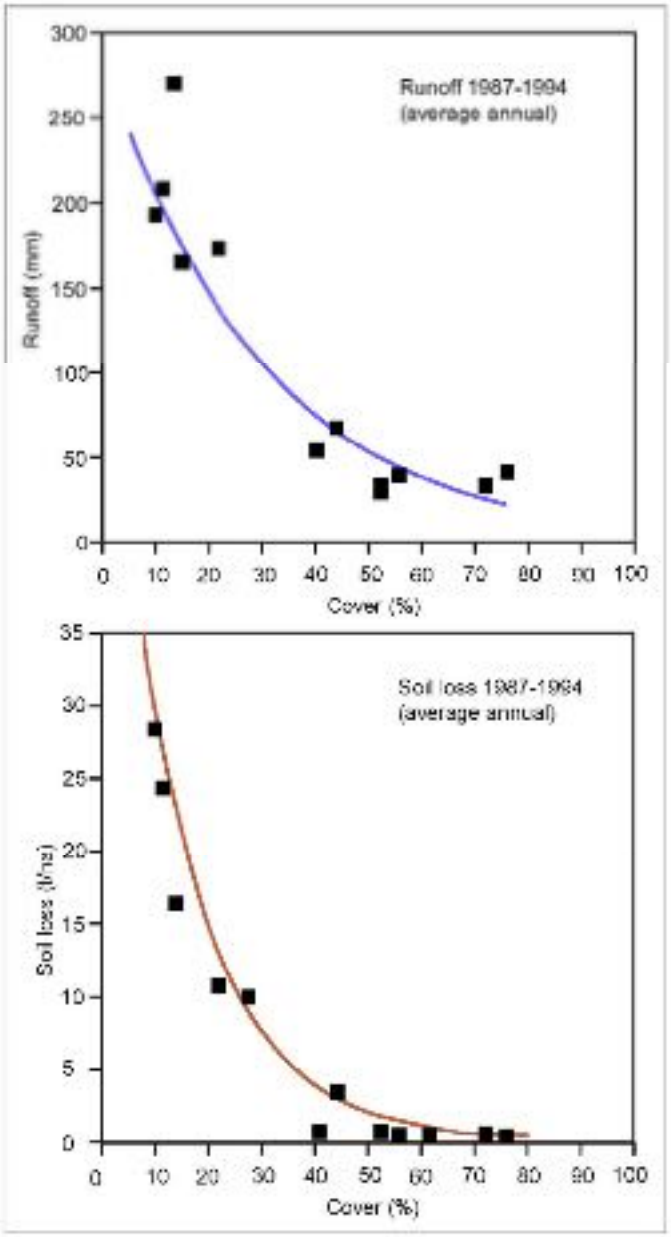


Figure 12: Average annual runoff and soil loss (1987–94) vs. ground cover for native pasture in Central Queensland (Mark Silburn, Queensland Department of Natural Resources and Water, pers. comm. 2005)

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.

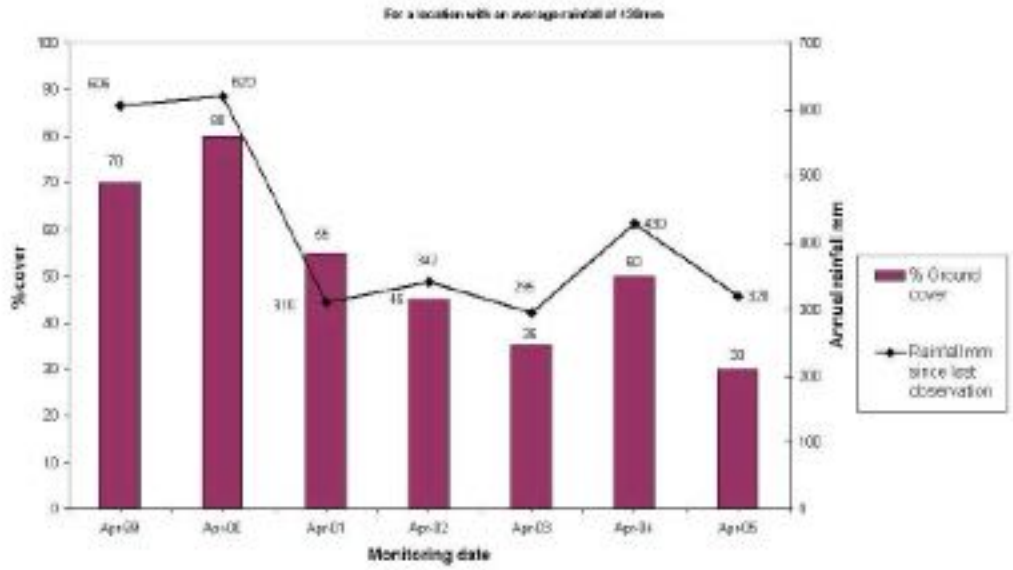


Figure 13: Rainfall and changes in pasture ground cover from 1999 to 2005

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/rainfallandpasturegrowthindex.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 grass fire 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 rates 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

protection from erosion as well as providing organic matter to improve the water-holding capacity of the soil. Cover may also be provided by using a surface mulch of plant residue from crops such as pineapples and bananas while in many tree crops a grass sod is recommended beneath the trees.

Urban areas

In an established urban environment, adequate ground cover should be provided by appropriate landscaping. Vulnerable areas will be land that has been disturbed while it is undergoing development and areas subject to high rates of pedestrian traffic on land that has not been given adequate protection (e.g. school grounds often have bare areas where high rates of runoff and erosion may occur).

A range of specialised products including hydromulching and geotextiles can be used to provide surface cover and to manage runoff on development sites. Disturbed land in urban areas is sometimes protected by fast-growing vegetation such as millet (summer growing) or oats (winter growing). These plants provide protection while the soil is in a loose and friable condition. When these annual crops mature, the remaining stubble will continue to provide some protection and by this time the soil will have consolidated and be less prone to erosion.

Protected areas

Private landholders can assist with maintaining biodiversity by providing a nature refuge on their property with assistance provided by the Queensland Department of Environment and Resource Management. A nature refuge is established via a voluntary conservation agreement between a landholder and the Queensland Government. A nature refuge is a category of protected area under the *Nature Conservation Act 1992*.

Each agreement is tailored to suit the management needs of the particular area and the needs of the landholder. In most cases, the agreement allows for the ecologically sustainable use of natural resources to continue. A nature refuge can cover part or all of a property protecting wildlife and wildlife habitat and emphasising the conservation of biodiversity as an important part of property management.

Other information sources

Books

Boulter, SL, Wilson, BA, Westrup, J, Anderson, ER, Turner, EJ, and Scanlan, JC (Editors) 2000, *Native vegetation management in Queensland – Background science and values*, Queensland Department of Natural Resources.

Tongway, DJ and Hindley, NL 2005, *Landscape function analysis – Procedures for monitoring and assessing landscapes, with special reference to minesites and rangelands*, CSIRO Sustainable Ecosystems.

CD-ROMs

Department of Primary Industries 2003, *Pasture Photo Standards CD*, Queensland Department of Primary Industries, .is available from the Queensland Government Bookshop <https://www.bookshop.qld.gov.au/> - Search for ' Pasture photo standards'.

PrimeNotes CD ROM Version 18 produced in May 2005 by the Queensland Department of Primary Industries and Fisheries contains over 5000 fact sheets about issues related to natural resource management and agricultural production. Fourteen agencies throughout Australia contributed information to the CD. This publication is available from some libraries.

Fact sheets

The Queensland Department of Environment and Resource Management has several fact sheets that are related to this topic:

- Soil limitation to water entry – understanding restrictive soil layers (L40)
- Erosion control in cropping land (L13)
- Erosion in school grounds (L42)
- Erosion control in grazing lands (L91)
- Managing for drought in grazing lands (L90)
- Identifying and monitoring salt-affected areas (L53)
- Catchments and water quality (C2)

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

Malloy, 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 Q192009, 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.		*e.g. Ground cover at "specified property"*
Name of the land manager or business responsible for the dataset.		
Brief assessment of reliability of the information in the dataset.		*Record which method you have decided to use, e.g. Level 1, 2a or 2b monitoring plus brief description of the method*
Brief history of the source and processing steps used to produce the dataset.		*Record which method you have decided to use, e.g. Level 1, 2a or 2b monitoring plus brief description of the method*
Maintenance and update frequency of the dataset.		
What location or area does the data relate to.		*Provide property or other location details and/or GPS Eastings and Northings*

The Land Manager's Monitoring Guide

Indicator: Ground cover

Level 1 field recording sheet - visual observations

Date							Recorder
	Observation number					Average	
Paddock name	1	2	3	4	5	% cover	Comments

The Land Manager's Monitoring Guide

Indicator: Ground cover

Level 1 example field recording sheet - visual observations

Date	30/2/05					Recorder	Jane W
	Observation					Average	
Paddock name	1	2	3	4	5	cover (%)	Comments
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	

The Land Manager's Monitoring Guide

Indicator: Ground cover

Level 1 field spreadsheet - pastures

Paddock name				
Site name number				
GPS reading				Additional data
Date	Ground cover (%)	Recording person	Comments (seasonal conditions, grazing pressure)	Rainfall mm since last observation

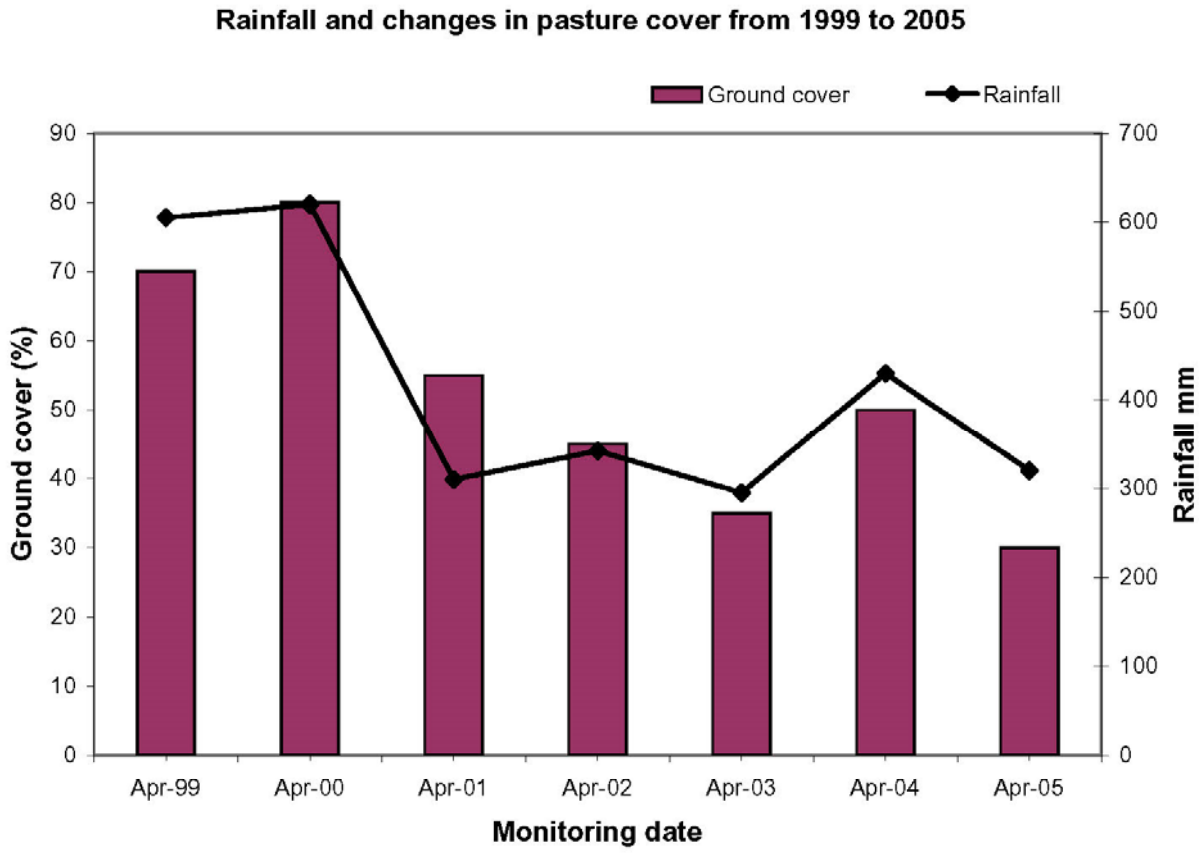
The Land Manager's Monitoring Guide

Indicator: Ground cover

Level 1 example field spreadsheet - pastures

Paddock name		Tank paddock		
Site name number				Additional data
Date	**Ground cover (%)**	**Recording person**	**Comments (seasonal conditions, grazing pressure)**	**Rainfall mm since last observation**
Apr-99	70	Jane W		605
Apr-00	80	Jane W		620
Apr-01	55	Jane W		310
Apr-02	45	Jane W		342
Apr-03	35	Jane W		295
Apr-04	50	Jane W		430
Apr-05	30	Jane W		320

The Land Manager's Monitoring Guide



For a location with an average rainfall of 430mm

The Land Manager's Monitoring Guide

Indicator: Ground cover

SCHEDULE 2: LEGALLY BINDING MECHANISM ON TITLE

Schedule 2a ([redacted])

Submit by Email | Print Form

Department of Natural Resources and Mines

Request for a Voluntary Declaration

Vegetation Management Act 1999

Section 1 - Proponent details

The proponent is the owner of the land and may comprise of more than one person where there is joint ownership of land.

Owner, of land includes -

(a) for freehold land - the registered owner; or
(b) for a lease, licence or permit under the Land Act 1994 - the lessee, licensee or permittee; or
(c) for indigenous land - the holder of title to the land; or
(d) for any tenure under any other Act - the holder of the tenure.

Extra pages may be attached to list additional owners.

All correspondence will be directed to the 'contact person'.

Purpose(s) of declaration

- [ ] participating in a conservation incentives program(s)
- [ ] carbon emission offsetting
- [x] to offset clearing associated with a development approval
- [ ] other conservation purposes

Owners of land

Title	Family name	Given name
	[redacted]	

Name of Company/Organisation (if the owner is a company): | ACN (if applicable):

Contact person

Title | Family name | Given name

Phone number | Mobile number | Fax number

Address

Postcode

Section 2 - Property Description and Tenure

This is the property on which the voluntary declaration area is proposed. The vegetation management plan should indicate the specific location of the proposed declared area on the property.

Extra pages may be attached to list additional lots.

Tenure of property(ies) containing proposed declaration area

Parcel (lot and plan)	Owner/s	Tenure (e.g. Freehold, Grazing Homestead Perpetual Lease)
Lot 9 SP1194	[redacted]	Freehold

Great state. Great opportunity.

Queensland Government

Section 3 - Registered interest holders in proposed declaration area

A registered interest is one registered under the Land Act 1994 or the Land Title Act 1994.

Registered interests are mortgages, leases, subleases, covenants, profit a prendes, easements and building management statements.

A declaration may not be made unless the holder of a registered interest (other than the proponent) in the proposed declaration area has consented in writing to the making of the declaration.

NOTE: Section 3 only requires the recording of registered interest **holders**– consent of registered interest holders is not required as part of the request. The proponent will need to seek written consent to the declaration of all registered interest holders once the Department has considered the request, and prior to the making of any declaration.

Extra pages may be attached to list additional lots and/or registered interest holders.

Parcel (lot and plan)	Type of Registered Interest	Registered interest holder's name and contact details

Section 4 - Type of declaration request

Specify the type of declaration that is requested, and the relevant criteria for the declaration. One or more of the criteria may be applicable to the area being sought for declaration.

The proponent must provide an explanation of how the declared area meets the criteria selected in this section. This explanation must be provided in the documents accompanying the request. The 'Guide to voluntary declarations under the *Vegetation Management Act 1999*' may be viewed for assistance in preparing a request.

☑ Area of high nature conservation value

- ☐ a wildlife refugium
- ☐ a centre of endemism
- ☑ an area containing a vegetation clump or corridor that contributes to the maintenance of biodiversity
- ☐ an area that makes a significant contribution to the conservation of biodiversity
- ☐ an area that contributes to the conservation value of a wetland, lake or spring.
- ☐ another area that contributes to the conservation of the environment

OR

☐ Area vulnerable to land degradation

- ☐ soil erosion
- ☐ rising water tables
- ☐ the expression of salinity, whether inside or outside the area
- ☐ mass movement by gravity of soil or rock
- ☐ stream bank instability
- ☐ a process that results in declining water quality

Section 5 - Management Plan

The Management Plan must contain all the components identified in this section. The Management Plan is to refer to the area identified in section 2 of this form. The Management Plan may also include any other information the applicant considers will assist in the determination of the request. For more information on the Management Plan, consult the Guide to Voluntary Declarations and the Management Plan template.

A Management Plan must accompany all voluntary declaration requests. The attached Management Plan

☑ contains the proponent's signature

☑ includes enough information to allow the chief executive to map the boundary of the stated area

☑ states the proponent's management intent, and management outcomes proposed by the proponent, for the conservation of the high nature conservation value of the area or the prevention of land degradation in the area

☑ states the activities the proponent intends to carry out, or refrain from carrying out, to achieve the stated management outcomes

☑ states the restrictions, if any, to be imposed on the use of, or access to, the area by other persons to achieve the stated management outcomes

Page 2 of 3

Section 6 - Information privacy statement

The Department of Natural Resources and Mines (DNRM) is collecting the information in this form and any attachments to process your request that the chief executive declare a stated area of land under the *Vegetation Management Act 1999*. The consideration of your request may involve consultation, and if so, details of your request and any attachments may be disclosed to third parties. These details will not otherwise be disclosed outside DNRM unless required or authorised by law.

Section 7 - Signature/s

The owner(s) of the land (proponent) must sign and date this section

If there are more than four owners, extra pages may be attached with a copy of the 'statement' with the signature(s)

A company:

- may execute a document without using a common seal if the document is signed by two (2) directors of the company or a director and a company secretary; or for a proprietary company that has a sole director who is also the sole company secretary - that director; or
- with a company seal may execute a document if the seal is fixed to the document and the fixing of the seal is witnessed by two (2) directors of the company or a director and a company secretary; or for a proprietary company that has a sole director who is also the sole company secretary - that director.

Statement

I/We

- consent to the collection and use of the personal information in this form for the purposes of assessing this request for a voluntary declaration under the *Vegetation Management Act 1999*; and
- declare that the information provided by me/us is true and correct

Proponent (Owner's) signature	Date	Company seal (if applicable)
	/ /	
Proponent (Owner's) signature	Date	
	/ /	
Proponent (Owner's) signature	Date	
	/ /	
Proponent (Owner's) signature	Date	
	/ /	

Office use only

Date received	Receiving officer	Reference number
/ /		

CURRENT TITLE SEARCH

DEPT OF NATURAL RESOURCES AND MINES, QUEENSLAND

Request No: 20004395
Search Date: 15/12/2014 10:34 **Title Reference: 50887354**
Date Created: 30/07/2012

Previous Title: 40064696

REGISTERED OWNER

Dealing No: 716595075 30/07/2012

[redacted]

DEED OF GRANT IN TRUST

THE GRANTEE TO HOLD THE SAID LAND IN TRUST FOR THE BENEFIT OF ABORIGINAL INHABITANTS AND FOR NO OTHER PURPOSE WHATSOEVER

ESTATE AND LAND

Estate in Fee Simple

LOT 18	CROWN PLAN BH164	
	County of BAUHINIA	Parish of BAUHINIA
	Local Government: WOORABINDA	
LOT 9	CROWN PLAN BH154	
	County of BAUHINIA	Parish of BAUHINIA
	Local Government: WOORABINDA	
LOT 5	CROWN PLAN KN135	
	County of KINBERLEY	Parish of WALLBURY
	Local Government: WOORABINDA	
LOT 39	CROWN PLAN KN148	
	County of KINBERLEY	Parish of DOARINGA
	Local Government: WOORABINDA	
LOT 1	CROWN PLAN LR146	
	County of LEURA	Parish of BALCOMBA
	Local Government: WOORABINDA	
LOT 73	CROWN PLAN WNA156	
	County of WOOROONA	Parish of WOOROONA
	Local Government: WOORABINDA	
LOT 135	SURVEY PLAN 241206	
	County of WOOROONA	Parish of WOOROONA
	Local Government: WOORABINDA	
LOT 136	SURVEY PLAN 241206	
	County of WOOROONA	Parish of WOOROONA
	Local Government: WOORABINDA	
LOT 137	SURVEY PLAN 241206	
	County of WOOROONA	Parish of WOOROONA
	Local Government: WOORABINDA	
LOT 138	SURVEY PLAN 241206	
	County of WOOROONA	Parish of WOOROONA
	Local Government: WOORABINDA	
LOT 139	SURVEY PLAN 241206	
	County of WOOROONA	Parish of WOOROONA
	Local Government: WOORABINDA	
LOT 140	SURVEY PLAN 241206	
	County of WOOROONA	Parish of WOOROONA

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CURRENT TITLE SEARCH

DEPT OF NATURAL RESOURCES AND MINES, QUEENSLAND

Request No: 28004395
Search Date: 15/12/2014 10:34 Title Reference: 50887354
Date Created: 30/07/2012

ESTATE AND LAND

Local Government: MOORABINDA

For exclusions / reservations for public purposes refer to Plan CP BH164
For exclusions / reservations for public purposes refer to Plan CP BH194
For exclusions / reservations for public purposes refer to Plan CP KM135
For exclusions / reservations for public purposes refer to Plan CP KM148
For exclusions / reservations for public purposes refer to Plan CP LR146
For exclusions / reservations for public purposes refer to Plan SP 241206

EASEMENTS, ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by Deed of Grant No. 30563185 (Lot 16 on CP BH164)
(Lot 9 on CP BH194)
(Lot 5 on CP KM135)
(Lot 39 on CP KM148)
(Lot 1 on CP LR146)
(Lot 6 on CP MNA141)

2. LEASE No 601334269 (CS24360) 28/10/1986
OVER PART OF THE LAND
TO ABORIGINES INLAND MISSION OF AUSTRALIA (PROPERTY HOLDING) PTY LIMITED
ORIGINAL TERM 30 YEARS
COMMENCING 01 NOV 1984
UNDER SECTION 19 OF THE LAND ACT (ABORIGINAL AND ISLANDER LAND GRANTS) AMENDMENT ACT 1982-1986

3. LEASE No 601334270 (CS24361) 28/10/1986
OVER PART OF THE LAND
TO THE CORPORATION OF THE SYNOD OF THE DIOCESE OF ROCKHAMPTON
ORIGINAL TERM: 30 YEARS
COMMENCING 01 NOV 1985
UNDER SECTION 19 OF THE LAND ACT (ABORIGINAL AND ISLANDER LAND GRANTS) AMENDMENT ACT 1982-1986

4. TRANSFER No 701501586 18/08/1998 at 16:17
LEASE: 601334270 (CS24361)
KADJA KADJA ABORIGINAL CORPORATION FOR EDUCATION

Page 2/5

CURRENT TITLE SEARCH

DEPT OF NATURAL RESOURCES AND MINES, QUEENSLAND

Request No: 20004395
Search Date: 15/12/2014 10:34

Title Reference: 50887354
Date Created: 30/07/2012

EASEMENTS, ENCUMBRANCES AND INTERESTS

5. TRUSTEE LEASE No 713510506 11/10/2010 at 14:31
   LEOTED PTY LTD A.B.N. 28 378 468 287
   OF PART OF THE GROUND FLOOR (LEASE G)
   SO FAR AS RELATES TO LOT 6 ON WNA141
   TERM: 05/03/2010 TO 05/03/2014 OPTION NIL

6. TRANSFER No 713798057 07/04/2011 at 11:08
   TRUSTEE LEASE: 713510506
   TRUSTEE LEASE: 713510510
   [redacted]

7. TRUSTEE LEASE No 713510510 11/10/2010 at 14:33
   LEOTED PTY LTD A.B.N. 28 378 468 287
   OF PART OF THE GROUND FLOOR (LEASE E)
   SO FAR AS RELATES TO LOT 6 ON WNA141
   TERM: 05/03/2010 TO 05/03/2014 OPTION NIL

8. TRUSTEE LEASE No 713852367 13/05/2011 at 14:44
   THE STATE OF QUEENSLAND
   (REPRESENTED BY DEPARTMENT OF COMMUNITIES)
   LEASES ZA - ZD ON SP232210, LEASE ZE ON SP232209, LEASE ZF
   ON SP232211, LEASE ZG ON SP232212, LEASE ZH ON SP232213,
   LEASE ZJ ON SP232214, LEASE ZK ON SP232215, LEASE ZL ON
   SP232216, LEASE ZM ON SP232219 AND LEASE ZN ON SP232220
   ALL SO FAR AS RELATE TO LOT 6 ON CP WNA141
   TERM: 15/07/2010 TO 14/07/2050 OPTION 40 YEARS

9. LEASE No 714400335 05/04/2012 at 11:16
   CENTRAL QUEENSLAND INDIGENOUS DEVELOPMENT LIMITED A.C.N. 110
   812 489
   OF LEASE F ON SP143252
   IN LOT 6 ON CP WNA141
   TERM: 01/10/2012 TO 01/09/2022 OPTION NIL

Page 3/5

CURRENT TITLE SEARCH

DEPT OF NATURAL RESOURCES AND MINES, QUEENSLAND

Request No: 20004395
Search Date: 15/12/2014 10:34

Title Reference: 50887354
Date Created: 30/07/2012

EASEMENTS, ENCUMBRANCES AND INTERESTS

10. TRUSTEE LEASE No 714877005 09/01/2013 at 15:22
THE STATE OF QUEENSLAND
(REPRESENTED BY DEPARTMENT OF HOUSING AND PUBLIC WORKS)
OF LEASES JN AND JM IN LOT 135 ON SP241206 ON SP251896, LEASES IIA TO IIE IN LOT 135 ON SP241206 ON SP251901, LEASES AA TO AK IN LOT 135 ON SP241206 ON SP253964, LEASES DA TO DJ IN LOT 135 ON SP241206 ON SP253965, LEASES DK TO DS IN LOT 135 ON SP241206 ON SP253966, LEASES DDC AND DDI TO DDC IN LOT 135 ON SP241206 ON SP253967, LEASES DDP TO DDU IN LOT 135 ON SP241206 ON SP253968, LEASES DT TO DZ IN LOT 135 ON SP241206 ON SP253969, LEASES DDA TO DDF IN LOT 135 ON SP241206 ON SP253970, LEASES BBJ TO BBQ IN LOT 135 ON SP241206 ON SP253971, LEASES BBD TO BBI IN LOT 135 ON SP241206 ON SP253972, LEASES BX TO BZ AND BBA TO BBC IN LOT 135 ON SP241206 ON SP253973, LEASES BP TO BW IN LOT 135 ON SP241206 ON SP253974, LEASES BH TO BO IN LOT 135 ON SP241206 ON SP253975, LEASES BA TO BG IN LOT 135 ON SP241206 ON SP253976, LEASES EA TO EG IN LOT 135 ON SP241206 ON SP253977 LEASES EH TO EJ AND FB IN LOT 135 ON SP241206 ON SP253978, LEASES DDV TO DDX IN LOT 135 ON SP241206 ON SP253979, LEASES HA TO HD IN LOT 135 ON SP241206 ON SP253980, LEASES HE TO HK IN LOT 135 ON SP241206 ON SP253981, LEASES IA TO IB AND II TO IL IN LOT 135 ON SP241206 ON SP253982, LEASES IC TO IG IN LOT 135 ON SP241206 ON SP253983, LEASES IM TO IZ IN LOT 135 ON SP241206 ON SP253984, LEASES JA TO JL IN LOT 135 ON SP241206 ON SP253985
TERM: 12/11/2012 TO 11/11/2052 OPTION NIL

11. TRUSTEE LEASE No 715194053 10/07/2013 at 11:23
THE STATE OF QUEENSLAND
(REPRESENTED BY DEPARTMENT OF HOUSING AND PUBLIC WORKS)
OF LEASE KA TO KI IN LOT 135 ON SP241206 ON SP251909
TERM: 16/05/2013 TO 15/05/2053 OPTION 40 YEARS

13. TRUSTEE LEASE No 715646870 10/03/2014 at 14:38
[redacted]
OF THE WHOLE OF LOT 73 ON WHA156
TERM: 08/02/1998 TO IN PERPETUITY OPTION NIL

15. TRUSTEE LEASE No 715946140 11/08/2014 at 13:30
THE STATE OF QUEENSLAND
(REPRESENTED BY DEPARTMENT OF HOUSING AND PUBLIC WORKS)
OF LEASES LA,LF,LK,LJ,LL,LN,LP,LR,LU,LV,LZ,LAB,LAD,LAG AND LAI ON SP264561 IN LOT 135 ON SP241206
TERM: 26/05/2014 TO 25/05/2054 OPTION NIL

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CURRENT TITLE SEARCH

DEPT OF NATURAL RESOURCES AND MINES, QUEENSLAND

Request No: 20904395
Search Date: 15/12/2014 10:34 **Title Reference: 50887354**
Date Created: 30/07/2012

ADMINISTRATIVE ADVICES

Dealing	Type	Lodgement Date	Status
711171537	VEG NOTICE VEGETATION MANAGEMENT ACT 1999	12/11/2007 14:42	CURRENT
715283A9	VEG NOTICE VEGETATION MANAGEMENT ACT 1999	26/03/2008 14:46	CURRENT

UNREGISTERED DEALINGS - NIL

CERTIFICATE OF TITLE ISSUED - No

Corrections have occurred - Refer to Historical Search

Caution - Charges do not necessarily appear in order of priority

** End of Current Title Search **

Requested By: D APPLICATIONS CITEC CONFIRM

Page 1/1

Schedule 2b ([redacted])

Submit by Email | Print Form

Department of Natural Resources and Mines

Request for a Voluntary Declaration

Vegetation Management Act 1999

[redacted]

Section 1 - Proponent details

The proponent is the owner of the land and may comprise of more than one person where there is joint ownership of land -

Owner, of land includes -

(a) for freehold land - the registered owner; or
(b) for a lease, license or permit under the Land Act 1994 - the lessee, licensee or permittee; o
(c) for indigenous land - the holder of title to the land; or
(d) for any tenure under any other Act - the holder of the tenure.

Extra pages may be attached to list additional owners.

All correspondence will be directed to the 'contact person'

Purpose(s) of declaration

- ☐ participating in a conservation incentives program(s)
- ☐ carbon emission offsetting
- ☐ to offset clearing associated with a development approval
- ☐ other conservation purposes

Owner/s of land

Title	Family name	Given name
	[redacted]	
	[redacted]	
	[redacted]	

Name of Company/Organisation (if the owner is a company)

ACN (if applicable)

Contact person

Title | Family name | Given name

Phone number | Mobile number | Fax number

Address

Postcode

Section 2 - Property Description and Tenure

This is the property on which the voluntary declaration area is proposed. The vegetation management plan should indicate the specific location of the proposed declared area on the property.

Extra pages may be attached to list additional lots.

Tenure of property(ies) containing proposed declaration area.

Parcel (lot and plan)	Owner/s	Tenure (e.g. Freehold, Crown Perpetual Lease)
Lot 22 AU37	[redacted]	Freehold

Great state. Great opportunity.

Section 3 - Registered interest holders in proposed declaration area

A registered interest is one registered under the Land Act 1994 or the Land Title Act 1994.

Registered interests are mortgages, leases, subleases, covenants, profit a prendes, easements and building management statements.

A declaration may not be made unless the holder of a registered interest (other than the proponent) in the proposed declaration area has consented in writing to the making of the declaration.

NOTE: Section 3 only requires the recording of registered interest **holders**– consent of registered interest holders is not required as part of the request. The proponent will need to seek written consent to the declaration of all registered interest holders once the Department has considered the request, and prior to the making of any declaration.

Extra pages may be attached to list additional lots and/or registered interest holders.

Parcel (lot and plan)	Type of Registered Interest	Registered interest holder's name and contact details

Section 4 - Type of declaration request

Specify the type of declaration that is requested, and the relevant criteria for the declaration. One or more of the criteria may be applicable to the area being sought for declaration.

The proponent must provide an explanation of how the declared area meets the criteria selected in this section. This explanation must be provided in the documents accompanying the request. The 'Guide to voluntary declarations under the *Vegetation Management Act 1999*' may be viewed for assistance in preparing a request.

- [x] Area of high nature conservation value
  - [ ] a wildlife refugium
  - [ ] a centre of endemism
  - [x] an area containing a vegetation clump or corridor that contributes to the maintenance of biodiversity
  - [ ] an area that makes a significant contribution to the conservation of biodiversity
  - [ ] an area that contributes to the conservation value of a wetland, lake or spring
  - [ ] another area that contributes to the conservation of the environment

OR

- [ ] Area vulnerable to land degradation
  - [ ] soil erosion
  - [ ] rising water tables
  - [ ] the expression of salinity, whether inside or outside the area
  - [ ] mass movement by gravity of soil or rock
  - [ ] stream bank instability
  - [ ] a process that results in declining water quality

Section 5 - Management Plan

The Management Plan must contain all the components identified in this section. The Management Plan is to refer to the area identified in section 2 of this form. The Management Plan may also include any other information the applicant considers will assist in the determination of the request. For more information on the Management Plan, consult the Guide to Voluntary Declarations and the Management Plan template.

A Management Plan must accompany all voluntary declaration requests. The attached Management Plan

- [x] contains the proponent's signature
- [x] includes enough information to allow the chief executive to map the boundary of the stated area
- [x] states the proponent's management intent, and management outcomes proposed by the proponent, for the conservation of the high nature conservation value of the area or the prevention of land degradation in the area
- [x] states the activities the proponent intends to carry out, or refrain from carrying out, to achieve the stated management outcomes
- [x] states the restrictions, if any, to be imposed on the use of, or access to, the area by other persons to achieve the stated management outcomes

Section 6 - Information privacy statement

The Department of Natural Resources and Mines (DNRM) is collecting the information in this form and any attachments to process your request that the chief executive declare a stated area of land under the *Vegetation Management Act 1999*. The consideration of your request may involve consultation, and if so, details of your request and any attachments may be disclosed to third parties. These details will not otherwise be disclosed outside DNRM unless required or authorised by law.

Section 7 - Signature/s

The owner(s) of the land (proponent) must sign and date this section

If there are more than four owners, extra pages may be attached with a copy of the 'statement' with the signature(s).

A company:

- may execute a document without using a common seal if the document is signed by two (2) directors of the company or a director and a company secretary; or for a proprietary company that has a sole director who is also the sole company secretary - that director; or
- with a company seal may execute a document if the seal is fixed to the document and the fixing of the seal is witnessed by two (2) directors of the company or a director and a company secretary; or for a proprietary company that has a sole director who is also the sole company secretary - that director.

Statement

I/We

- consent to the collection and use of the personal information in this form for the purposes of assessing this request for a voluntary declaration under the *Vegetation Management Act 1999*; and
- declare that the information provided by me/us is true and correct

Proponent (Owner's) signature	Date	Company seal (if applicable)
	/ /	
Proponent (Owner's) signature	Date	
	/ /	
Proponent (Owner's) signature	Date	
	/ /	
Proponent (Owner's) signature	Date	
	/ /	

Office use only

Date received	Receiving officer	Reference number
/ /		

CURRENT TITLE SEARCH

DEPT OF NATURAL RESOURCES AND MINES, QUEENSLAND

Request No: 20315089
Search Date: 10/02/2015 08:06 **Title Reference: 16273044**
Date Created: 22/04/1982

REGISTERED OWNER

Dealing No: 713681791 25/01/2011

[redacted] A.C.N. 010 678 809

ESTATE AND LAND

Estate in Fee Simple

LOT 22 CROWN PLAN AU37
County of AUBURN Parish of BARTSCH
Local Government: WESTERN DOWNS

EASEMENTS, ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by
Deed of Grant No. 16273044 (POR 22)

2. EASEMENT IN GROSS No 715771947 15/05/2014 at 15:04
burdening the land
[redacted]
over
EASEMENT CR ON SP265436

3. EASEMENT IN GROSS No 716063165 08/10/2014 at 15:45
burdening the land
[redacted]
over
EASEMENT CX ON SP261962

ADMINISTRATIVE ADVICES - NIL
UNREGISTERED DEALINGS - NIL

CERTIFICATE OF TITLE ISSUED - No

Caution - Charges do not necessarily appear in order of priority

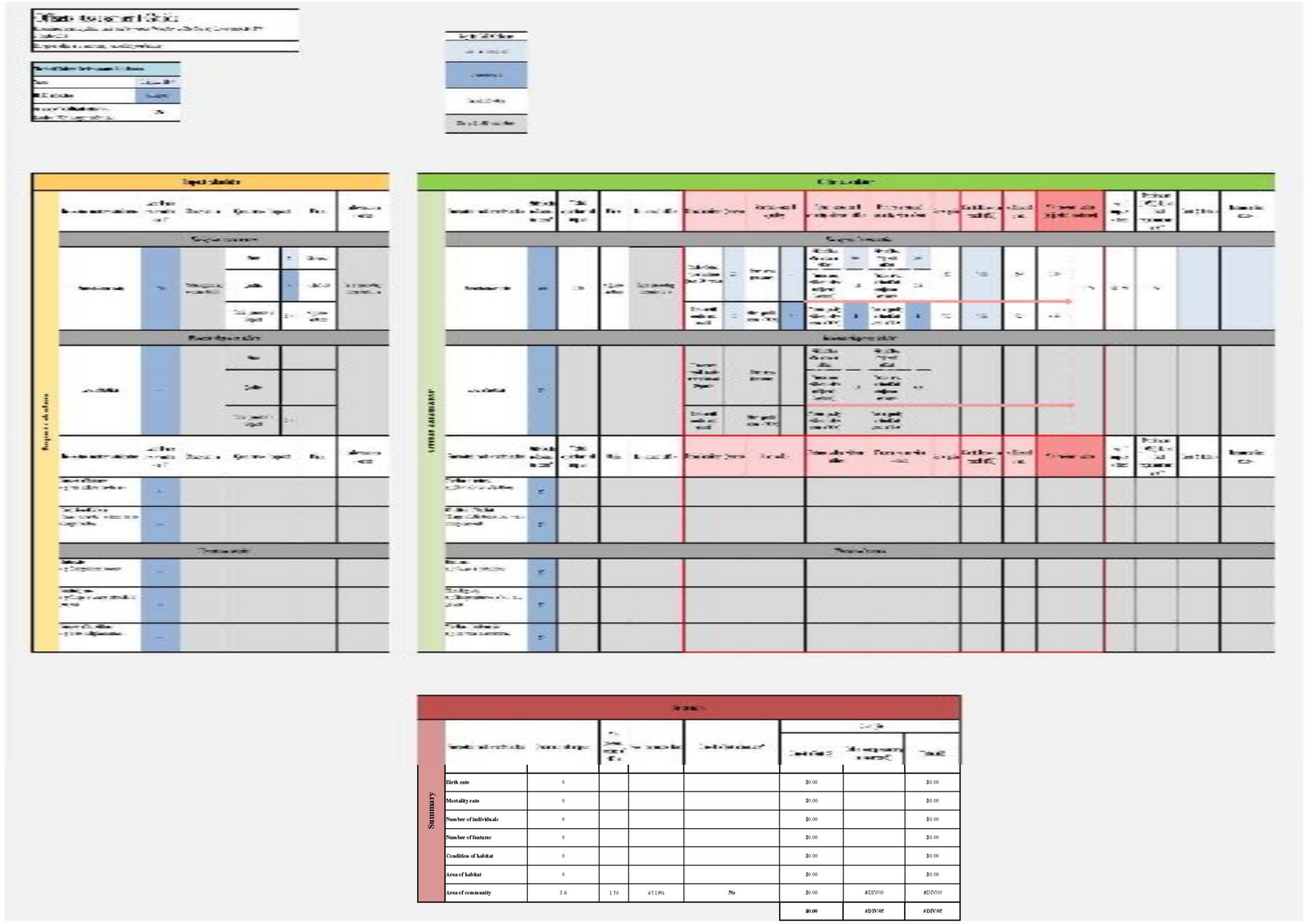
** End of Current Title Search **

Requested By: D APPLICATIONS CITEC CONFIRM

Page 1/1

APPENDIX A: EPBC CALCULATOR RESULTS

Appendix A1.1 EPBC Calculator Results – Brigalow (remnant)



Summary								
	Birth rate	0				$0.00		$0.00
	Mortality rate	0				$0.00		$0.00
	Number of individuals	0				$0.00		$0.00
	Number of features	0				$0.00		$0.00
	Condition of habitat	0				$0.00		$0.00
	Area of habitat	0				$0.00		$0.00
	Area of community	3.6	1.70	47.19%	No	$0.00	#DIV/0!	#DIV/0!
						$0.00	#DIV/0!	#DIV/0!

2015-03-30 BNCOP Brigalow TEC Offset Calculations - Remnant

Appendix A1.2 EPBC Calculator Results – Brigalow (regrowth)

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Brigalow TEC
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	1.2%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	Yes	Refer supporting documentation	Area	9	Hectares	Refer supporting documentation
			Quality	4	Scale 0-10	
			Total quantum of impact	3.60	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		Area			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g. Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)		% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																					
Area of community	Yes	3.60	Adjusted hectares	Refer supporting documentation	Risk-related time horizon (max. 20 years)	20	Start area (hectares)	6	Risk of loss (%) without offset	90%	Risk of loss (%) with offset	10%	4.80	75%	3.60	2.84	2.26	62.91%	No		
									Future area without offset (adjusted hectares)	0.6	Future area with offset (adjusted hectares)	5.4									
					Time until ecological benefit	10	Start quality (scale of 0-10)	2	Future quality without offset (scale of 0-10)	0	Future quality with offset (scale of 0-10)	7	7.00	75%	5.25	4.66					
Threatened species habitat																					
Area of habitat	No				Time over which loss is averted (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset										
									Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0									
					Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)										
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start value		Future value without offset		Future value with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value		% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Number of features e.g. Nest hollows, habitat trees	No																				
Condition of habitat Change in habitat condition, but no change in extent	No																				
Threatened species																					
Birth rate e.g. Change in nest success	No																				
Mortality rate e.g. Change in number of road kills per year	No																				
Number of individuals e.g. Individual plants/animals	No																				

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	0				$0.00		$0.00
Area of community	3.6	2.26	62.91%	No	$0.00	#DIV/0!	#DIV/0!
					$0.00	#DIV/0!	#DIV/0!

2015-03-30 BNCOP Brigalow TEC Offset Calculations - Regrowth

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	South-eastern Long-eared Bat
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	0.2%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Refer supporting documentation	Area	27	Hectares	Refer supporting documentation
			Quality	5	Scale 0-10	
			Total quantum of impact	138.50	Adjusted hectares	
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of roadkills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)	Start area and quality	Future area and quality without offset	Future area and quality with offset	Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																
Area of community	No				Risk-related time horizon (max. 20 years)	Start area (hectares)	Risk of loss (%) without offset	Risk of loss (%) with offset								
							Future area without offset (adjusted hectares) 0.0	Future area with offset (adjusted hectares) 0.0								
					Time until ecological benefit	Start quality (scale of 0-10)	Future quality without offset (scale of 0-10)	Future quality with offset (scale of 0-10)								
Threatened species habitat																
Area of habitat	Yes	138.50	Adjusted hectares	Refer supporting documentation	Time over which loss is averted (max. 20 years) 20	Start area (hectares) 105	Risk of loss (%) without offset 10%	Risk of loss (%) with offset 10%	0.00	75%	0.00	0.00	27.79	20.06%	No	
							Future area without offset (adjusted hectares) 94.5	Future area with offset (adjusted hectares) 94.5								
					Time until ecological benefit 10	Start quality (scale of 0-10) 4	Future quality without offset (scale of 0-10) 3	Future quality with offset (scale of 0-10) 7	4.00	75%	3.00	2.94				
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)	Start value	Future value without offset	Future value with offset	Raw gain	Confidence in result (%)	Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Number of features e.g. Nest hollows, habitat trees	No															
Condition of habitat Change in habitat condition, but no change in extent	No															
Threatened species																
Birth rate e.g. Change in nest success	No															
Mortality rate e.g Change in number of roadkills per year	No															
Number of individuals e.g. Individual plants/animals	No															

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	138.5	27.79	20.06%	No	$0.00	#DIV/0!	#DIV/0!
Area of community	0				$0.00		$0.00
					$0.00	**#DIV/0!**	**#DIV/0!**

2015-03-30 BNCOP South-eastern Long-eared Bat Offset Calculations - Zamia (2)

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	South-eastern Long-eared Bat
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	0.2%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Refer supporting documentation	Area	2.77	Hectares	Refer supporting documentation
			Quality	5	Scale 0-10	
			Total quantum of impact	138.50	Adjusted hectares	
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Number of features: e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g. Change in number of road kills per year	No					
Number of individuals: e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset									
									Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0								
					Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)									
Threatened species habitat																				
Area of habitat	Yes	138.50	Adjusted hectares	Refer supporting documentation	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	420	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	10%	0.00	75%	0.00	0.00	111.16	80.26%	No	
									Future area without offset (adjusted hectares)	378.0	Future area with offset (adjusted hectares)	378.0								
					Time until ecological benefit	10	Start quality (scale of 0-10)	8	Future quality without offset (scale of 0-10)	5	Future quality with offset (scale of 0-10)	9	4.00	75%	3.00	2.94				
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start value		Future value without offset		Future value with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Number of features: e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g. Change in number of road kills per year	No																			
Number of individuals: e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals:	0				$0.00		$0.00
Number of features:	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	138.5	111.16	80.26%	No	$0.00	#DIV/0!	#DIV/0!
Area of community	0				$0.00		$0.00
					$0.00	#DIV/0!	#DIV/0!

2015-03-30 BNCOP South-eastern Long-eared Bat Offset Calculations - Tin Hut Creek (2)

Appendix A3 EPBC Calculator Results – Ornamental snake

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Delma impulsa (Ornamental Snake)
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	0.2%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Refer supporting documentation	Area	33.5	Hectares	Refer supporting documentation
			Quality	3	Scale 0-10	
			Total quantum of impact	10.05	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g. Change in number of roadkills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

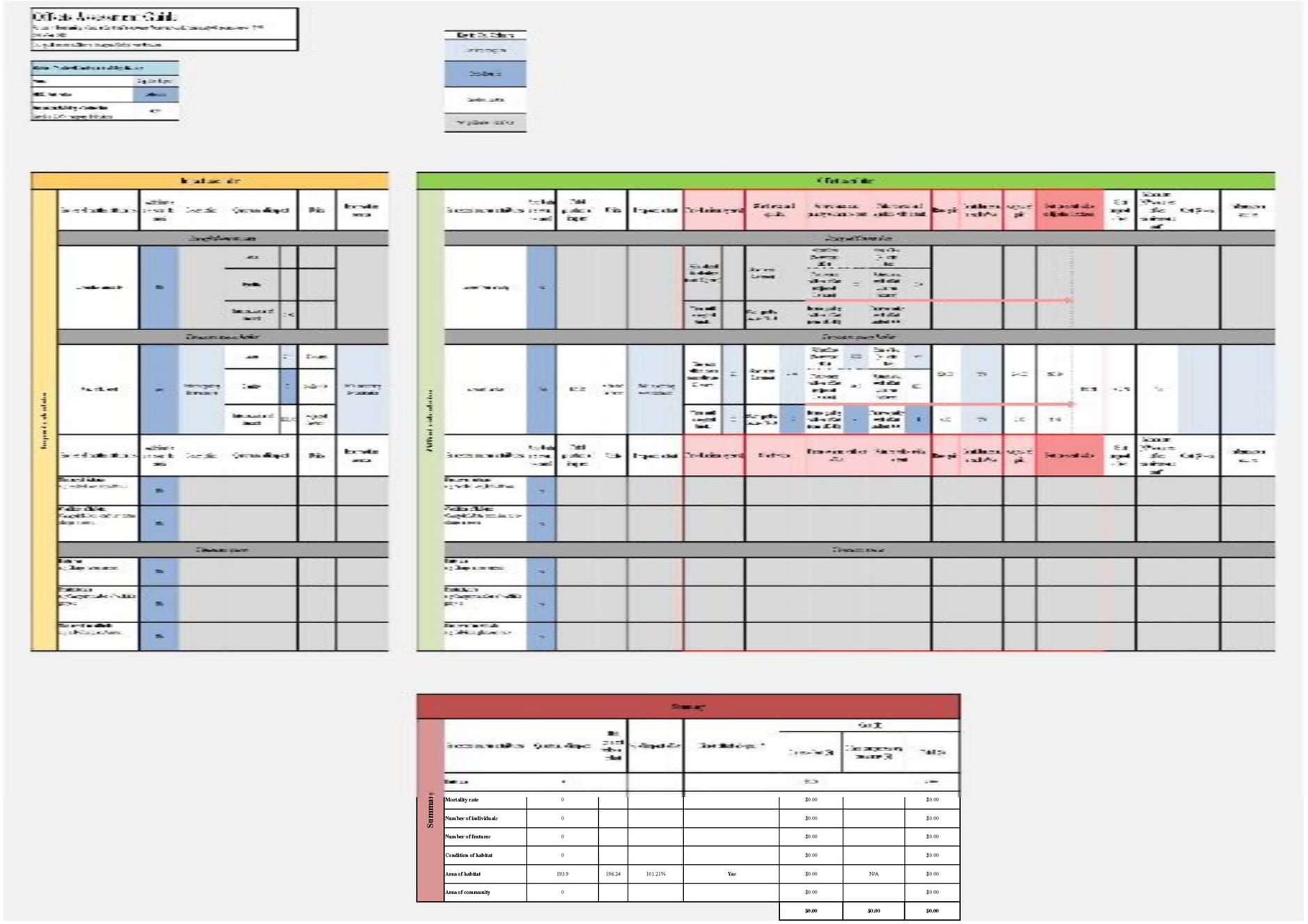
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset									
									Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0								
					Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)									
Threatened species habitat																				
Area of habitat	Yes	10.05	Adjusted hectares	Refer supporting documentation	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	23	Risk of loss (%) without offset	90%	Risk of loss (%) with offset	10%	18.40	75%	13.80	13.26	10.30	102.45%	Yes	
									Future area without offset (adjusted hectares)	2.3	Future area with offset (adjusted hectares)	20.7								
					Time until ecological benefit	10	Start quality (scale of 0-10)	4	Future quality without offset (scale of 0-10)	1	Future quality with offset (scale of 0-10)	7	6.00	75%	4.50	4.41				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g. Change in number of roadkills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	10.05	10.30	102.45%	Yes	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

2015-03-30 BNCOP Ornamental Snake Offset Calculations

Appendix A4 EPBC Calculator Results – Squatter pigeon (southern)



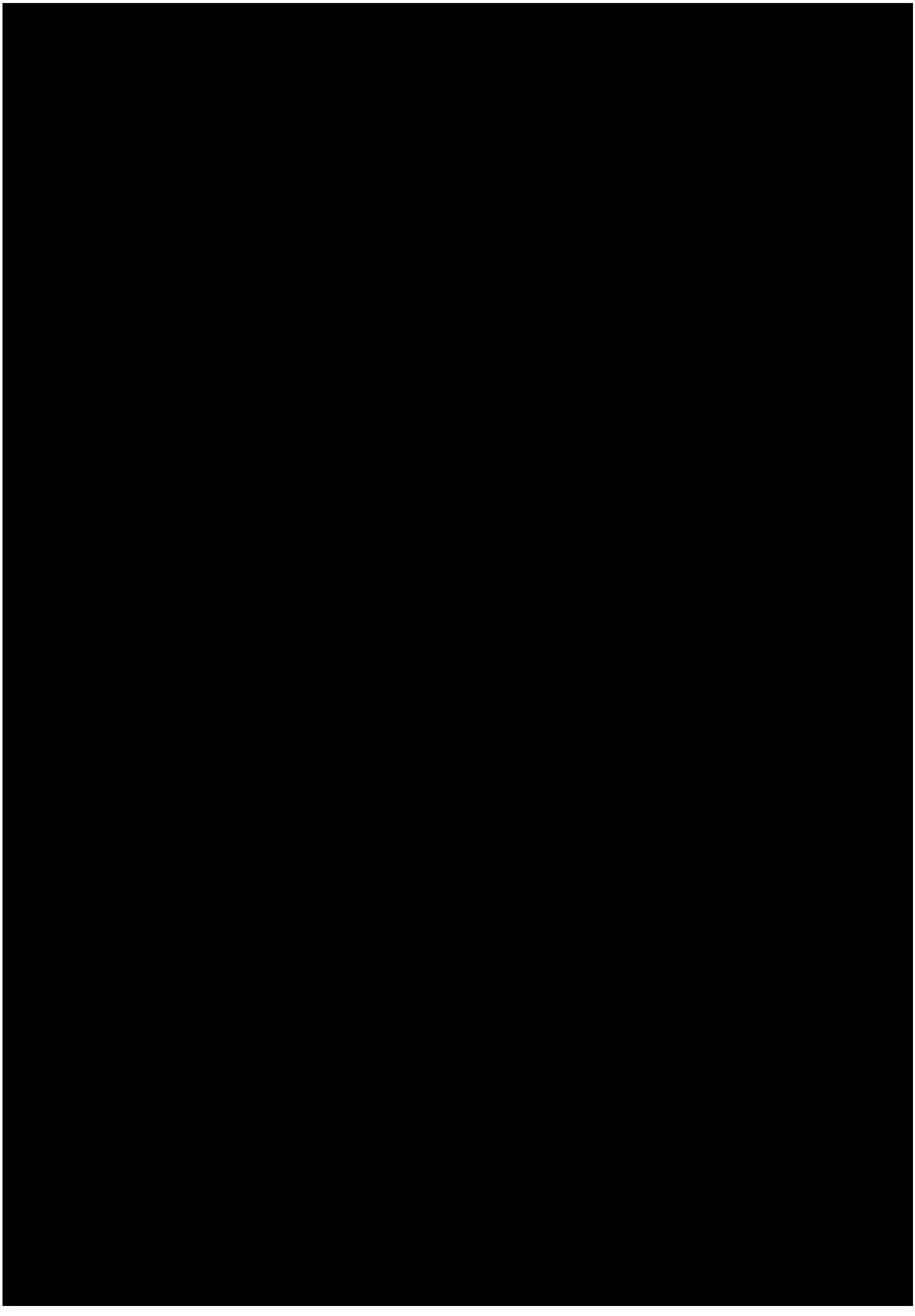
Summary							
					Cost		
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	193.9	196.24	101.21%	Yes	$0.00	NA	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

2015-03-30 BNCOP Squatter Pigeon Offset Calculations

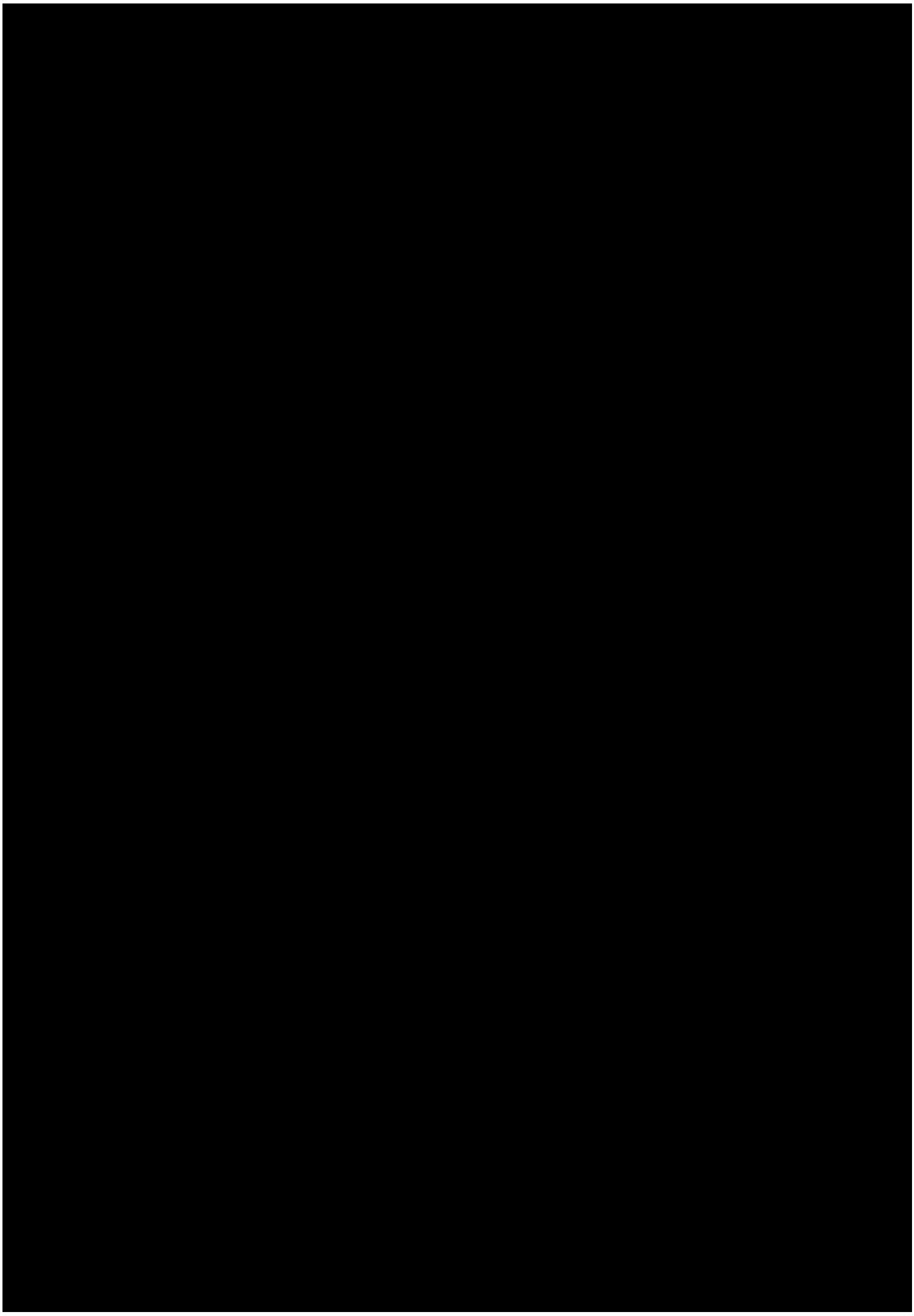
APPENDIX B: OFFSET MAPPING

Appendix B.1 Offset Maps – [redacted]

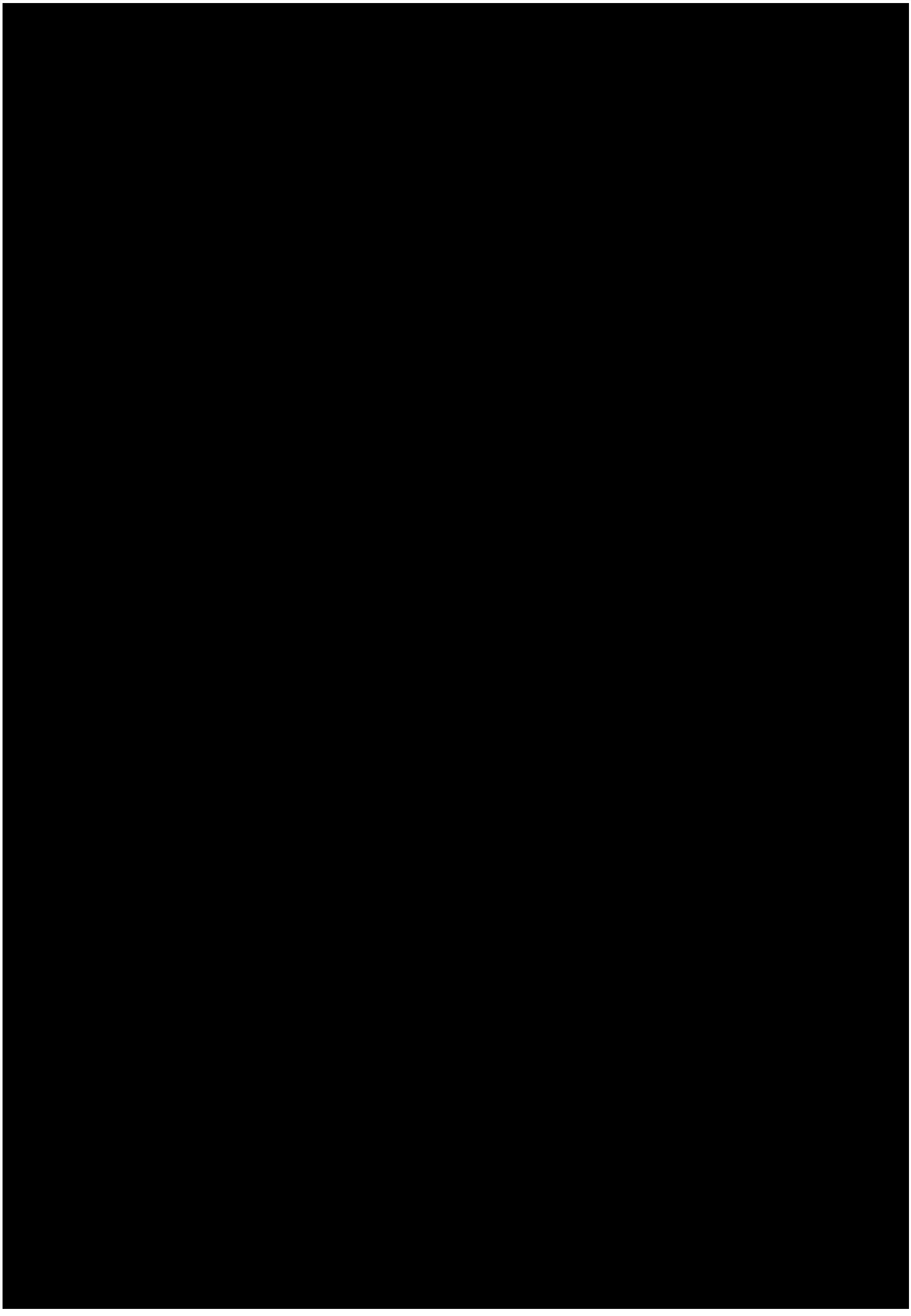
Offset Location Map



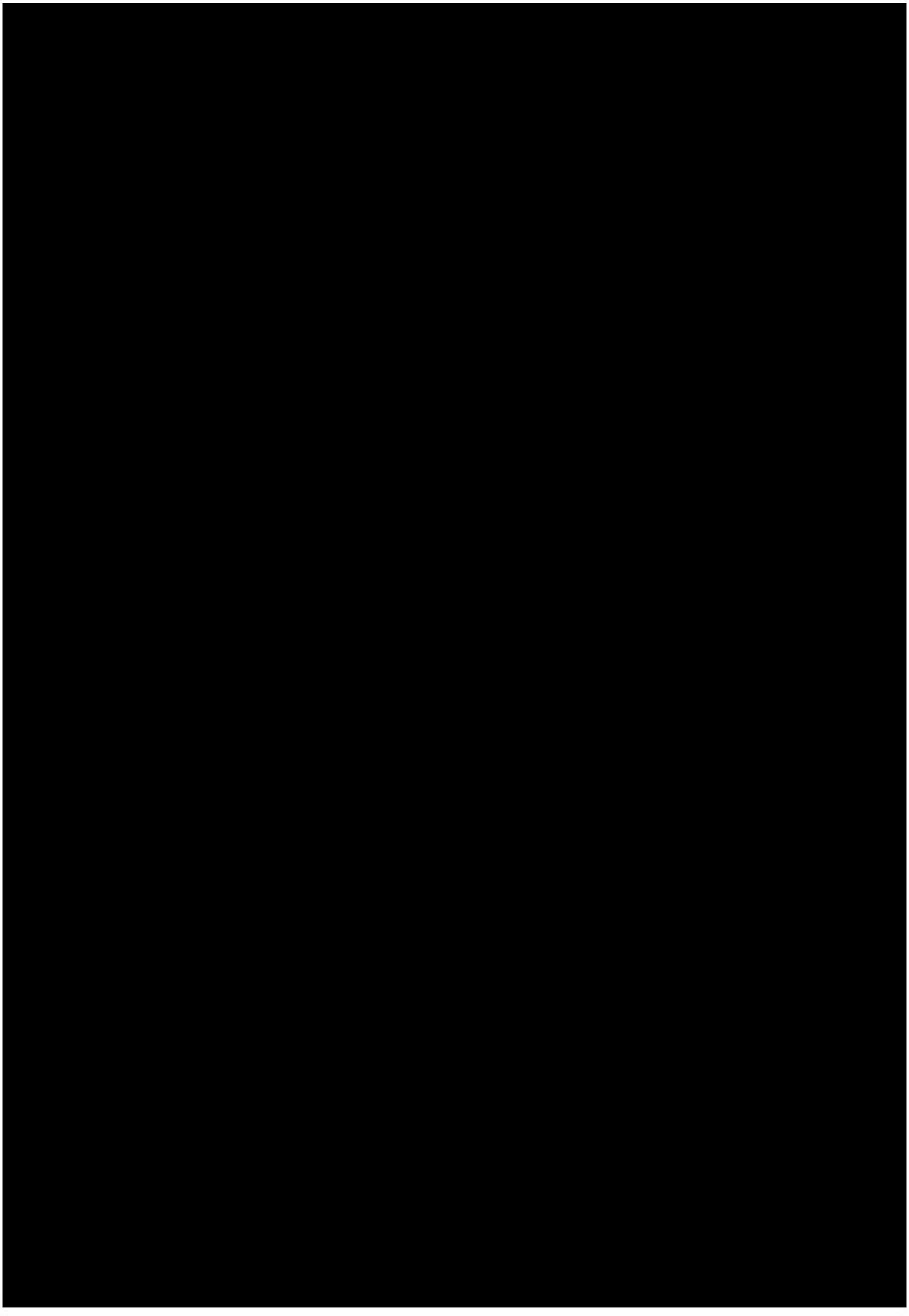
State offset area – TLO Facility *Solanum spp.* offset



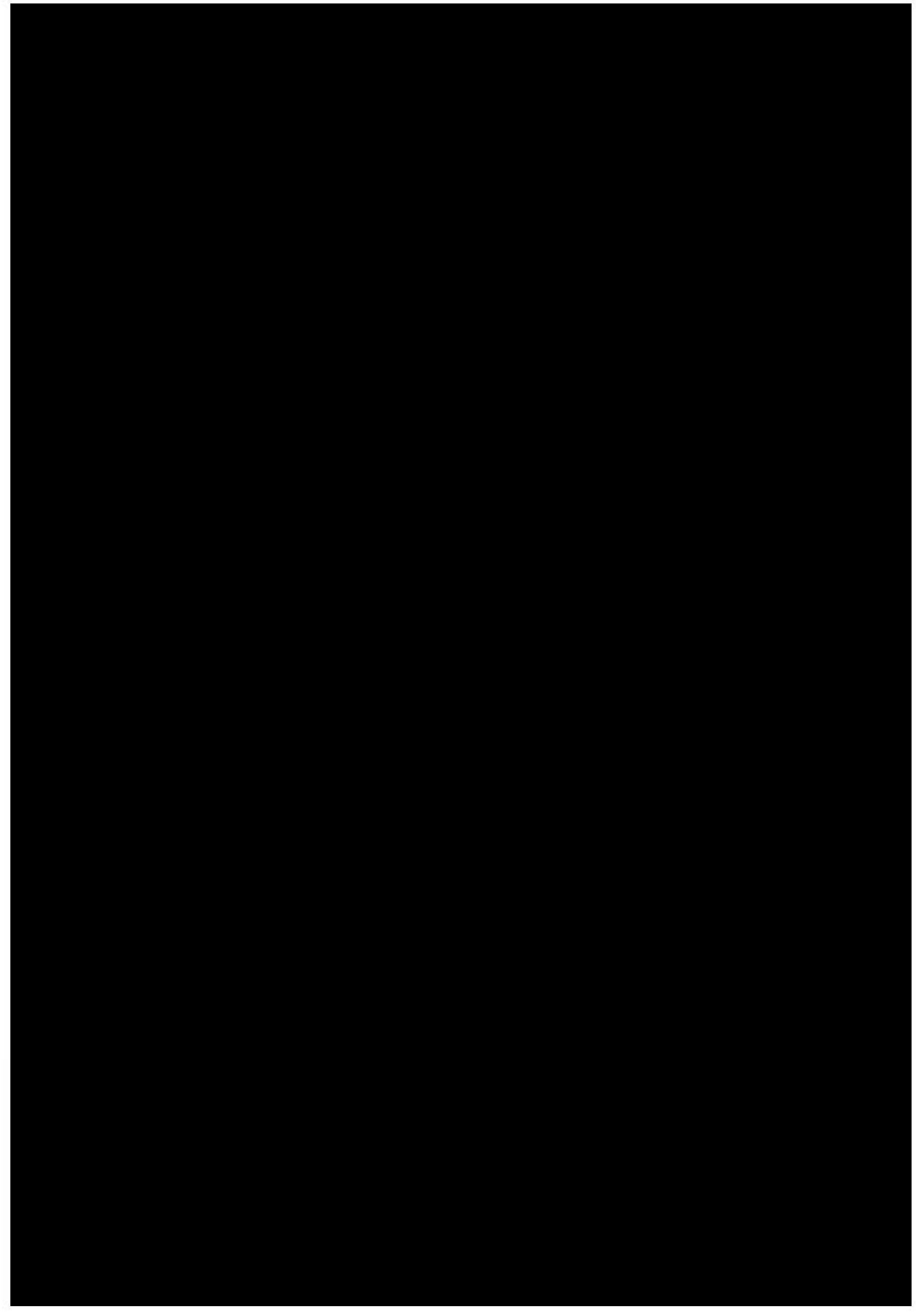
State offset area – Private Access Road *Solanum spp.* Offset



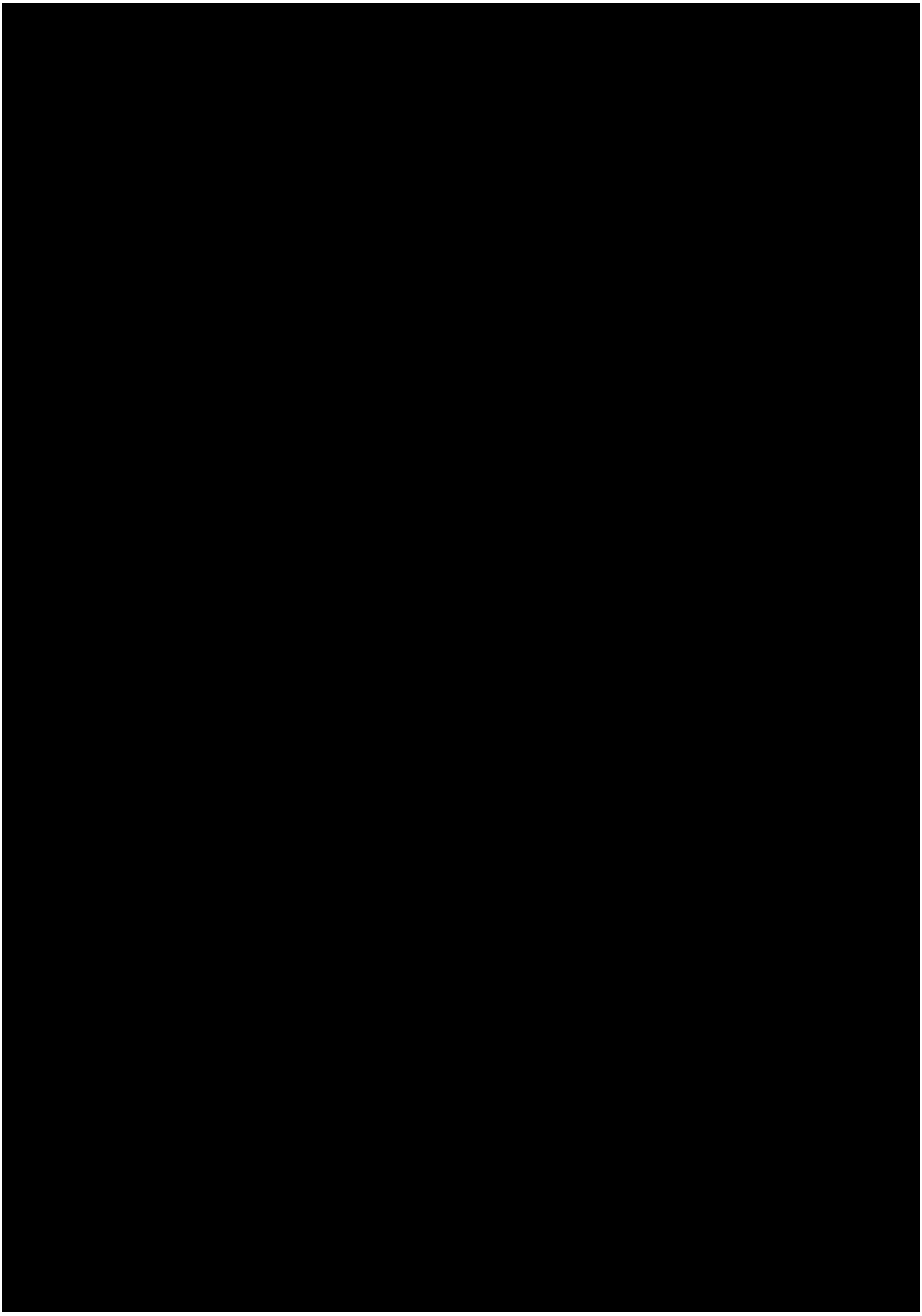
EPBC Offset Area Map including the Queensland offset within the boundaries



Survey Site Locations

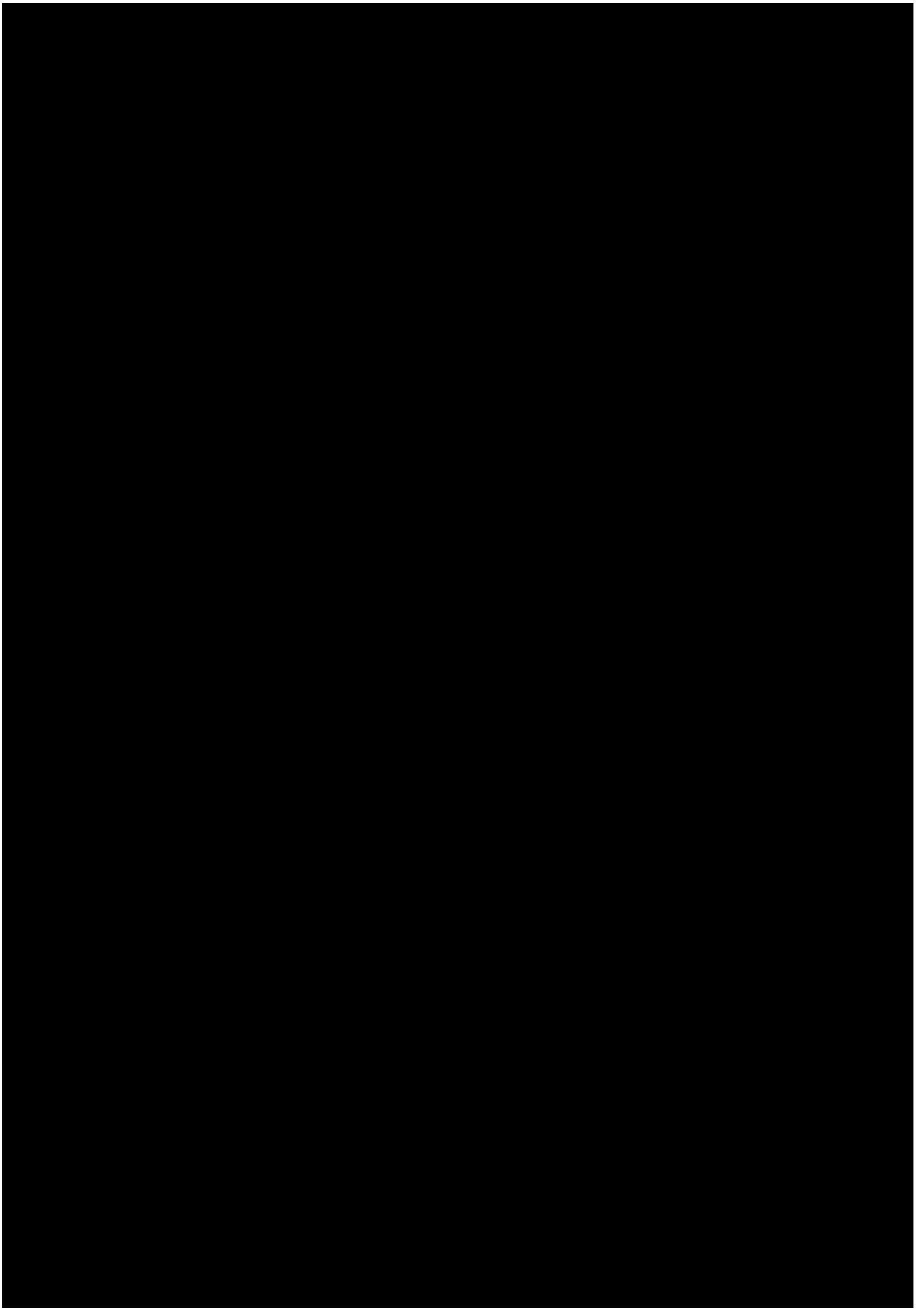


[redacted] – Offset Fencing Plan

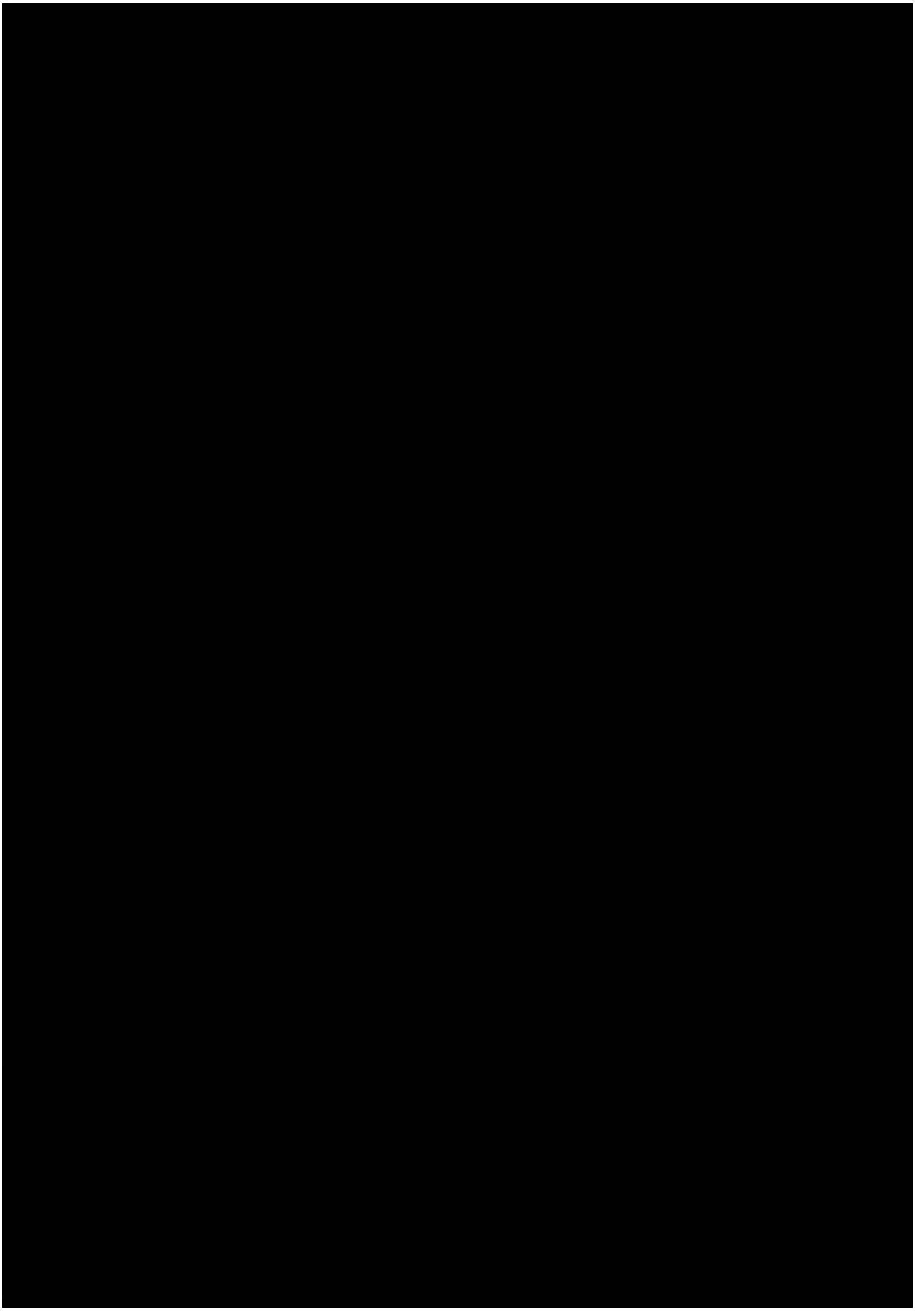


Appendix B.2 Offset Maps – [redacted]

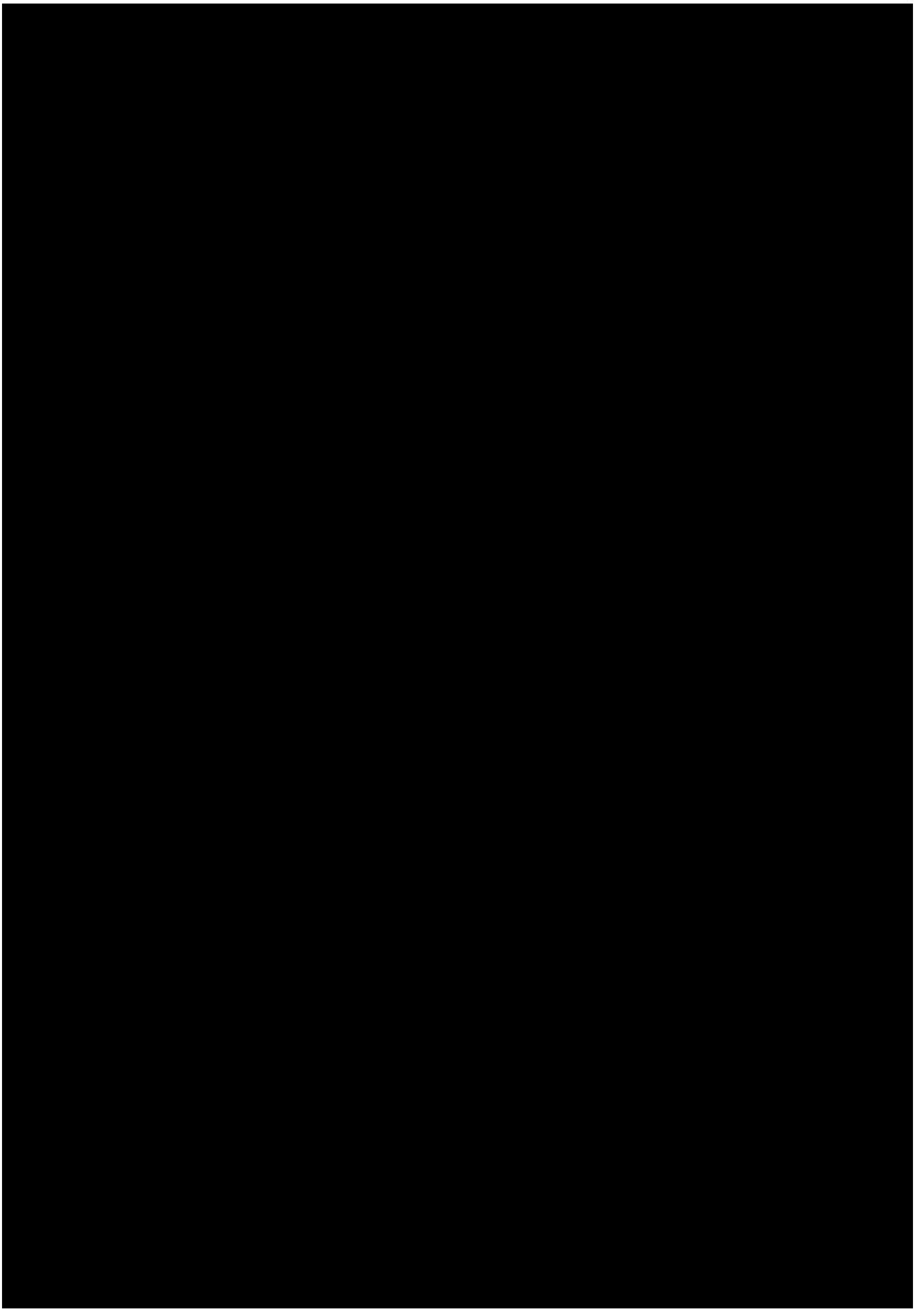
Offset Location Map



Offset Area Map – “[redacted]”



Survey Site Locations – [redacted]



APPENDIX C: FIELD ASSESSMENT REPORTS

Appendix C.1 Notes on EPBC Calculator Inputs – Impact Site

Please see pdf file supplied separately

Appendix C.2 Notes on EPBC Calculator Inputs – Offset Sites

Please see pdf file supplied separately

Appendix C.3 Field Assessment Report – [redacted] & [redacted]

Please see pdf file supplied separately

Appendix C.4 Ornamental Snake Survey Report – [redacted]

Please see pdf file supplied separately

APPENDIX D: WILDLIFE ONLINE REPORTS

APPENDIX D.1 Wildnet Online Report – [redacted]

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Acanthizidae	*Acanthiza nana*	yellow thornbill		C		2
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		1
animals	birds	Anatidae	*Chenonetta jubata*	Australian wood duck		C		1
animals	birds	Anatidae	*Cygnus atratus*	black swan		C		1
animals	birds	Anatidae	*Anas superciliosa*	Pacific black duck		C		1
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		1
animals	birds	Artamidae	*Cracticus tibicen*	Australian magpie		C		5
animals	birds	Artamidae	*Artamus personatus*	masked woodswallow		C		1
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		1
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		1
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		3
animals	birds	Cacatuidae	*Eolophus roseicapillus*	galah		C		1
animals	birds	Cacatuidae	*Nymphicus hollandicus*	cockatiel		C		3
animals	birds	Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike		C		1
animals	birds	Climacteridae	*Climacteris picumnus*	brown treecreeper		C		2
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		3
animals	birds	Columbidae	*Geopelia humeralis*	bar-shouldered dove		C		1
animals	birds	Columbidae	*Geopelia striata*	peaceful dove		C		2
animals	birds	Corvidae	*Corvus coronoides*	Australian raven		C		1
animals	birds	Corvidae	*Corvus sp.*					2
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		5
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		2
animals	birds	Falconidae	*Falco cenchroides*	Nankeen kestrel		C		1
animals	birds	Falconidae	*Falco berigora*	brown falcon		C		1
animals	birds	Maluridae	*Malurus lamberti*	variegated fairy-wren		C		3
animals	birds	Maluridae	*Malurus cyaneus*	superb fairy-wren		C		4
animals	birds	Megaluridae	*Megalurus timoriensis*	tawny grassbird		C		1
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		2
animals	birds	Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater		C		3
animals	birds	Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater		C		1
animals	birds	Meliphagidae	*Manorina melanocephala*	noisy miner		C		2
animals	birds	Meliphagidae	*Meliphaga lewinii*	Lewin's honeyeater		C		1
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		1
animals	birds	Meliphagidae	*Gavicalis virescens*	singing honeyeater		C		1
animals	birds	Monarchidae	*Myiagra rubecula*	leaden flycatcher		C		1
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		4
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		2
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		2
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		1
animals	birds	Phalacrocoracidae	*Microcarbo melanoleucos*	little pied cormorant		C		1
animals	birds	Phasianidae	*Coturnix ypsilophora*	brown quail		C		1
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		1
animals	birds	Psittacidae	*Trichoglossus haematodus moluccanus*	rainbow lorikeet		C		1
animals	birds	Ptilonorhynchidae	*Ptilonorhynchus maculatus*	spotted bowerbird		C		1
animals	birds	Rhipiduridae	*Rhipidura albiscapa*	grey fantail		C		2
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		4

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Threskiornithidae	*Platalea regia*	royal spoonbill		C		1
animals	birds	Threskiornithidae	*Platalea flavipes*	yellow-billed spoonbill		C		1
fungi	sac fungi	Parmeliaceae	*Parmotrema praesorediosum*			C		2/2
plants	higher dicots	Aizoaceae	*Tetragonia tetragonoides*	New Zealand spinach		C		1/1
plants	higher dicots	Amaranthaceae	*Alternanthera*			C		1/1
plants	higher dicots	Amaranthaceae	*Alternanthera denticulata*	lesser joyweed		C		1/1
plants	higher dicots	Apiaceae	*Centella asiatica*			C		1/1
plants	higher dicots	Asteraceae	*Centipeda minima subsp. minima*			C		2/2
plants	higher dicots	Asteraceae	*Parthenium hysterophorus*	parthenium weed	Y			1/1
plants	higher dicots	Asteraceae	*Gnaphalium polycaulon*		Y			1/1
plants	higher dicots	Asteraceae	*Xanthium occidentale*		Y			1/1
plants	higher dicots	Asteraceae	*Aster subulatus*	wild aster	Y			1/1
plants	higher dicots	Asteraceae	*Soliva anthemifolia*	dwarf jo jo weed	Y			1/1
plants	higher dicots	Boraginaceae	*Heliotropium indicum*		Y			1/1
plants	higher dicots	Brassicaceae	*Rorippa eustylis*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Senna barclayana*			C		1/1
plants	higher dicots	Chenopodiaceae	*Einadia nutans subsp. linifolia*			C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena tetracuspis*	brigalow burr		C		1/1
plants	higher dicots	Chenopodiaceae	*Einadia polygonoides*	knotweed goosefoot		C		1/1
plants	higher dicots	Chenopodiaceae	*Atriplex semibaccata*	creeping saltbush		C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia hyssopifolia*		Y			1/1
plants	higher dicots	Fabaceae	*Glycine tabacina*	glycine pea		C		1/1
plants	higher dicots	Fabaceae	*Desmodium varians*	slender tick trefoil		C		1/1
plants	higher dicots	Fabaceae	*Tephrosia leptoclada*			C		1/1
plants	higher dicots	Fabaceae	*Sesbania cannabina var. cannabina*			C		1/1
plants	higher dicots	Lamiaceae	*Basilicum polystachyon*			C		1/1
plants	higher dicots	Onagraceae	*Ludwigia peploides subsp. montevidensis*			C		1/1
plants	higher dicots	Solanaceae	*Solanum elachophyllum*			E		1/1
plants	higher dicots	Verbenaceae	*Glandularia aristigera*		Y			1/1
plants	higher dicots	Verbenaceae	*Stachytarpheta jamaicensis*	Jamaica snakeweed	Y			1/1
plants	lower dicots	Papaveraceae	*Argemone mexicana*	prickly poppy	Y			1/1
plants	monocots	Alismataceae	*Damasonium minus*	starfruit		C		1/1
plants	monocots	Alismataceae	*Caldesia oligococca*			C		1/1
plants	monocots	Cyperaceae	*Cyperus pygmaeus*	dwarf sedge		C		2/2
plants	monocots	Cyperaceae	*Fimbristylis aestivalis*			C		1/1
plants	monocots	Juncaginaceae	*Cycnogeton dubius*			C		1/1
plants	monocots	Najadaceae	*Najas tenuifolia*	water nymph		C		1/1
plants	monocots	Poaceae	*Chloris gayana*	rhodes grass	Y			1/1
plants	monocots	Poaceae	*Walwhalleya subxerophila*			C		1/1
plants	monocots	Poaceae	*Eragrostis trichophora*		Y			1/1
plants	monocots	Poaceae	*Sporobolus elongatus*			C		1/1
plants	monocots	Poaceae	*Astrebla squarrosa*	bull mitchell grass		C		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.

APPENDIX D.2 Wildnet Online Report – [redacted]

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		1
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		1
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		1
animals	birds	Cacatuidae	*Eolophus roseicapillus*	galah		C		1
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		1
animals	birds	Meliphagidae	*Nesoptilotis leucotis*	white-eared honeyeater		C		2
animals	birds	Meliphagidae	*Caligavis chrysops*	yellow-faced honeyeater		C		1
animals	birds	Meliphagidae	*Manorina melanocephala*	noisy miner		C		1
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		1
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		1
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		1
animals	birds	Pardalotidae	*Pardalotus punctatus*	spotted pardalote		C		1
animals	birds	Petroicidae	*Eopsaltria australis*	eastern yellow robin		C		1
animals	reptiles	Varanidae	*Varanus panoptes*	yellow-spotted monitor		C		1
plants	higher dicots	Asteraceae	*Olearia ramulosa*			C		1/1
plants	higher dicots	Haloragaceae	*Gonocarpus urceolatus*			C		1/1
plants	higher dicots	Lamiaceae	*Westringia cheelii*			C		1/1
plants	higher dicots	Myrtaceae	*Micromyrtus gracilis*			C		1/1
plants	higher dicots	Rhamnaceae	*Cryptandra ciliata*			NT		1/1
plants	monocots	Poaceae	*Aristida jerichoensis*			C		1/1
plants	monocots	Poaceae	*Schizachyrium fragile*	firegrass		C		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.

APPENDIX E: EPBC APPROVAL

Appendix E EPBC Approval

Approval

Baralaba North Coal Mine Continued Operations, Baralaba, Queensland (EPBC 2013/7036)

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

person to whom the approval is granted	[redacted]
proponent's ABN	[redacted]
proposed action	To construct and operate an open cut coal mine extension 150 km west of Rockhampton, Queensland.
decision	To approve the proposed action for each of the following controlling provisions: • Listed threatened species and communities (sections 18 and 18A) • A water resource, in relation to coal seam gas development and large coal mining development (sections 24D and 24E)
Conditions of approval	This approval is subject to the conditions specified below.
expiry date of approval	This approval has effect until 15 December 2039
Decision-maker	
name and position	[redacted]
signature	[redacted]
date of decision	22 December 2014

1

Conditions of approval

1. The **Minister** may determine that a plan, strategy or program approved by the Queensland Government satisfies a plan, strategy or program required under these conditions.

Disturbance Limits

2. For the purpose of the action, the **approval holder** must not take any action outside the Baralaba North Continued Operations Project (BNCOP) Action Area or inside the Area of Exclusion of Mining Activities shown as red hatching at Attachment A.

3. To protect **EPBC Act listed threatened species and communities** within the **project area**, the whole of project maximum disturbance limits in Table 1 apply to the project. The **approval holder** must not exceed these maximum disturbance limits.

Table 1: Whole of project maximum disturbance limits

Threatened Ecological Communities	Maximum disturbance limits (hectares)
Brigalow (*Acacia harpophylla* dominant and co-dominant)	9
Coolibah-Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	0
Threatened Species	**Maximum disturbance limits (hectares)**
Squatter Pigeon (southern) (*Geophaps scripta scripta*)	277
Ornamental Snake (*Denisonia maculata*)	33.5
South-eastern Long-eared Bat (*Nyctophilus corbeni*)	277
Koala (*Phascolarctos cinereus*)	5

EPBC Species Impact Management

4. The **approval holder** must prepare and submit, for the **Minister's** written approval, a Matters of National Environmental Significance Management Plan (MNESMP). The MNESMP must include:

    a. measures that will be taken to avoid, mitigate and manage **impacts** to **EPBC Act listed threatened species and communities** and their habitat during clearance of vegetation, including the use of a **spotter/catcher** at all times during clearance of vegetation;
    b. measures that will be taken to avoid, mitigate and manage **impacts** to EPBC **Act listed threatened species and communities** and their habitats during construction, operation and decommissioning of the Project;
    c. details of how measures proposed in the MNESMP are consistent with the measures proposed in relevant **conservation advice, recovery plans** and **threat abatement plans**; and
    d. a program for monitoring the outcomes of mitigation and management measures to minimise direct **impacts** to **EPBC Act listed threatened species and communities** and their habitat.

    The MNESMP must be approved prior to **commencement** of the action. The approved EPBC Species Impact Management Plan must be implemented.

Offsets

5. The **approval holder** must provide environmental offsets for authorised unavoidable **impacts** to Brigalow (*Acacia harpophylla* dominant and co-dominant), Ornamental Snake (*Denisonia maculata*), Squatter Pigeon (Southern) (*Geophaps scripta scripta*) and South-eastern Long-eared Bat (*Nyctophilus corbeni*). The **approval holder** must ensure that environmental offsets comply with the principles of the EPBC **Act Environmental Offsets Policy**.

6. The **approval holder** must prepare and submit an Offset Management Plan, for the written approval of the **Minister**. The Offset Management Plan must include:

    a. a detailed baseline description of offset areas, including surveys undertaken, condition of existing EPBC **Act listed threatened species and communities** and their habitat;
    b. how the offset areas provide connectivity with other habitats and biodiversity corridors;
    c. performance and completion criteria for evaluating the management of the offset area, and criteria for triggering remedial action (if necessary);
    d. a description of the management measures that will be implemented for the protection of EPBC **Act listed threatened species and communities** listed at condition 5 and their habitat, including a discussion of how measures proposed are consistent with the measures in relevant **conservation advice**, **recovery plans** and **threat abatement plans**;
    e. a program to monitor and report on the effectiveness of these measures, and progress against the performance and completion criteria; and
    f. a timeline for when actions identified in the Offset Management Plan will be implemented for the offset area and the proposed legal mechanism for securing the offset.

    The **approval holder** must not **commence** the action until the Offset Management Plan has been approved by the **Minister** in writing. The approved Offset Management Plan must be implemented.

7. The **approval holder** must register and legally secure, in accordance with Queensland legislation, offsets for authorised unavoidable impacts within two (2) years of the **commencement** of the action.

Water

8. The **approval holder** must undertake management and monitoring of water resources in accordance with the Environmental Authority issued for the project under the *Environmental Protection Act 1994* (Qld).

9. The **approval holder** must make available to the **Minister** on request, all plans or programs and any reviews of plans or programs required under the Environmental Authority issued for the project under the *Environmental Protection Act 1994* (Qld), including the Receiving Environment Monitoring Program, Erosion and Sediment Control Plan, Water Management Plan and Groundwater Monitoring and Management Program.

General

10. Within 20 business days after the **commencement** of the action, the **approval holder** must advise the **Department** in writing of the actual date of **commencement**.

11. The **approval holder** must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement the management plans, reports or strategies required by this approval, and make them available upon request to the **Department**. Such records may be subject to

audit by the **Department** or an independent auditor in accordance with section 458 of the **EPBC Act**, or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the **Department's** website. The results of audits may also be publicised through the general media.

12. Within three months of every 12 month anniversary of the **commencement** of the action, the **approval holder** must publish a report on its website addressing compliance with the conditions of this approval over the previous 12 months, including the implementation of any management plans or programs as specified in these conditions. Documentary evidence providing proof of the date of publication must be provided to the **Department** at the same time as the compliance report is published. The compliance reports must remain on the website for the period this approval has effect.

13. The **approval holder** must notify the **Department** in writing of potential non-compliance with any condition of this approval as soon as practical and within no later than ten (10) business days of becoming aware of the potential non-compliance. The notice provided to the **Department** under this condition must specify:

    a) the condition which the **approval holder** has potentially breached;

    b) the nature of the potential non-compliance;

    c) when and how the **approval holder** became aware of the non-compliance;

    d) how the non-compliance will affect the anticipated **impacts** of the approved action, in particular how the non-compliance will affect the **impacts** on the matters of national environmental significance;

    e) the measures the approval holder will take to address the **impacts** of the non-compliance on the matters of national environmental significance and rectify the non-compliance; and

    f) the time by which the approval holder will rectify the non-compliance.

14. Upon the direction of the **Minister**, the **approval holder** must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the **Minister**. The independent auditor must be approved by the **Minister** prior to the commencement of the audit. Audit criteria must be agreed to by the **Minister** and the audit report must address the criteria to the satisfaction of the **Minister**.

15. If the **approval holder** wishes to carry out any activity other than in accordance with the management plan as specified in conditions 4 and 6, the **approval holder** must submit to the **Department** for the **Minister's** written approval a revised version of that management plan. The approval holder must not **commence** the varied activity until the **Minister** has approved the varied management plan. The **Minister** will not approve a varied management plan unless the revised management plan would result in an equivalent or improved environmental outcome over time. If the **Minister** approves the revised management plan, that management plan must be implemented in place of the management plan originally approved.

16. If, at any time after five (5) years from the date of this approval, the **approval holder** has not **commenced** the action, then the **approval holder** must not **commence** the action without the written agreement of the **Minister**.

17. Unless otherwise agreed to in writing by the **Minister**, the **approval holder** must publish all management plans or programs referred to in these conditions of approval on its website. Each management plan must be published on the website within 1 month of being approved and remain available on that website for the life of the approval.

Definitions

Approval holder: means the person to whom the approval is granted or any person acting on their behalf, or to whom the approval is transferred under section 145B of the EPBC Act.

Commence/commencement: Unless the activity is specifically defined for the purposes of these conditions, commencement of an activity includes any physical disturbance including clearing of vegetation, earthworks, new road works, construction of new camps, development of mining associated infrastructure and mining operations. Commencement does not include:

a) minor physical disturbance necessary to undertake pre-clearance surveys or establish monitoring programs; or

b) activities that are critical to commencement that are associated with mobilisation of plant and equipment, materials, machinery and personnel prior to the start of development only if such activities will have no adverse impact on matters of national environmental significance, and only if the proponent has notified the Department in writing before an activity is undertaken.

Conservation advice: means an approved conservation advice by the Minister under the EPBC Act for an EPBC Act listed species or community.

Department: means the Australian Government Department administering the *Environment Protection and Biodiversity Conservation Act 1999*.

EPBC/ EPBC Act: means the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

EPBC Act Environmental Offsets Policy means the EPBC Act Environmental Offsets Policy (October 2012) including the Offsets Assessment Guide.

EPBC listed threatened species and communities: means a threatened flora or fauna species listed under the EPBC Act and an endangered ecological community listed under the EPBC Act.

Fauna spotter/catcher means a person licensed under the relevant State legislation and who has demonstrated experience in surveying for and identifying species listed under the EPBC Act.

Impact/s: as defined in section 527E of the EPBC Act.

Legally secure: means to secure a covenant or similar legal agreement in relation to a site, to provide enduring protection for the site against development incompatible with conservation.

Minister: means the Minister administering the *Environment Protection and Biodiversity Conservation Act 1999* and includes a delegate of the Minister.

Project area: means the area identified as the project area shown as the BNCOP Action Area in Attachment A.

Recovery Plan: means a recovery plan approved by the Minister under the EPBC Act.

Threat abatement plan: means a threat abatement plan approved by the Minister under the EPBC Act.

ATTACHMENT A