



Tharbogang Landfill and Quarry

Landscape and Biodiversity Management Plan

Rehabilitation and Biodiversity Offset Strategy Management Plan

Prepared for
Griffith City Council



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Abbreviations

ABBREVIATION	DESCRIPTION
BAM	Biobanking Assessment Methodology
BCC	Biobanking Credit Calculator
BOA	Biodiversity Offset Area
BOS	Biodiversity Offset Strategy
BVT	Biometric Vegetation Type
CMA	Catchment Management Area
CoA	Conditions of Approval
DECCW	NSW Department of Environment, Climate Change and Water (now OEH)
DGRs	Director General's Requirements
DII	NSW Department of Industry and Investment
DNG	Derived Native Grassland
DNR	NSW Department of Natural Resources (now part of OEH)
DoP	NSW Department of Planning (now DP&I)
DP&I	NSW Department of Planning and Infrastructure
EA	Environmental Assessment Repo
ELA	Eco Logical Australia Pty Ltd
EP&A Act	NSW <i>Environmental Planning & Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
GCC	Griffith City Council
HBTs	Hollow bearing trees
LBMP	Landscape and Biodiversity Management Plan
LTMS	Long Term Management Strategy
NOW	NSW Office of Water
NPW Act	NSW National Parks and Wildlife Act 1974
NPWS	National Parks and Wildlife Service (now part of OEH)
OEH	NSW Office of Environment and Heritage
PCOs	Pesticide Control Orders
PVP	Property Vegetation Plan
QRA	Quarry Rehabilitation Area
RBOSMP	Rehabilitation and Biodiversity Offset Strategy Management Plan
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>

1 Introduction

This Landscape and Biodiversity Management (LBMP) has been prepared by Eco Logical Australia Pty Ltd (ELA) for Collaborative Planning and Engineering Associates (CPE Associates Pty Ltd) on behalf of Griffith City Council (GCC). The LBMP includes two components:

- Rehabilitation and Biodiversity Offset Strategy Management Plan (RBOSMP)
- Long Term Management Strategy (LTMS)

The LBMP has been prepared for the proposed future expansion of an existing landfill and quarry located at Tharbogang, approximately 10 kilometres (km) northwest of Griffith. The existing landfill and quarry is restricted to Lot 202, which is part of a number of land holdings of approximately 595 hectares (ha) owned by GCC (Lots 181-185, 201 and 202 // DP 756035). The existing landfill/quarry itself is positioned in a natural depression in the centre of this lot and has a direct footprint of approximately 29.6 ha, including associated buildings and roads (**Figure 1**).

The proposed future expansion of this quarry will result in an increase to the final direct footprint of 14.1 ha, with indirect impacts due to edge effects associated with these direct impacts to be equivalent to 3.75 ha. A Biodiversity Offset Strategy (BOS) (ELA 2011) for these impacts was prepared by ELA (2011). This BOS utilised a 'maintain or improve' offset calculation to measure the impacts caused by the proposed works and the predicted improvement of the proposed offset sites. This assessment indicated that an area of 35.3 ha was required to offset the direct impacts and a further 0.22 ha to offset the potential indirect impacts.

Subsequent negotiation with DP&I and OEH resulted in the creation of a Biodiversity Offset Area (BOA) covering an area of 95.31 ha, on Lots 181 and 182, adjacent to the impact footprint and consisting of *Inland Grey Box - Poplar Box - White Cypress Pine Tall Woodland* (hereafter referred to, Poplar Box Woodland). The woodland vegetation has been mapped in two condition classes, in addition to 1.41 ha of derived native grassland (DNG).

When the proposed quarry has reached the end of its working life, rehabilitation actions will also be required in this area. This Quarry Rehabilitation Area (QRA) will be approximately 14.75 ha. The existing vegetation in the QRA is *Dwyer's Red Gum – White Cypress Pine – Currawang Shrubby Woodland* (hereafter referred to as Dwyer's Red Gum Woodland).

The BOA and QRA are presented in **Figure 2** and **Figure 3**.

Planning consent (the Approval) for the expansion and landfilling was issued by the NSW Department of Planning (DoP) in July 2010, subject to a number of conditions, including revising the BOS (as discussed in ELA 2011). The conditions were modified on 13 September 2011 (06_0334 MOD 1) to modify conditions 45 through 48 and the addition of 48 (a) and (b). Conditions 45 through 48(b) are listed below:

- 45.** *The Proponent shall implement the Biodiversity Offset Area (BOA) on Lots 181 and 182, DP 756035 including 95.31 ha of 'Inland Grey Box – Poplar Box – White Cypress Pine Tall*

Woodland', as described in the application (06_0034 MOD 1) to the satisfaction of the Director-General, in consultation with the EPA.

- 46.** Within one year of the approval of (06_0034 MOD 1), unless the Director-General agrees otherwise, Council must provide appropriate long term security for the BOA defined in Condition 45 through one of the following mechanisms:

- a) a Conservation Agreement under the National Parks and Wildlife Act 1974; or
- b) a Biobanking Agreement under the Threatened Species Conservation Act 1995.

The agreement must remain in force in perpetuity.

- 47.** The Proponent shall ensure the long term security of the BOA referred to in Conditions 45 and 46, prior to any clearing onsite.

- 48.** The Proponent shall prepare and implement a Landscape and Biodiversity Management Plan for the project in accordance with Condition 49 to the satisfaction of the Director-General. This plan must:

- a) be prepared by suitably qualified person(s), approved by the Director-General;
- b) be submitted to the Director-General for approval within 12 months of the date of (06_0034 MOD 1); and
- c) include a:
 - i. Rehabilitation and Biodiversity Offset Strategy Management Plan; and
 - ii. Long Term Management Strategy.

Note: The Department accepts that the initial Landscape and Biodiversity Management Plan may not include the detailed Long Term Management Strategy. However, a conceptual strategy must be included in the initial plan, along with a timetable for augmentation of the strategy with each subsequent review of the plan.

- 48(a).** To ensure that the BOA is implemented in accordance with the performance and completion criteria in the Rehabilitation and Biodiversity Offset Strategy Management Plan, Council must secure implementation funds via one of the following mechanisms to the satisfaction of the Director-General:

- a) a Biobanking Agreement under the Threatened Species Conservation Act 1995;
- b) lodgement of a conservation bond with the Department;
- c) a Voluntary Planning Agreement under Section 93F of the EP&A Act;

The sum of the funds shall be determined by:

- calculating the full cost of implementing the Rehabilitation and Biodiversity Offset Strategy Management Plan, and
- employing a suitably qualified quantity surveyor to verify the calculated costs.

The funding must be secured within six months of the approval of the Rehabilitation and Biodiversity Offset Strategy Management Plan required by condition 48, unless otherwise agreed to by the Director-General.

- 48(b).** The Department notes that if a Biobanking Agreement is implemented for the BOA defined by Condition 45, the requirements of Conditions 45, 46, 48 and 48 (a) are likely to be satisfied. The Department requests that on approval of any Biobanking Agreement, a copy of the agreement is submitted to the Department which includes management and monitoring plans and funding arrangements.

This management plan, as required in Condition 48 will guide the implementation of management actions in the BOA, as required by Condition 45. These management works will be funded for the duration of the quarry's lifespan via a commitment by GCC to provide and report on expenditure of funds on an annual basis, as required by Conditions 46 and 47. This commitment will be secured via

a Planning Agreement under Section 93F of the EP&A Act, as required by Condition 48(a). In this case, Condition 48(b) is not applicable.

The approval also included two conditions, conditions 49 and 50 of Schedule 3 of PA 06_0334, regarding the preparation and implementation of a Rehabilitation and Biodiversity Offset Strategy Management Plan (RBOSMP). These specify:

- 49.** *The Rehabilitation and Biodiversity Offset Management Plan must include:*
- (a) *Rehabilitation objectives for the site and offset areas;*
 - (b) *Description of the measures that would be implemented to:*
 - *Rehabilitate and stabilise site;*
 - *Minimize the removal of mature trees;*
 - *Implement the Biodiversity Offset Strategy; and*
 - *Manage remnant vegetation and habitat on site and in the offset areas.*
 - (c) *Detailed performance and completion criteria of the rehabilitation and stabilization of the site;*
 - (d) *Detailed description of how the performance of the rehabilitation of the quarry areas would be monitored over time to achieve the stated objectives;*
 - (e) *Detailed description of what measures would be implemented to rehabilitate and manage the landscape of the site included the procedures to be implemented for:*
 - *Progressively rehabilitating and stabilizing areas disturbed by quarrying;*
 - *Implementing revegetation and regeneration within the disturbance areas;*
 - *Protecting areas outside the disturbance areas including the Biodiversity Offset Strategy Areas;*
 - *Vegetation clearing protocols, including a protocol for clearing any trees containing hollows and the relocation of hollows from felled trees;*
 - *Managing impacts on fauna, in particular threatened species;*
 - *Controlling weeds and pests;*
 - *Controlling access;*
 - *Bushfire management; and*
 - *Reducing the visual impact of the project.*
 - (f) *A description of the potential risks to successful rehabilitation and a description of the contingency measures that would be implemented to mitigate these risks; and*
 - (g) *Details of who is responsible for monitoring, reviewing, and implementing the plan.*
- 50.** *Long Term Management Strategy must:*
- (a) *Define the objectives and criteria for quarry closure post extraction management;*
 - (b) *Be prepared in consultation with DECCW, NOW and DII;*
 - (c) *Investigate and/or describe options for the future use of the site;*
 - (d) *Describe the measures that would be implemented to minimise or manage the environmental effects of the project; and*
 - (e) *Describe how the performance of these measures would be monitored over time.*

This RBOSMP seeks to address these requirements. In particular, this RBOSMP identifies the specific management actions which the GCC (or future land owners) will be required to carry out as part of the BOS. It is noted that management actions beyond the scope of this RBOSMP may be carried out at the discretion of the GCC as long as they are not inconsistent with this RBOSMP.

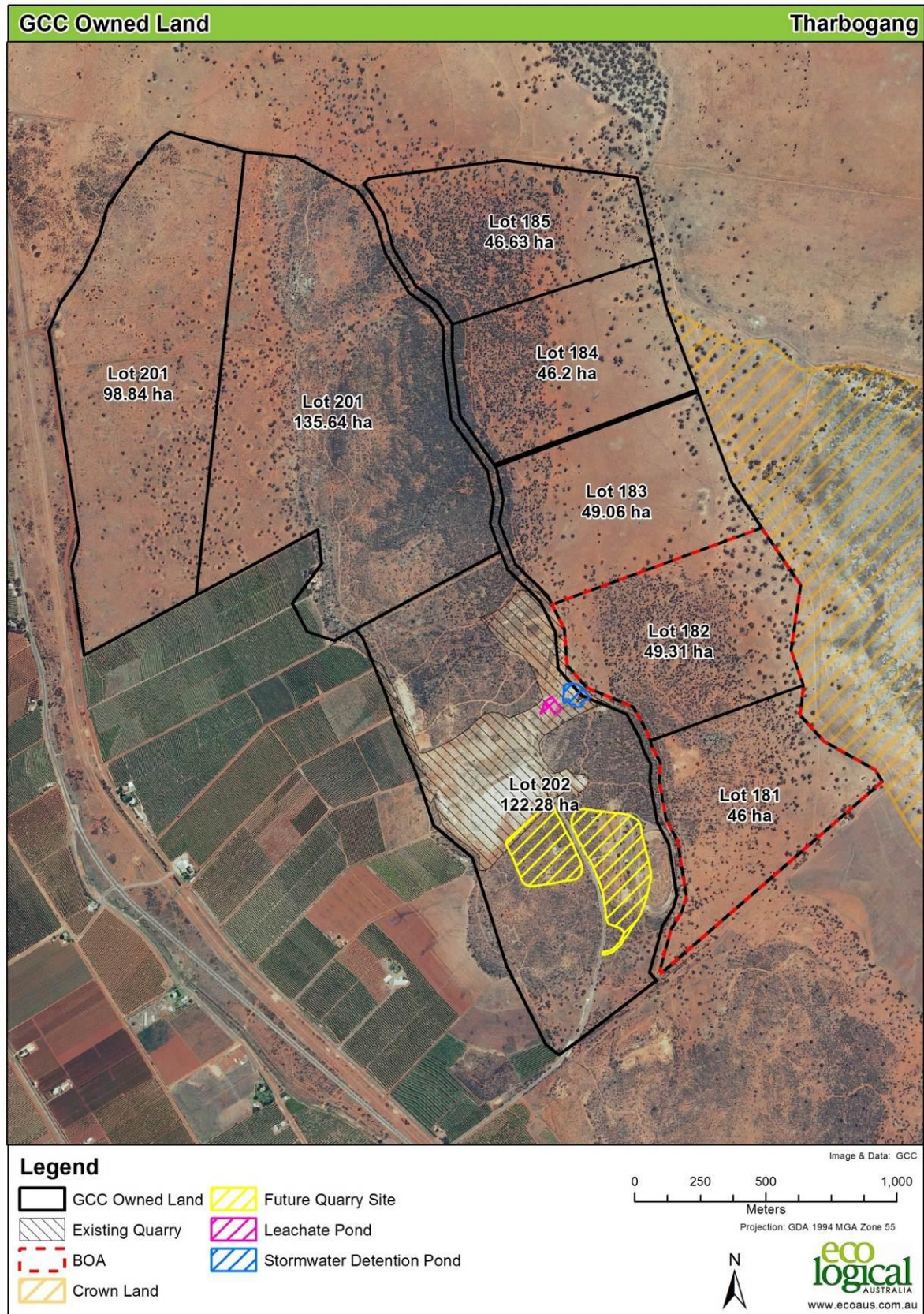


Figure 1: Aerial imagery of Griffith City Council lands , the Biodiversity Offset (BOA) and Quarry Rehabilitation Areas (future quarry site)

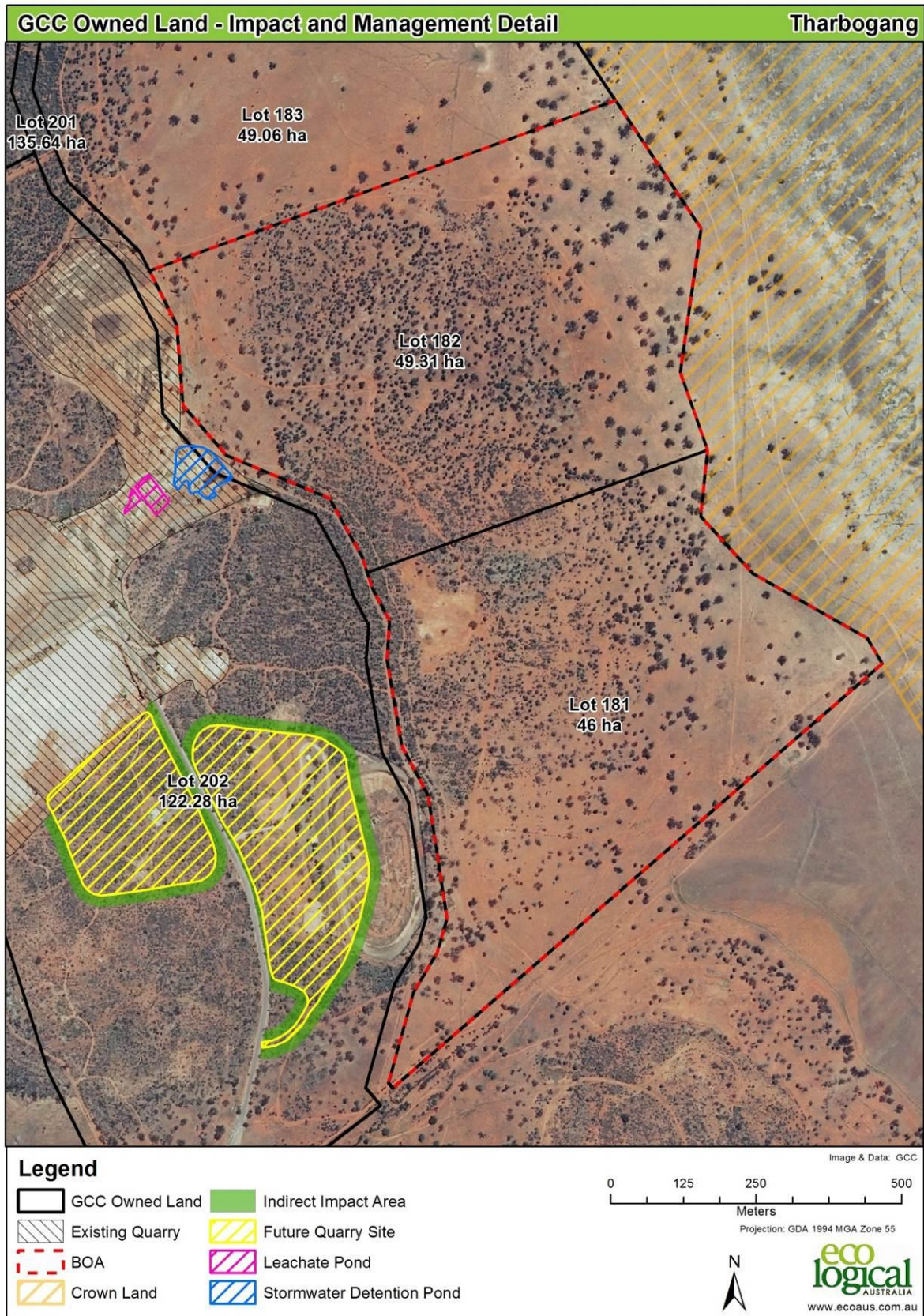


Figure 2: Biodiversity Offset Area and Quarry Rehabilitation Area (future quarry site)

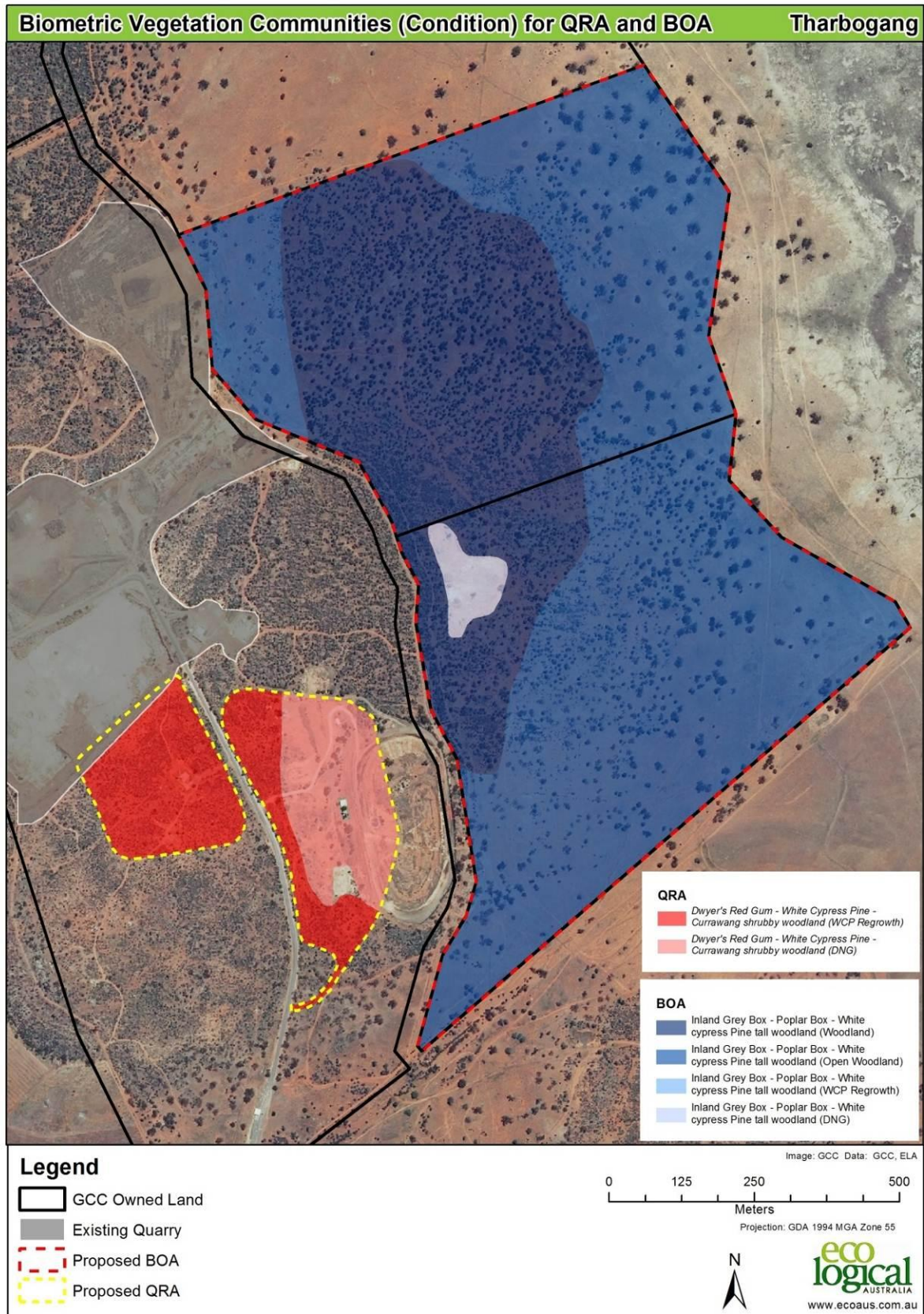


Figure 3: Existing and proposed vegetation types in the BOA and QRA

1.1 COMPLIANCE WITH CONDITIONS OF APPROVAL

Table 1 indicates where in this management plan each of the Conditions of Approval (CoA) have been addressed.

Table 1: Summary of Condition of Approval Requirements

CONDITION NO.	REQUIREMENTS	SECTION ADDRESSED
48	<i>The Proponent shall prepare and implement a Landscape and Biodiversity Management Plan for the project in accordance with Condition 49 to the satisfaction of the Director-General. This plan must:</i>	
48 a)	<i>Be prepared by suitably qualified person(s), approved by the Director-General;</i>	Appendix A
48 b)	<i>Be submitted to the Director-General for approval within 12 months of the date of (06_0034 MOD 1); and</i>	Submitted before 13 September 2012
48 c)	<i>Include a:</i> <i>- Rehabilitation and Biodiversity Offset Strategy Management Plan; and</i>	Section 1-10
	<i>- Long Term Management Strategy.</i>	Section 11
49	<i>The Rehabilitation and Biodiversity Offset Management Plan must include:</i>	
49 a)	<i>Rehabilitation objectives for the site and offset areas;</i>	Section 10
49 b)	<i>Description of the measures that would be implemented to:</i>	Section 4
	<i>Rehabilitate and stabilize site;</i>	
	<i>Minimize the removal of mature trees;</i>	
	<i>Implement the Biodiversity Offset Strategy; and</i>	
	<i>Manage remnant vegetation and habitat on site and in the offset areas.</i>	
49 c)	<i>Detailed performance and completion criteria of the rehabilitation and stabilization of the site;</i>	Section 10
49 d)	<i>Detailed description of how the performance of the rehabilitation of the quarry areas would be monitored over time to achieve the stated objectives;</i>	Section 7 and 8
49 e)	<i>Detailed description of what measures would be implemented to rehabilitate and manage the landscape of the site included the procedures to be implemented for:</i>	
	<i>Progressively rehabilitating and stabilizing areas disturbed by quarrying;</i>	Section 4 and 5

CONDITION NO.	REQUIREMENTS	SECTION ADDRESSED
	<i>Implementing revegetation and regeneration within the disturbance areas;</i>	
	<i>Protecting areas outside the disturbance areas including the Biodiversity Offset Strategy Areas;</i>	
	<i>Vegetation clearing protocols, including a protocol for clearing any trees containing hollows and the relocation of hollows from felled trees;</i>	
	<i>Managing impacts on fauna, in particular threatened species;</i>	Section 4-8
	<i>Controlling weeds and pests;</i>	Section 4
	<i>Controlling access;</i>	
	<i>Bushfire management; and</i>	
	<i>Reducing the visual impact of the project.</i>	
49 f)	<i>A description of the potential risks to successful rehabilitation and a description of the contingency measures that would be implemented to mitigate these risks; and</i>	Section 4
49 g)	<i>Details of who is responsible for monitoring, reviewing, and implementing the plan.</i>	Section 4
50	<i>Long Term Management Strategy must:</i>	
50 a)	<i>Define the objectives and criteria for quarry closure post extraction management</i>	Section 11
50 b)	<i>Be prepared in consultation with DECCW, NOW and DII</i>	
50 c)	<i>Investigate and/or describe options for the future use of the site</i>	
50 d)	<i>Describe the measures that would be implemented to minimise or manage the environmental effects of the project and</i>	
50 e)	<i>Describe how the performance of these measures would be monitored over time</i>	

1.2 REHABILITATION AND BIODIVERSITY OFFSET OBJECTIVES

The RBOSMP objectives are based around the three specific categories of integrating landscapes, achieving sustainable growth and development, and establishing the final land use.

Integrated Landscapes

- To provide a vegetated corridor across GCC land holdings and link adjacent sub-regional habitat corridors (including Lake Wyangan, Barren Box Swamp, the McPherson Ranges and the Cocoparra Ranges) (see **Figure 4**)
- To reduce the visibility of landfill and quarry operations from adjacent properties, Tharbogang and the local road network
- To blend the created landforms with the surrounding topography
- To provide a low maintenance, geotechnically stable and safe landform with minimal erosion

Sustainable Growth and Development

- To achieve a soil profile capable of sustaining the specified final land use
- To establish native vegetation with the species diversity commensurate to each relevant ecological community

Final Land Use

- To re-instate woodland ecological communities commensurate with the remnant woodland vegetation within the BOA and QRA
- Undertake habitat augmentation to improve and promote corridors for fauna movement linking adjacent remnant woodland vegetation with the rehabilitation of the Project Site

The RBOSMP will also provide direction to GCC to:

- Identify the land required to be managed in accordance with this RBOSMP
- Provide a clear, concise, staged and instructional working document outlining the management actions for the BOA and QRA
- Provide a management framework that will lead to an improvement in the condition of native vegetation on the site utilising expert knowledge of resilience in natural landscapes and through specific bushland restoration techniques
- Minimise the impacts of key threats to the site through specific management actions. Key threats include the weeds *Echium plantagineum* (Paterson's Curse), *Opuntia aurantiaca*. (Tiger Pear), *Hypericum perforatum* (St John's Wort), *Lycium ferocissimum* (African Boxthorn) and *Marrubium vulgare* (White Horehound).
- Outline the monitoring, performance evaluation and reporting procedures that are practical and able to be implemented and understood by the Property Manager.

1.3 LEGISLATIVE REQUIREMENTS

Management actions described in this Management Plan entail works undertaken within the habitat of threatened species. Notwithstanding the fact that these actions are, in general, for conservation purposes, there is a risk that some actions may cause harm or damage to a threatened species. However, the approved consent (PA 06_0334 and modifications), of which this RBOSMP is a part, provides a defence against prosecution for any impacts associated with the implementation of the

management actions outlined herewith. As such, a licence under Section 91 of the TSC Act or Sections 120 or 132C of the NSW *National Parks & Wildlife Act 1974* (NPW Act) is not required.

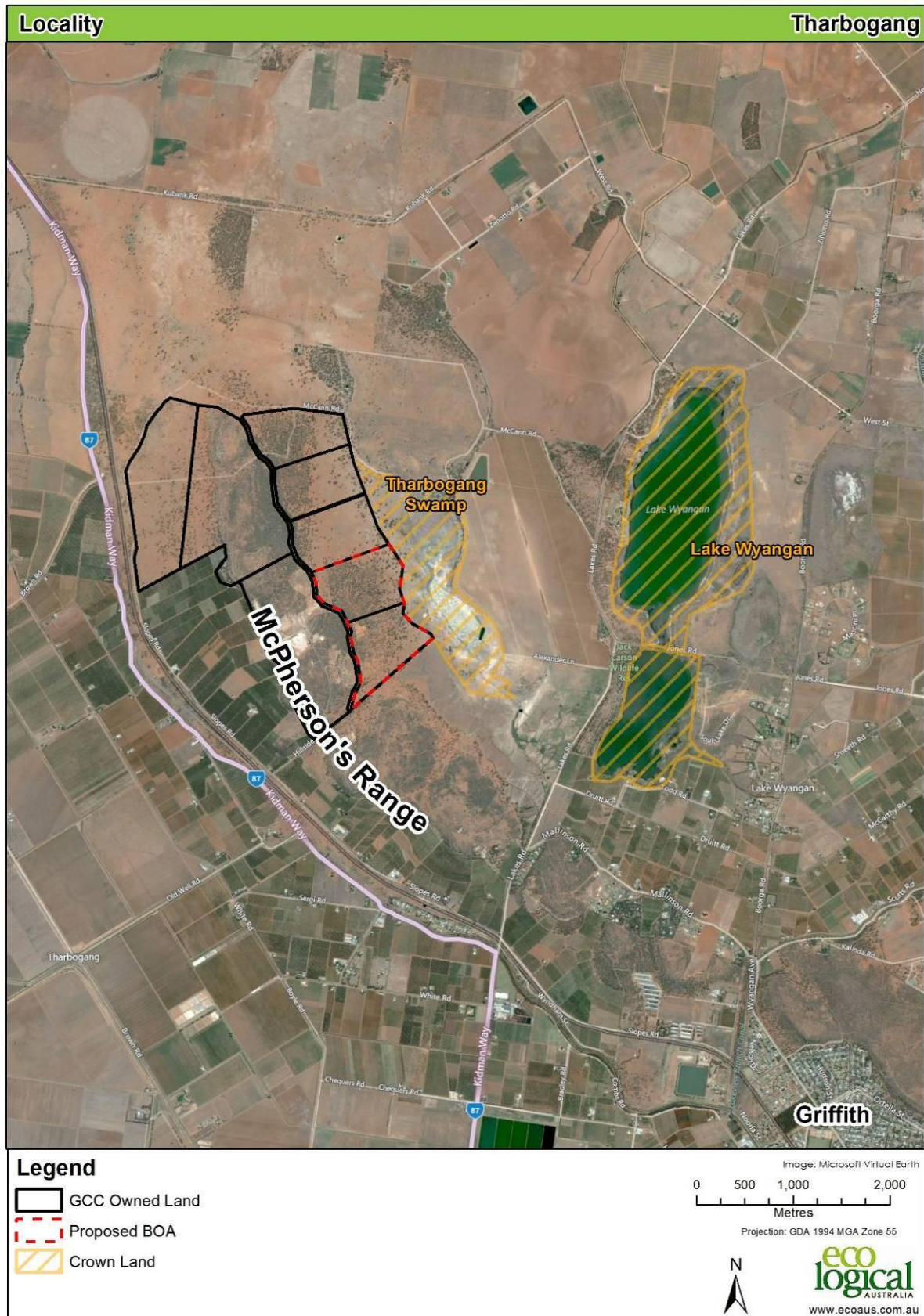


Figure 4: Regional Context of Biodiversity Offset Area

2 Description of rehabilitation and offset sites

2.1 LOCATION IN A REGIONAL CONTEXT

The BOA and QRA are located approximately 10 km north of the city of Griffith in western New South Wales (NSW), near the township of Tharbogang (**Figure 4**). The BOA is located on Lot 181 and 182, to the east of an existing landfill and quarry operation run, owned and operated by GCC on Lot 202. The QRA is located to the south of this quarry, in Lot 202. The BOA covers approximately 95.31 ha which includes 93.9 ha of Poplar Box Woodland and 1.4 ha of DNG. The QRA covers approximately 14.75 ha, of which 14.10 ha currently comprises Dwyer's Red Gum Woodland and 0.65 ha of cleared land.

The BOA and QRA are located at southern extremity of the McPherson Ranges, a hook shaped range of low hills approximately 40 km long. In addition, they are near a number of other important areas of habitat within the Griffith Local Government Area (LGA), including Tharbogang Swamp (immediately east of the BOA), Lake Wyangan (~4 km east), Barren Box Swamp (~12 km north-west), and the Cocoparra Ranges (~24 km east).

2.2 CLIMATIC INFORMATION

The closest long term meteorological station is Griffith Airport (8 km south east). This site has been collecting data on the Griffith area since 1960. The Griffith area is influenced by a temperate weather system and experiences warm summer and mild winter temperatures. Summer maximum temperatures are experienced in January with an average maximum of 32.8 degrees Celsius (°C) (daily) and average minimum of 16.9°C (nightly). Winter minimums are experienced in July with an average maximum of 14.5°C (daily) and minimum of 3.5°C (nightly). The average rainfall is 393.7 millimetres (mm)/year (~32.78 mm/month), spread fairly evenly throughout the year with slightly higher levels recorded in December (33.5 mm) and slightly lower in April (27.7mm). Trans-evaporation generally exceeds average annual rainfall, resulting in dry conditions (Balance 2009).

Table 2: Rainfall and Temperature Data for the BOA

TEMP (C°)	J	F	M	A	M	J	J	A	S	O	N	D
Mean max temperature	32.8	32.1	28.7	24.0	19.2	15.5	14.5	16.5	19.8	23.8	27.9	30.8
Mean min temperature	16.9	17.3	14.2	10.2	7.1	4.5	3.5	3.9	5.8	8.9	12.6	15.1
Highest mean max temperature	37.3	36.1	32.2	28.3	21.2	18.7	17.1	21.0	23.5	27.2	33.3	33.9
Lowest mean min temperature	12.5	14.4	10.3	6.9	3.0	1.2	0.9	1.4	2.0	6.2	6.0	9.1

RAINFALL (mm)	J	F	M	A	M	J	J	A	S	O	N	D
Mean rainfall	33.4	28.8	33.2	27.7	35.7	33.7	33.5	36.2	32.9	40.5	33.3	33.5
Highest monthly rainfall	257.1	138.2	216.8	170.2	136.0	74.8	88.4	87.6	116.1	143.0	128.0	127.8
Lowest monthly rainfall	0	0	0	0.5	1.2	0.3	1.1	2.2	2.2	0	0	0

Source: www.bom.gov.au

2.3 GEOLOGY, TOPOGRAPHY, GEOMORPHOLOGY AND SOILS

The Department of Mines and Geological Survey of NSW Services, Sheet 51 55-10 “Narrandera” (Pogson 1977), identifies the site geology as being part of the Griffith Syncline which comprises a succession Upper Devonian sandstones, siltstones and conglomerates that belong to the Cocoparra Group. The Cocoparra Group contains, Mailman Gap Member, coarse pebble sandstone and conglomerate unit along the ridgelines and the Jimberoo Formation, a medium to coarse grained sandstone, along the eastern slopes (Balance 2009). The remainder of the slopes on site are largely obscured by residual and colluvial deposits, but may contain older units such as the Barrat Formation, pebbly sandstone and sandstone. The floodplains to the north, east and west of the ridge line are largely comprised of undefined Quaternary formations of flat to gently undulating plains of red and brown clayey sand, loam and lateritic soils (Pogson 1977).

The Griffith area is largely flat, sloping east to west and relieved primarily by the McPherson Range which extends to the north-east for approximately 30km and north-west, through the BOA, approximately 10km. McPherson Range displays the structural features common to Devonian formations and extensive faulting has resulted in its characteristic rock formations. The Range represents the boundary between the slopes country and the flat riverine plain to the west. Gaps in the ridgeline occur at Tharbogang, and just north-west of Griffith. These gaps are responsible for directing calcareous clays into the Lake Wyangan area by acting as wind tunnels (Balance 2009). The BOA includes elevations from 125 m on the Australian Height Datum (AHD) along the floodplains up to a maximum 180 m along the ridgeline.

The soils at nearby Scenic Hill have been classified as Gradational; (non-Calcareous) Soils of the McPherson Range. These soils are not calcareous throughout; surface textures commonly range from sandy loam to clay loam, less commonly loamy sand, clayey sand and sand, and occasionally sandy clay, silty clay or light clay; there is a gradual increase in texture grade (clayiness) with depth, sometimes followed by a decrease below B horizon; acid, neutral and alkaline soil trends occur (Balance 2009).

The soils of the McPherson Range have a moderately high permeability which has implications for plant growth. The semi-arid climate and low rainfall events mean that the soils have little chance of retaining water for long periods of time. Most water from rainfall events is leached downwards through the profile where it is transported laterally along the bedrock to the groundwater system. Overland flow is likely to be limited due to the presence of top soil and native vegetation (Balance 2009). However, the relatively fertile A horizon of the soil profile indicates that some nutrient recycling has occurred so that when leaching moves nutrients through the profile, uptake of nutrients by plants

occurs which moves the nutrients up through transpiration. The vegetation cover also protects the soil profile from Aeolian erosion (Balance 2009).

2.4 VEGETATION

The native vegetation of the BOA, QRA and the surrounding area has been mapped during various previous vegetation assessments by Eldridge (2002), ERC (2003), Ecosurveys (2006), and ELA (2011). The ERC (2003) assessment was confined to Lot 202 and the Ecosurveys (2006) assessment included both Lot 202 and Lot 201. In the intervening period from 2006 to 2011, GCC acquired the neighbouring Lots 181, 182, 183, 184 and 185. These Lots were included in the assessment by ELA (2011). As each survey applied different methodology and determined different vegetation communities, these have been summarised in **Table 3** and compared to accepted biometric vegetation types (DECC 2008). It should be noted that the terms Bimble Box and Poplar Box have been used interchangeably in the past as the common name for the species *Eucalyptus populnea* subsp. *bimbil*. Similarly, Dwyer's Red Gum (*E. dwyeri*), is also known by the common names Dwyer's Gum and Dwyer's Mallee Gum.

Eldridge (2002) conducted a survey of the entire Murrumbidgee Irrigation Area which determined that there were five vegetation types within Lot 201. These were:

- Bimble (Poplar) Box
- Dwyer's [Red] Gum/Currawang
- White Cypress Pine
- Yarran
- Other Remnant Vegetation (mainly consisting of Wilga)

The vegetation of the impact area for which the BOA was required were assessed by ERC (2003). This determined that there were four vegetation types, namely:

White Cypress Pine Forest;

- Occasional remnant *Eucalyptus populnea* (Poplar or Bimble Box) and *Eucalyptus dwyeri* (Dwyer's Red Gum) was recorded
- Understorey largely consisted of juvenile *Callitris glaucophylla* (White Cypress Pine) with some *Geijera parviflora* (Wilga) and *Acacia doratoxylon* (Currawang)
- Ground cover in this area was sparse, largely consisting of native forbs with some grasses.

Bimble Box – White Cypress Pine Woodland;

- The overstorey consisted of *Eucalyptus populnea* with *Callitris glaucophylla* dominating the lower strata
- Contained many remnant old growth *Eucalyptus populnea*. Tree health was generally very good, with few trees showing signs of dieback and stress
- Understorey was generally sparse consisting of juvenile *Callitris glaucophylla* regrowth, with the occasional *Acacia doratoxylon*, *Dodonea cuneata* (Wedge-leaf Hop-bush) and *Dodonea viscosa* subsp. *angustissima* (Narrow-leaf Hop-bush)
- Ground cover consisted of native grasses with some introduced species.

Dwyer's Mallee Gum – White Cypress Pine – Currawang Woodland; and

- This community was generally associated with rocky outcrops, the ridgeline and upper slope areas
- The overstorey was dominated by *Eucalyptus dwyeri* with some areas dominated by patches of *Callitris glaucophylla*
- *Acacia doratoxylon* and *Callitris glaucophylla* dominated the lower stratum, particularly *Callitris glaucophylla* on lower and south facing slopes
- The understorey consisted largely of juvenile *Callitris glaucophylla* and *Eucalyptus dwyeri*, *Pittosporum angustifolium* (Weeping Pittosporum) and the occasional *Eucalyptus populnea*. *Callitris glaucophylla* became dominant in the lower lying mid-section forming a significant ecotone
- The ground layer was generally sparse and consisted of native grasses and forbs.

Mixed Bimble Box – White Cypress Pine – Dwyer's Mallee Gum, open forest (Not mapped on Lot 201).

- This community is largely dominated by *Callitris glaucophylla*, well represented throughout all age structures.
- Numerous old growth and mature *Eucalyptus populnea*, *Callitris glaucophylla* and *Eucalyptus dwyeri* were recorded along the gully floors and drainage lines. *Eucalyptus dwyeri* and *Acacia doratoxylon* became dominant as slope increased.
- Early to advanced regrowth of *Callitris glaucophylla* and *Acacia doratoxylon* dominated the understorey stratum. The shrub layer apart from the *Callitris glaucophylla* was patchy.
- Ground cover comprised a mixture of predominately native grasses, with some forbs and introduced species.

The GCC lands (including the BOA site) were surveyed 5th to 9th September 2011 by three ELA ecologists, Bruce Mullins, Lucas McKinnon and Andrew Whitford. The vegetation of the BOA had not been specifically mapped in any previous survey, but was assessed by ELA using Biobanking methodology. This determined there was one main biometric vegetation type in the BOA, 'Inland Grey Box - Poplar Box - White Cypress Pine Tall Woodland' (Poplar Box Woodland), in three condition classes, Woodland, Open Woodland, and Derived Native Grassland (DNG).

Poplar Box Woodland is characterised by:

- Occurring on the red and brown clayey sand of the gently undulating plains, footslopes and floodplains of the region
- *Callitris glaucophylla* dominance to various degrees
- Dominant myrtaceous overstorey species in this community was *Eucalyptus populnea*
- Midstorey dominance by *Geijera parviflora*
- Areas of DNG containing *Austrostipa scabra* subsp. *scabra* (Speargrass)

The relationship of this community to the communities previously mapped within the GCC lands is shown in **Table 3**. Where a previous vegetation community is split by the newer mapping, it has been placed within the group that most accurately describes it. A second biometric vegetation community 'Dwyer's Red Gum - White Cypress Pine - Currawang Shrubby Woodland' is located in the QRA and will be impacted by the proposed quarry. This community will represent the final vegetation goal of

rehabilitation in the QRA when these works are conducted. A vegetation map of the entire GCC land area at Tharbogang is presented in **Figure 5**.

Table 3: Compilation of the relationship between vegetation communities in previous surveys

ELDRIDGE 2002	ERC 2003	ECOSURVEYS 2006	ELA 2011	BIOMETRIC VEGETATION TYPE
Dwyer's Gum / Currawang	Dwyer's Mallee Gum – White Cypress Pine – Currawang Woodland	Dwyer's Red Gum / Currawang Woodland	Dwyer's Red Gum - White Cypress Pine - Currawang Shrubby Woodland	Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly of the NSW South Western Slopes Bioregion (Benson 185)
Bimble Box / White Cypress	Mixed Bimble Box – White Cypress Pine – Dwyer's Mallee Gum, Open Forest	-		
White Cypress Pine	White Cypress Pine Forest	White Cypress Pine Open Forest / Regrowth	Inland Grey Box - Poplar Box - White Cypress Pine Tall Woodland	Inland Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Penneplain Bioregion (Benson 82)
	Bimble Box – White Cypress Pine Woodland	White Cypress Pine - Poplar Box Woodland		
Bimble Box	-	Poplar Box Grassy Woodland		

¹ Bimble Box and Poplar Box = *Eucalyptus populnea*

² White Cypress Pine communities recognised by ERC (2003) and Ecosurveys (2006) are considered ser's of the BioMetric vegetation types in ELA (2011), hence the overlap with the BVT's and previous vegetation classifications

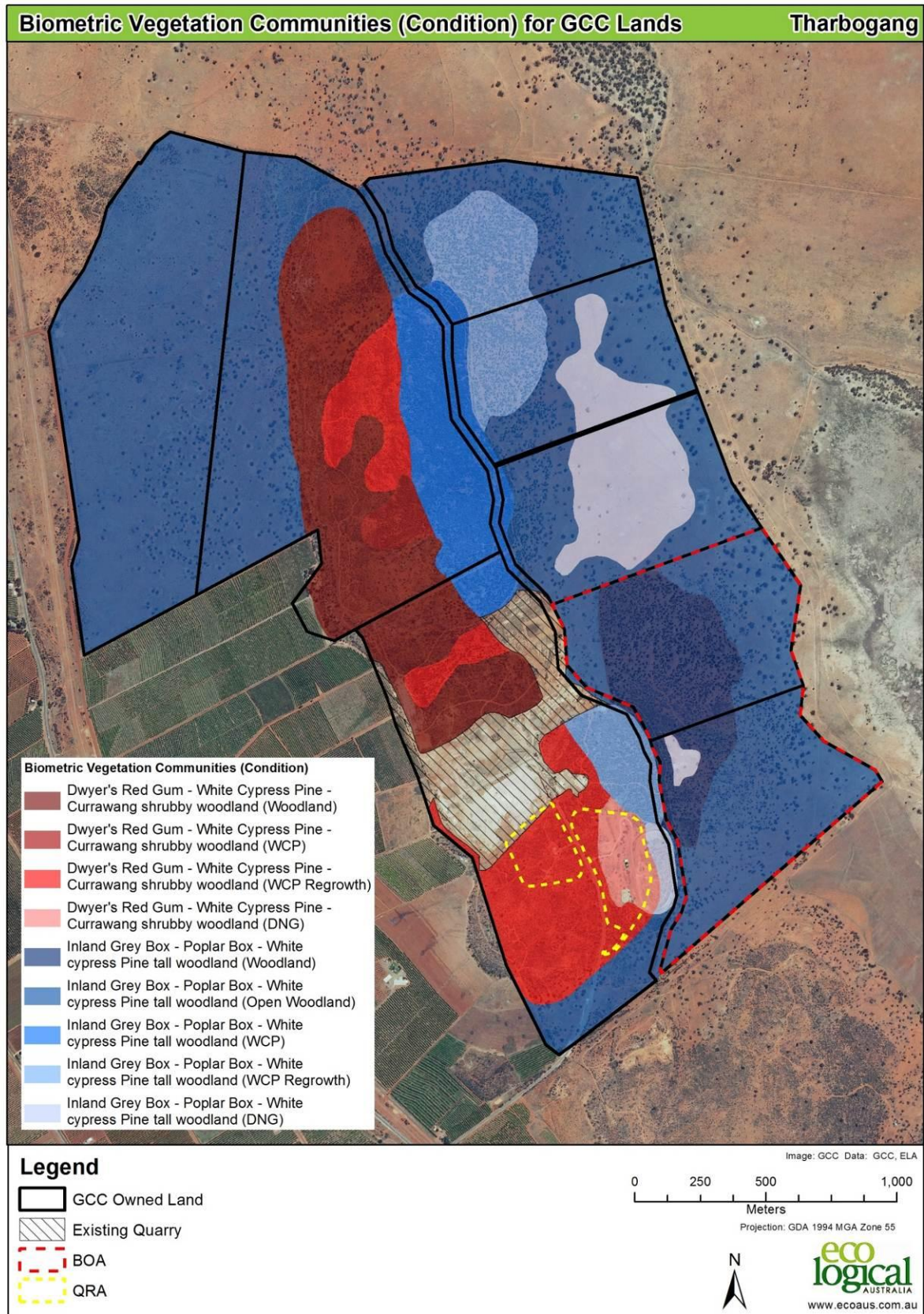


Figure 5: BioMetric Vegetation Type map of the GCC Owned Lands

2.5 VEGETATION CONDITION

2.5.1 Biodiversity Offset Area

The vegetation in the BOA has been mapped in three condition classes, Woodland, Open Woodland and Derived Native Grassland (DNG), reflecting the varying extent of previous land clearing on the floodplain.

The woodland areas are found in a moderate condition when compared against the BioMetric benchmarks (DECC 2008), with the native species richness and groundcover well above the benchmark, though other measures of condition such as over-storey, mid-storey, coarse woody debris and hollow bearing trees are somewhat reduced as would be expected given past management (i.e. clearing, grazing, pasture improvement and firewood collection). Natural regeneration of all canopy species is occurring.

The open woodland areas retain a similar number/proportion of Hollow Bearing Trees (HBTs) per hectare (~10/ha) as the woodland areas, though the over-storey and shrub cover is found to be below the lower benchmark. The mid-storey and understorey (grasses and native forbs etc) are found to be above the benchmark. This natural resilience will respond well to appropriate management and aid the transition of the BOA to a benchmark state. Similarly to the woodland areas, the species richness of these areas and the amount of cumulated coarse woody debris has been reduced due to the past management practices. Natural regeneration of all canopy species is occurring.

The DNG has had the canopy and mid-storey completely cleared with only the groundlayer of predominantly native grasses intact, with varying occurrences of native and exotic forbs and exotic grasses. There is no coarse woody debris or natural regeneration of the former canopy species occurring in the DNG. Under appropriate conservation management, including the removal of grazing, active weed and feral animal control, and where necessary, assisted regeneration, the area of woodland (canopy and shrub cover) will significantly increase in the short to medium term and species richness can be enhanced over the long term through targeted weed control and species enrichment plantings. This 'improvement' to the biodiversity values of the BOA assists the project in meeting an 'improve or maintain' outcome, as defined in the Biobanking Assessment Methodology (BAM).

2.5.2 Quarry Rehabilitation Area

The vegetation in the QRA was mapped with two different condition classes, open woodland and DNG. However, these categories are not as applicable as with the BOA since when rehabilitation works are initiated, the vegetation will not be present. Rehabilitation works will aim to achieve BioMetric benchmarks (DECC 2008) for the community, or as near as reasonably possible (**Table 4**).

The data from the plots conducted in the BOA (Poplar Box Woodland) and the QRA (Dwyer's Red Gum Woodland) are shown in **Table 4**. Observed data for Dwyer's Red Gum Woodland was averaged from the five plots undertaken in the QRA. Observed data for Poplar Box Woodland is taken from the one plot undertaken in the BOA.

Table 4: BioMetric benchmarks for communities for in BOA and QRA

BIOMETRIC VEGETATION TYPE		DWYER'S RED GUM - WHITE CYPRESS PINE - CURRAWANG SHRUBBY WOODLAND MAINLY OF THE NSW SOUTH WESTERN SLOPES BIOREGION (BENSON 185)	INLAND GREY BOX - POPLAR BOX - WHITE CYPRESS PINE TALL WOODLAND ON RED LOAMS MAINLY OF THE EASTERN COBAR PENEPLAIN BIOREGION (BENSON 82)
Native plant species richness	BioMetric	27	25
	Observed	28	32
Native over-storey cover (%)	BioMetric	8-30	8-35
	Observed	0.3	3.5
Native mid-storey cover	BioMetric	3-23	3-23
	Observed	9.1	0
Native ground cover (grasses)	BioMetric	3-10	13-50
	Observed	38	50
Native ground cover (shrubs)	BioMetric	5-20	3-5
	Observed	4	0
Native ground cover (other)	BioMetric	3-8	3-15
	Observed	36	42
Number of trees with hollows (per ha)	BioMetric	1	1
	Observed	0	1
Total length of fallen logs (m)	BioMetric	30	75
	Observed	7.8	21

Vegetation types were mapped across the entire property and trimmed to the boundary of the offset site after the mapping was completed (**Figure 5**). The area and proportion of each vegetation type within the BOA is shown in **Table 5**.

Table 5: Area of Biometric Vegetation Types in Biodiversity Offset Area

INLAND GREY BOX WOODLAND	AREA OF SITE (HA)	AREA OF SITE (%)
Woodland	33.20	34.84
Open Woodland	60.68	63.68
Derived Native Grassland (DNG)	1.41	1.48
Total	95.31	100.0

2.6 VEGETATION COMMUNITY DESCRIPTION

Inland Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion (Poplar Box Woodland)

This community occurs on gently undulating plains and footslopes of the relict Cobar Peneplain floodplain. Within the BOA it is found in a variety of structural condition states including derived native grasslands (**Figure 6**), open woodland (**Figure 7**) and woodlands with various levels of *Callitris glaucophylla* (White Cypress Pine) dominance (**Figure 8**). The dominant myrtaceous overstorey species in this community was *Eucalyptus populnea* (Poplar or Bimble Box).

Geijera parviflora (Wilga) and *C. glaucophylla* were the most commonly encountered mid-storey species in this community, with a groundcover dominated by the native grasses, *Austrostipa scabra*, *Austrodanthonia bipartita* (a Wallaby Grass) and *Enteropogon acicularis* (Curly Windmill Grass), common native herbs included *Einadia nutans* (Nodding Saltbush), *Erodium crinitum* (Blue Storksbill), *Atriplex semibaccata* (Berry Saltbush) and *Triptilodiscus pygmaeus* (Common Sunray).

Species characteristic of this vegetation type are provided in **Table 6**. A full flora inventory of the site is provided in **Appendix 1**.

Table 6: Characteristic flora species of Inland Grey Box – Poplar Box – White Cypress Pine tall woodland present in the BOA

DOMINANT CANOPY SPP	MAIN ASSOCIATED SPP	CHARACTERISTIC MID-STOREY SPP	CHARACTERISTIC GROUNDCOVER SPP
Poplar or Bimble Box (<i>Eucalyptus populnea</i> subsp. <i>bimbi</i>), White Cypress Pine (<i>Callitris glaucophylla</i>)	Bulloak (<i>Allocasuarina luehmannii</i>)	<i>Dodonaea viscosa</i> subsp. <i>spatulata</i> , <i>Geijera parviflora</i> (Wilga), <i>Myoporum montanum</i> (Western Boobialla), <i>Parsonsia eucalyptophylla</i>	<i>Austrodanthonia bipartita</i> , <i>Calotis cuneifolia</i> , <i>Austrostipa scabra</i> subsp. <i>scabra</i> (Speargrass), <i>Einadia nutans</i> subsp. <i>nutans</i> , <i>Enteropogon acicularis</i> (Curly Windmill Grass), <i>Eragrostis lacunaria</i> .



Figure 6: Example of Poplar Box – Derived Native Grassland condition class



Figure 7: Example of Poplar Box – Open Woodland condition class



Figure 8: Example of Poplar Box – Woodland condition class

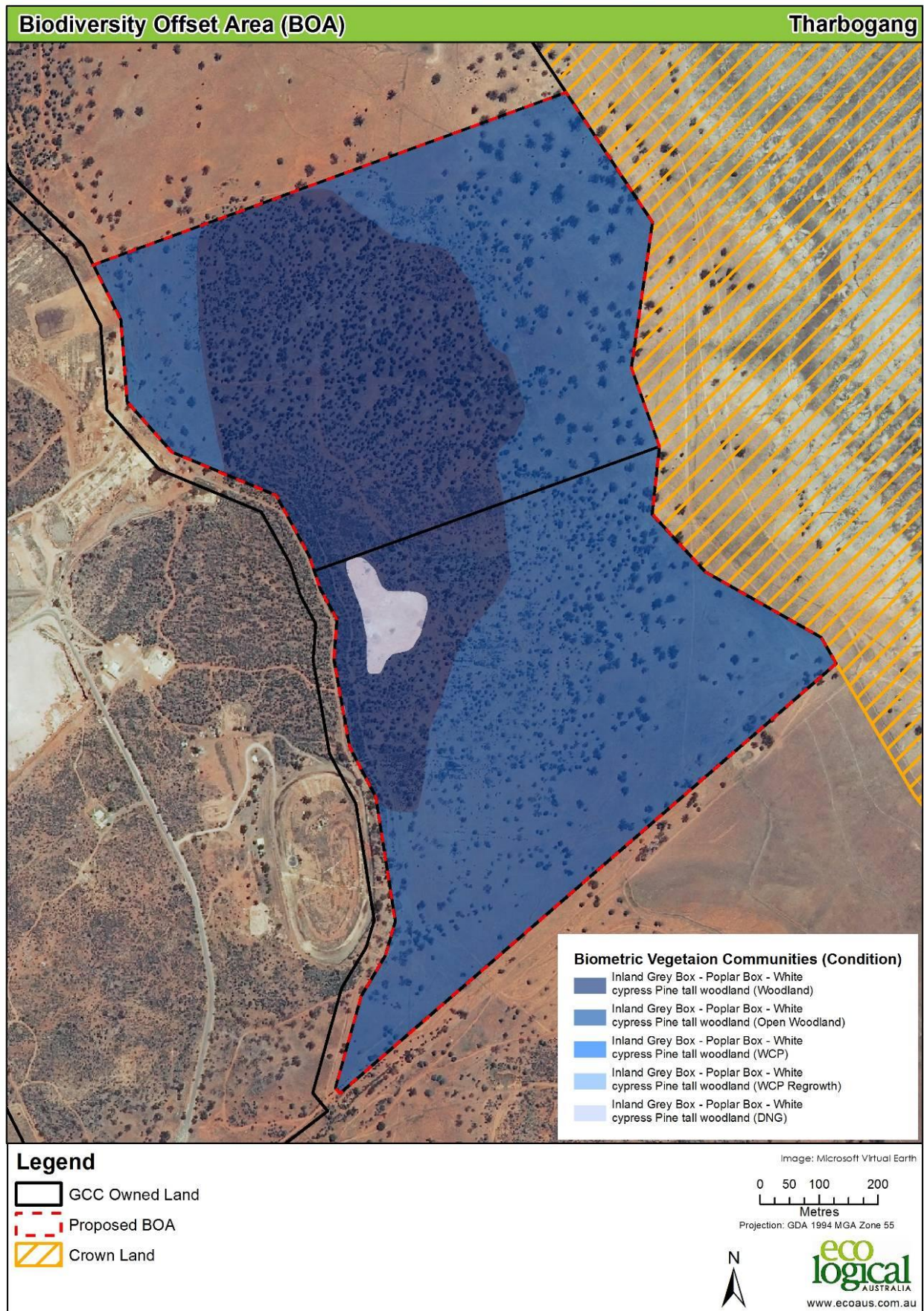


Figure 8: Detail of BOA with Vegetation Communities

2.7 FLORA

While no targeted flora surveys were undertaken for this RBOSMP, surveys have been undertaken for GCC lands in the past. No flora species listed under either the NSW *Threatened Species Conservation Act 1995* (TSC Act) or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) have been found on GCC lands, including the BOA. Likewise, no Rare or Threatened Australian Plants (ROTAP) listed plant species have been recorded in the within the GCC lands. Due to nearby records, the ROTAP listed species, *Lomandra patens*, was considered as a potential species (ERC 2002) but was not recorded at the site during field surveys. A full list of threatened species with potential to occur on site either through proximity of sightings or available habitat is listed in **Appendix 1**.

Thirty-seven (37) weed species were observed in the GCC lands during the site assessment, 12 of which were also recorded in the BOA and 26 of which in the QRA (ELA 2011). A further 62 unique species were recorded by Eldridge (2002), ERC (2003) and EcoSurveys (2006) in the GCC lands and adjacent land to the east and south (**Appendix 1**). The most abundant weed species recorded across the site include, *Echium plantagineum* (Paterson's Curse), *Carthamus lanatus* (Saffron Thistle) and *Arctotheca calendula* (Capeweed). Other significant weed species recorded include *Xanthium spinosum* (Bathurst Burr), *Lycium ferocissimum* (African Boxthorn) and *Opuntia* spp. (Prickly Pear and Tiger Pear). These species are generally in very low – low abundance.

Six (6) weed species listed under the NSW *Noxious Weed Act 1993* in the GCC Local Government Area (LGA), were found within the GCC lands (**Table 7**). All are Class 4 noxious weeds. The growth of Class 4 Noxious weeds must be managed in a manner that reduces its numbers, spread and incidence and continuously inhibits its reproduction. These species were recorded in a few scattered localities and are considered rare on the site. Two of these species, *Lycium ferocissimum* and *Rubus fruticosus* spp. agg. are also listed as a Weed of National Significance (WoNS). No noxious weeds or WoNS were recorded in the BOA or QRA during recent surveys (ELA 2011).

Table 7: List of Noxious Weeds observed on the site

SPECIES NAME	COMMON NAME	NOXIOUS WEED CATEGORY	WONS
<i>Alternanthera pungens</i>	Khaki Weed	4	-
<i>Lycium ferocissimum</i>	African Boxthorn	4	Y
<i>Marrubium vulgare</i>	Horehound	4	-
<i>Opuntia aurantiaca</i>	Tiger Pear	4	-
<i>Rubus fruticosus</i> spp. agg.	Blackberry	4	Y
<i>Xanthium spinosum</i>	Bathurst Burr	4	-

2.8 FAUNA HABITAT

The vegetation of the GCC lands, including the BOA and QRA, forms part of a much larger corridor linking the McPherson Range with remnant vegetation associated with Kidman Way and Griffith-Hillston rail line which eventually connects with remnant vegetation east of Tabbita (including Tabbita State Forest). The McPherson Range corridor is the largest connected area of remnant vegetation within the Griffith LGA and currently allows the movement of fauna species across the region. It

maintains the connection between local populations of fauna species and ensures the genetic flow between sub-populations of fauna inhabiting the Griffith LGA (Balance 2009).

The vegetation communities of the BOA and QRA provide various foraging, roosting and breeding opportunities for many species. The site offers a variety of habitats ranging from open woodland with a grassy understorey, to grassland on the flats and areas of dense understory regrowth closer to the lower slopes. Many of the mature trees, particularly *Eucalyptus populneus* subsp. *bimbil*, contain hollows, crevices and bark slabs, which provide suitable nesting and roosting sites for some birds, arboreal mammals and microchiropteran bat species (ERC 2003).

HBT's are present within the BOA and QRA though no formal survey of density has been undertaken. Assessments of Lot 201 adjacent found that the density of HBT's was high, with approximately 300 HBT's identified during surveys (Ecosurveys 2006), and extrapolation from the BioMetric plots undertaken by ELA (2011) found HBT's to occur at ~10/ha in adjacent woodlands. Hollow bearing trees provide nesting sites for many bird species including the threatened Grey-crowned Babbler (*Pomatostomus temporalis*) and declining woodland birds, and arboreal mammals. Land clearance, agriculture and scraping for surficial gravel has largely removed this habitat feature from surrounding areas in the LGA (Balance 2009).

Standing dead trees and fallen timber were a common occurrence in most areas and provided resting and foraging opportunities for bird species. Fallen timber was found scattered throughout the GCC lands, comprising mainly small logs (Ecosurveys 2006, ELA 2011). This habitat feature provides suitable habitat for reptiles and ground dwelling mammals, and is likely to increase the diversity of insects thus providing a valuable resource for ground foraging birds. The removal of fallen timber from adjoining agricultural land has resulted in a corresponding decline in reptiles and ground foraging, roosting and nesting birds (Ecosurveys, 2006).

Loose bark on the mature *Callitris glaucophylla* and *Eucalyptus populneus* subsp. *bimbil* was identified as suitable roosting habitat for microchiropteran bat species. High bat activity and diversity was recorded along flyways in Lot 202, including the QRA, and many bats were observed leaving roosting trees (ERC 2002). Anabat analysis revealed with varying degrees of confidence the presence of ten bat species including the threatened Southern Myotis (*Myotis macropus*) (probable) and Little Pied Bat (*Chalinolobus picatus*) (possible). No threatened bat species were captured during harp trapping.

The ground layer of the BOA and QRA provides suitable foraging and sheltering habitat for reptiles and small ground dwelling mammals. The ground layer consists of a mixture of native and introduced grasses and forbs, with some herbaceous plants and small shrubs, interspersed with clay patches.

No drainage lines or waterbodies were identified in the BOA or QRA. However, two ephemeral drainage lines and a permanent dam have been identified in Lot 201, adjacent (Ecosurveys 2006). These drainage lines flow during periods of heavy and /or persistent rainfall by channelling surface sheet flows from the ridgeline, east towards Tharbogang Swamp (Coffey Geotechnics 2007). They may provide temporary habitat for amphibians during wet and, and reptiles during dry periods. The permanent dam located in Lot 201 provides habitat for ducks and a water resource for other fauna although the quality has been degraded by grazing pressures, poor dam design and weed infestation (Ecosurveys, 2006).

2.9 FAUNA

While no targeted fauna surveys were undertaken for this RBOSMP, surveys have been undertaken for GCC lands in the past. A total of nine fauna species listed under either the TSC Act or EPBC Act have been found on GCC lands, including the BOA and QRA. An additional four species of bird not listed under State or Commonwealth but identified as declining woodland bird species in south-western NSW have also been identified on site (Reid 1999). These species are shown in **Table 7**. A full list of threatened species with potential to occur on site either through proximity of sightings or available habitat is listed in **Appendix 1**.

The Condition of Approval (CoA) for the provision of a BOA do not include any requirements to provide habitat for any specific threatened species, although it is expected that the vegetation types protected in the offset area will provide habitat for a range of threatened species. These species and others are likely to utilise habitat in the offset area as its condition is enhanced, particularly the canopy and shrub layer. Baseline flora and fauna inventories will be undertaken as part of the implementation of this management plan as described in **Section 1**.

Table 7: Threatened and rare fauna recorded on GCC land

COMMON NAME	SCIENTIFIC NAME	ERC 2000	ERC 2003	ECOSURVEYS 2006	ECOSURVEYS 2009	ELA 2011
AVIFAUNA						
Barking Owl	<i>Ninox connivens</i>		A			
Brown Treecreeper (eastern subspecies)#	<i>Climacteris picumnus victoriae</i>		X			
Chestnut-rumped Thornbill#	<i>Acanthiza uropygialis</i>	X	X	X	X	
Dusky Woodswallow#	<i>Artamus cyanopterus</i>		X		X	
Glossy Black-cockatoo	<i>Calyptorhynchus lathami</i>		A			
Grey Falcon	<i>Falco hypoleucos</i>		A			
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	X	X	X	X	X
Little Eagle	<i>Hieraaetus morphnoides</i>	X				
Major Mitchell's Cockatoo	<i>Cacatua leadbeateri</i>			X		
Painted Honeyeater	<i>Grantiella picta</i>		A			
Rainbow Bee-eater	<i>Merops ornatus</i>		X			
Red-capped Robin#	<i>Petroica goodenovii</i>	X	X	X	X	X

COMMON NAME	SCIENTIFIC NAME	ERC 2000	ERC 2003	ECOSURVEYS 2006	ECOSURVEYS 2009	ELA 2011
AVIFAUNA						
Rufous Whistler [#]	<i>Pachycephala rufiventris</i>			X	X	
Southern White Face [#]	<i>Aphelocephala leucopsis</i>			X		
Superb Parrot	<i>Polytelis swainsonii</i>		A			
White-throated Needle-tail	<i>Hirundapus caudacutus</i>		X			
MAMMALIA (Microchiroptera)						
Inland Forest Bat	<i>Vespadelus baverstocki</i>		X			
Little Pied Bat	<i>Chalinolobus picatus</i>		X			
Southern Myotis	<i>Myotis macropus</i>		X			

Species recorded within the GCC lands during surveys including ERC 2000, 2003; Ecosurveys 2006, Ecosurveys 2009, ELA 2011. 'A' indicates the species was found Adjacent to the site (i.e. within 5km).

[#] Species not listed as threatened, endangered or migratory under State or Commonwealth legislation, but identified as declining woodland bird species in south-western NSW (Reid 1999).

Four introduced mammal species and four introduced bird species were found on and adjacent to the BOA and QRA in recent surveys (**Table 8**). The impacts of all the mammal species identified are listed as Key Threatening Processes under both the NSW TSC Act and Commonwealth EPBC Act. They are:

- Competition and grazing by the feral European Rabbit (*Oryctolagus cuniculus*);
- Competition and habitat degradation by Feral Goats (*Capra hircus*);
- Predation by the European Red Fox (*Vulpes vulpes*); and
- Predation by the Feral Cat (*Felis catus*).

A threatening process is defined as a key threatening process (KTP) if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community or if it could cause species, populations or ecological communities that are not threatened to become threatened.

Table 8: Introduced fauna recorded onsite

SCIENTIFIC NAME	COMMON NAME	ERC 2000	ERC 2003	ECOSURVEYS 2006	ECOSURVEYS 2006	ELA 2011
MAMMALS						
<i>Capra hircus</i>	Feral Goat					X
<i>Felis catus</i>	Feral Cat	X	X			

SCIENTIFIC NAME	COMMON NAME	ERC 2000	ERC 2003	ECOSURVEYS 2006	ECOSURVEYS 2006	ELA 2011
<i>Oryctolagus cuniculus</i>	European Rabbit	X	X			X
<i>Vulpes vulpes</i>	European Red Fox	X	X			X
BIRDS						
<i>Carduelis carduelis</i>	European Goldfinch			X		
<i>Passer domesticus</i>	House Sparrow	X	X			
<i>Sturnus vulgaris</i>	European Starling	X	X	X	X	X
<i>Turdus merula</i>	Common Blackbird		X			X

3 Management strategies

3.1 RESILIENCE CATEGORIES

The resilience of the site was assessed using the following categories:

- Very high resilience – Three levels of intact native vegetation are present (overstorey, midstorey, and ground cover) throughout the site, with variable density. Soil is undisturbed and there is sufficient native vegetation remaining in-situ to enable the natural regeneration of native vegetation. Very low levels of management are required to facilitate rehabilitation.
- High resilience – At least two levels of intact native vegetation present throughout, with three levels present in some portion. Overstorey should be present in some portion. Low levels of management are required to facilitate restoration.
- Moderate resilience – At least one level of intact native vegetation present throughout, with two or three levels present in some portions. Overstorey should be present in some portion. Some minor soil disturbance present. Moderate levels of management are required to facilitate restoration.
- Low resilience - At least one level of intact native vegetation present in some portion. Overstorey not present. Some soil disturbance. High levels of management are required to facilitate restoration.
- Very low resilience – No intact native vegetation is present on-site. Overstorey not present. Soil is disturbed. Very high levels of management are required to facilitate restoration.

3.2 MANAGEMENT ZONES

The offset area has been divided into three management zones according to condition and resilience, and the QRA has been made into an additional zone. These management zones (**Table 9**) are briefly described below and illustrated in **Figure 9**. **Section 4** outlines a list of actions and the investment required in each zone to achieve the restoration of a functioning ecosystem and a sustainable landscape in perpetuity.

Table 9: Management Zones

MANAGEMENT ZONE	DESCRIPTION	CONDITION	AREA OF ZONE (HA)
MZ1	DNG	High	1.41
MZ2	Open Woodland	High	60.68
MZ3	Woodland	Very High	33.20
MZ4	Woodland (projected)	Very Low	14.75
Total			95.31

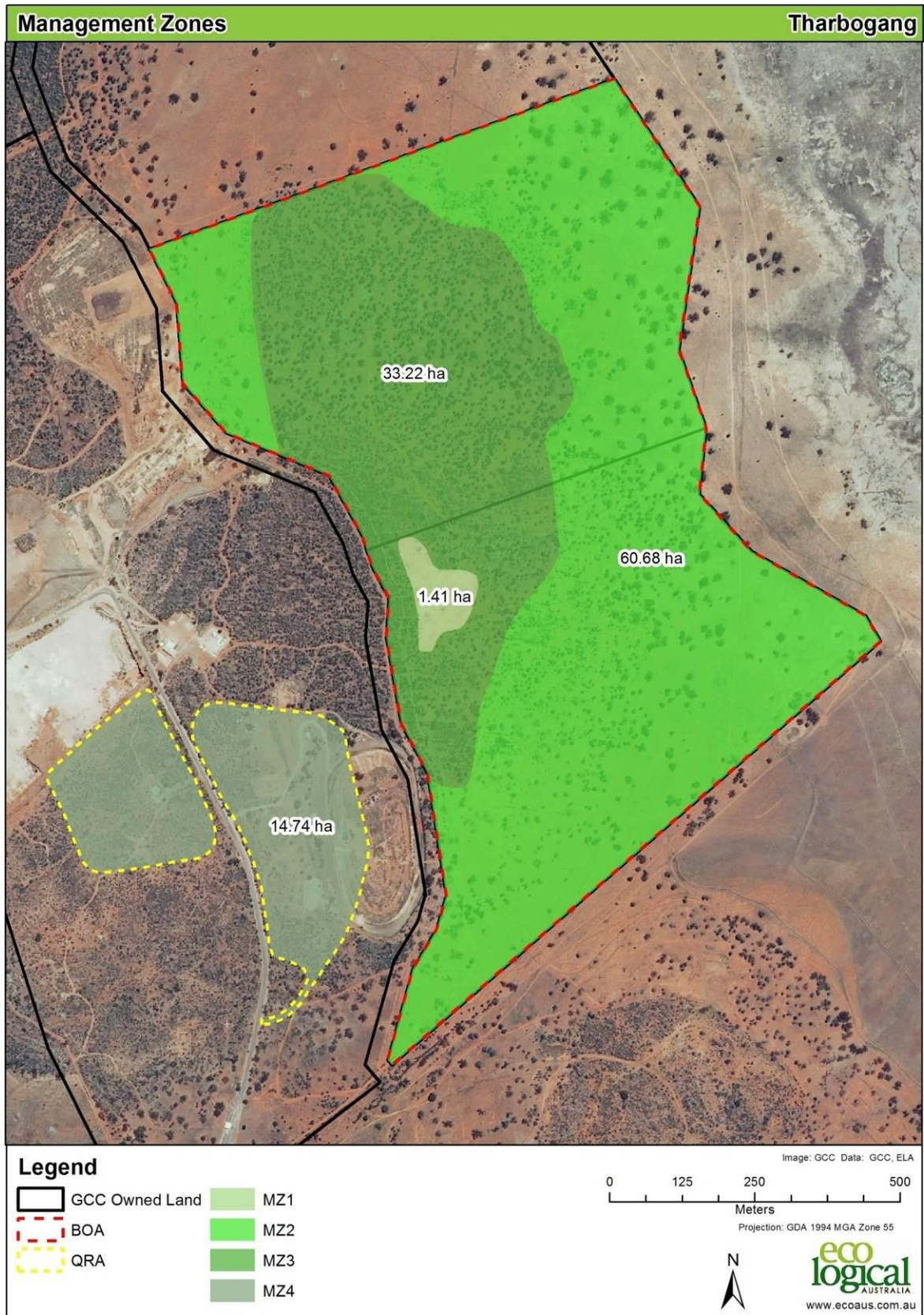


Figure 9: Biodiversity Offset and Quarry Rehabilitation Area Management Zones

Management Zones 2 and 3 have very high levels of resilience (the ability for native vegetation to naturally regenerate) and only require minor intervention works to control weeds. Management Zone 1 has a high level of resilience but a lower condition class and may require increased intervention. Management Zone 4 represents the QRA and as such will be unvegetated and have very low resilience when rehabilitation actions are implemented in the future.

In Management Zones 1, 2 and 3 there are very low levels of weed invasion. Priority species for control include *Hypericum perforatum* (St. Johns Wort) and *Echium plantagineum* (Paterson's Curse). *Lycium ferocissimum* (African Boxthorn), *Rubus fruticosus* sp agg (Blackberry), *Xanthium spinosum* (Bathurst Burr) and *Opuntia* spp. (Prickly and Tiger Pear) are also present in low densities. Refer to **Section 4.5** and **Appendix 2** for preferred control measures. Management Zone 4 is likely to have a high level of weed invasion if unmanaged post quarry works and landfilling. More weed species have been found in the QRA as in the BOA and they are likely to find the soil disturbance and lack of native competition conducive to rapid growth.

Throughout the majority of the BOA, no broadscale revegetation work is required due to its high resilience. However, some supplementary planting may be required to introduce endemic Poplar Box Woodland species that are currently underrepresented. In addition, some areas such as Management Zone 1 may be slow to recover an overstorey and may require planting to accelerate that process. The revegetation methodologies and rate suggested below are indicative only and used as a basis for developing management actions in **Section 4**. The property manager may need to vary the revegetation methodology because of the issues with availability of numbers and diversity species and/or equipment/labour. Also opportunities for direct seeding will be undertaken in circumstances that allow and rates/densities may be modified given changes in environmental conditions (either natural regrowth or poor soil moisture etc.). The species to be used for direct seeding and tubestock revegetation within Management Zone 1 are taken from Benson et al. (2008), though only species known from the GCC lands and adjacent areas have been identified for re-seeding (Eldridge 2002, ERC 2003, Ecosurveys 2006, ELA 2011). Species composition and projected foliage cover are compared against BioMetric benchmarks for this vegetation type (DECC 2008).

3.2.1 MZ1 – Derived Native Grassland – High Resilience

Management Zone 1 (MZ1) is 1.41 ha. This area has high levels of resilience with greater than 50% cover of native species in the ground layer, but the overstorey is absent. Management in this zone will focus on removing weeds and increasing native cover and diversity, especially of overstorey and shrub species.

It is anticipated that the natural regeneration of the overstorey will occur once livestock grazing is excluded. If no regeneration of the overstorey is occurring after five years, revegetation with tubestock will be required with species identified in **Table 10**.

Regeneration of species composition in the midstorey and understorey will be monitored annually, with species complexity presumed likely to increase with the removal of grazing, as more palatable species begin to recolonise. In the event that species composition does begin to increase and record 75% of benchmark within 5 years, direct seeding should be considered. Revegetation species and proportion seed mix is identified in **Table 10**.

Completion criteria for this management zone requires native species composition to 75% of benchmark or more.

Table 10: Species to be used in the revegetation of Management Zone 1 (Benson et al. 2008)

SPECIES NAME	COMMON NAME	% OF MIX	APPROX. NUMBERS REQUIRED
OVERSTOREY			
<i>Allocasuarina luehmanii</i>	Buloke	30%	22
<i>Brachychiton populneus</i>	Kurrajong	20%	15
<i>Eucalyptus populnea</i> subsp. <i>bimbil</i>	Poplar Box	50%	35
MIDSTOREY / UNDERSTOREY			
<i>Acacia deanei</i> subsp. <i>paucijuga</i>	Deane's Wattle	15%	220
<i>Acacia hakeoides</i>	Hakea Wattle	5%	70
<i>Acacia montana</i>	Mallee Wattle	5%	70
<i>Apophyllum anomalum</i>	Warrior Bush	5%	70
<i>Bertya cunninghamii</i>		3%	35
<i>Dodonaea viscosa</i> subsp. <i>spatulata</i>	Hop-bush	15%	200
<i>Eremophila glabra</i> subsp. <i>glabra</i>	Tarbush	3%	35
<i>Eremophila longiflora</i>	Berrigan	3%	35
<i>Eremophila mitchellii</i>	Budda	15%	200
<i>Geijera parviflora</i>	Wilga	10%	150
<i>Maireana aphylla</i>	Leafless Bluebush	3%	35
<i>Myoporum montanum</i>	Western Boobialla	3%	35
<i>Olearia pimeleoides</i>	Daisy Bush	3%	35
<i>Parsonsia eucalyptophylla</i>	Gargaloo	5%	70
<i>Pimelea microcephala</i> subsp. <i>microcephala</i>	Shrubby Rice Flower	5%	70
<i>Ptilotus obovatus</i>	Smoke Bush	5%	70

3.2.2 MZ2 – Open Woodland –High Resilience

Management Zone 2 (MZ2) is 60.68 ha and is the largest management zone in the BOA. There is greater than 50% cover of native species in the ground layer with an intact overstorey. However, PFC for the overstorey is below benchmark, and the shrub layer varies from below benchmark standards to exceeding them, reflecting the amount of immature regrowth of *Callitris glaucophylla* present (see **Table 4, Section 2**). Management in this zone will focus on removing weeds, especially around the edges of the BOA and increasing diversity of the native vegetation.

With the removal of grazing, this zone will be monitored and compared against benchmarks for species composition. In the event that species composition does begin to increase and record 75% of benchmark within 5 years, direct seeding should be considered. To help facilitate increased diversity in this community, direct seeding would occur in years five - nine if necessary. If satisfactory results

are not achieved by year ten, revegetation with tubestock will be required. Indicative numbers and species to be used for direct seeding and tubestock revegetation in MZ2 are identified in **Table 11**.

Table 11: Species to be used in the revegetation of Management Zone 2 (Benson et al. 2008)

SPECIES NAME	COMMON NAME	% OF MIX	APPROX. NUMBERS REQUIRED
OVERSTOREY			
<i>Allocasuarina luehmannii</i>	Buloke	40%	250
<i>Brachychiton populneus</i>	Kurrajong	40%	250
<i>Eucalyptus populnea</i> subsp. <i>bimbil</i>	Poplar Box	20%	100
MIDSTOREY / UNDERSTOREY			
<i>Acacia deanei</i> subsp. <i>paucijuga</i>	Deane's Wattle	10%	1200
<i>Acacia hakeoides</i>	Hakea Wattle	5%	600
<i>Acacia montana</i>	Mallee Wattle	5%	600
<i>Apophyllum anomalum</i>	Warrior Bush	5%	600
<i>Bertya cunninghamii</i>		5%	600
<i>Dodonaea viscosa</i> subsp. <i>spatulata</i>	Hop-bush	10%	1200
<i>Eremophila glabra</i> subsp. <i>glabra</i>	Tarbush	5%	600
<i>Eremophila longiflora</i>	Berrigan	5%	600
<i>Eremophila mitchellii</i>	Budda	5%	600
<i>Geijera parviflora</i>	Wilga	10%	1200
<i>Maireana aphylla</i>	Leafless Bluebush	5%	600
<i>Myoporum montanum</i>	Western Boobialla	5%	600
<i>Olearia pimeleoides</i>	Daisy Bush	5%	600
<i>Parsonsia eucalyptophylla</i>	Gargaloo	5%	600
<i>Pimelea microcephala</i> subsp. <i>microcephala</i>	Shrubby Rice Flower	10%	1200
<i>Ptilotus obovatus</i>	Smoke Bush	5%	600

3.2.3 MZ3 – Woodland – Very High Resilience

Management Zone 3 (MZ3) is 33.20 ha in size. The overstorey in this management zone is intact and there is greater than 50% cover of native species in the ground layer. This zone represents a climax condition class for this vegetation type and species composition is above benchmark for this community. Management in this zone will focus on retaining the native diversity while removing the few weeds present and preventing reinvasion. It is not anticipated that any revegetation or direct seeding works will be required in this zone.

3.2.4 MZ4 – Woodland (projected) – Very Low Resilience

Management Zone 4 (MZ4) is 14.75 ha in size. This zone encompasses the QRA and as such will be severely disturbed by quarrying works before rehabilitation works are initiated. When rehabilitation works are initiated no native vegetation layers will be intact. Management in this zone will focus on revegetation and weed control to get this zone as close as reasonably possible to benchmark condition. Indicative numbers and species to be used for direct seeding and tubestock revegetation in MZ4 are identified in **Table 12**.

Table 12: Species to be used in the revegetation of Management Zone 4 (Benson et. al. 2008)

SPECIES NAME	COMMON NAME	% OF MIX	APPROX. NUMBERS REQUIRED
OVERSTOREY			
<i>Acacia doratoxylon</i>	Currawang	25%	400
<i>Allocasuarina verticillata</i>	Drooping She-oak	20%	300
<i>Eucalyptus dwyeri</i>	Dwyer's Red Gum	50%	700
<i>Eucalyptus populnea</i> subsp. <i>bimbil</i>	Poplar Box	5%	70
MIDSTOREY			
<i>Acacia deanei</i> subsp. <i>paucijuga</i>	Deane's Wattle	30%	4400
<i>Acacia montana</i>	Mallee Wattle	10%	1500
<i>Cassinia laevis</i>	Cough Bush	20%	3000
<i>Dodonaea viscosa</i> subsp. <i>spatulata</i>	Hop-bush	10%	1500
<i>Grevillia floribunda</i>	Seven Dwarfs Grevillea	20%	3000
<i>Indigofera adesmiifolia</i>	Tick Indigo	10%	1500
UNDERSTOREY			
<i>Amphipogon caricinus</i>	Long Greybeard Grass	5%	1500
<i>Austrodanthonia setacea</i>	Smallflower Wallaby Grass	10%	3000
<i>Austrostipa densiflora</i>		5%	1500
<i>Austrostipa scabra</i>	Speargrass	5%	1500
<i>Calotis cuneifolia</i>	Purple Burr-daisy	5%	1500
<i>Hibbertia obtusifolia</i>	Hoary guinea flower	15%	4400
<i>Laxmannia gracilis</i>	Slender Wire Lily	5%	1500
<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	Many-flowered Mat-rush	5%	1500
<i>Melichrus urceolatus</i>	Urn-heath	15%	4400
<i>Platysace lanceolata</i>	Shrubby Platysace	15%	4400
<i>Rytidosperma erianthum</i>		5%	1500
<i>Thyridolepis mitchelliana</i>	Mulga Mitchell Grass	5%	1500
<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>	Australian bluebell	5%	1500

4 Management actions in the BOA

The following sections of this RBOSMP outline the management actions that will be undertaken on the offset area as part of the BOS addressing the requirements identified in CoA no 45-49.

4.1 AGREE TO CONSERVE OFFSET AREAS

CoA 46 requires GCC to implement suitable arrangements to provide long term security for the BOA to the satisfaction of the Director-General.

GCC will investigate and make the necessary arrangements for a Conservation Agreement under Section 69B of the *National Parks and Wildlife Act 1974* (NPW Act) to provide in perpetuity management of the BOA by June 30, 2013. This will be complemented by a Planning agreement under s93F of the EP&A Act, to allocate adequate funds for land management of these areas.

4.2 MANAGEMENT OF HUMAN DISTURBANCE

The management of human disturbances includes managing unauthorised access to prevent recreational 4WD, trail bikes, horse riding, rubbish dumping and unauthorised grazing and shooting on the BOA.

Recreational four wheel driving, trail bikes, horse riding and rubbish dumping have the ability to damage or destroy native vegetation, introduce invasive species to the site and displace native fauna species potentially reducing the biodiversity of the BOA. These human disturbances may be caused accidentally by the Property Manager/delegate or by illegal trespassers. Minimising disturbances within the BOA is required in order to adequately manage remnant vegetation and habitat on the site.

Human disturbance within the BOA will be managed by maintaining fences and signage as further discussed in **Section 4.3**; community consultation with neighbouring residents to ensure they are aware of the new management objectives of the property and the consequences to GCC if the offset site is not managed in accordance with this management plan; and illegal access will be managed by maintaining boundary fences and locking all boundary gates, including access to/from neighbouring properties, at all times. Gates will be locked using GCC locks and the Biodiversity Offset Property Manager will be responsible for authorising access.

GCC will appoint a Biodiversity Offset Property Manager (GCC Environment Officer) who will be responsible for coordinating the implementation and reporting on all aspects of this management plan. Approval from the Property Manager must be obtained prior to entering or undertaking activities on or in the offset site. Persons will only be permitted into the offset area to undertake management and monitoring actions identified in this RBOSMP.

4.3 FENCING AND SIGNAGE

Fences and signage will be utilised to identify the boundaries of the BOA to minimise potential human disturbance through authorised and/or unauthorised access. The fences will also be designed to restrict the access of neighbouring livestock. Ongoing maintenance of fences will be implemented as required to ensure adequate access restrictions are in place at all times.

New fences and replacement fences will incorporate the following 'wildlife friendly' specifications (Rawlings et al. 2010):

- The top two strands of the stock proof fence that are currently barbed wire will be replaced with plain wire;
- A night-visible fencing material (e.g. Borderline®) will be installed along the fence adjacent to high risk areas such as woodlands and wetlands; and
- No permanent internal fencing is to be constructed within the BOA. If internal fencing is required it should be temporary (e.g. polywire electric).

The total boundary of the BOA is 4.77 km. The perimeter includes 3.91 km of existing fencing to be maintained and 0.86 km of new fencing to be installed. Five gates also exist within the BOA boundary along the southern perimeter. Installations of two new gates at the north-eastern and north-western corners of the site are proposed to facilitate access through the new fenceline. Signs will be installed on all gates of the BOA as per the specifications in **Appendix 3**.

Figure 10 outlines existing fencing, proposed new fencing and installation of two new gates for the BOA boundary. A number of the existing fencelines are outside the mapped cadastral boundaries of the BOA. However, given that the adjacent land is Crown Land managed by GCC, adjustment of these fencelines or installation of new fencing in these areas is not part of the proposed action.



Figure 10: Existing and proposed fences/gates

4.4 MANAGEMENT OF GRAZING FOR CONSERVATION

Grazing of the site by livestock has the potential to suppress the regrowth of native vegetation through physical damage causing soil compaction and erosion, though moving from a grazing system to no grazing at all may result in major weed outbreaks. There is also potential that an extended period of wet years may increase vegetative biomass significantly, reducing the inter-tussock spaces and hampering the colonisation of herbs and forbs. As the ecosystem is approaching an equilibrium under a grazing regime, it is recommended that weaning the ecosystem off grazing with careful monitoring will achieve a more desirable outcome.

Stock access to the BOA will be controlled by maintaining existing stock proof fencing and installing new fencing around the boundaries of the BOA where required. All gates will be locked and accessible only by GCC and/or their representative. At the discretion of the future offset area land manager, there is potential for 'pulse' or 'crash' grazing to be introduced into the BOA depending upon management requirements.

This will be determined after initial works are complete and monitoring is underway. 'Pulse' grazing in the BOA should be undertaken only for ecological purposes. If undertaken, 'pulse' or 'crash' grazing should adhere to the following specifications shown in *Grassy Guide* (Barlow 1998) and *A Guide to Managing Box Gum Grassy Woodlands* (Rawlings et al. 2010). Pulse grazing should:

- Take into account variability within the BOA. Pulse grazing is most effective in grasslands (i.e. MZ1) and less effective in woodlands (i.e. MZ2 and MZ3)
- Be undertaken in such a way as to promote patchiness (i.e. areas of different age, density, and species)
- Take into account the ecological requirements of the native species being targeted for promotion
- Not be undertaken during spring unless for control of annual exotics
- Not be conducted during wet conditions
- Utilise 'clean' (i.e. weed free) stock, e.g., if sheep are used they should be introduced off-shears and with empty stomachs
- Incorporate adequate rest time for the patch after grazing to promote native recovery
- Weed and erosion control may also be required.

If deciding to graze, clear objectives of grazing must be outlined (e.g. duration, grazing of exotic species, reduced biomass, creation of inter-tussock spaces). Regular monitoring is then required to identify when the objectives are met, and to allow land managers to respond quickly to rapid changes in grassland condition. The type of livestock used, duration of grazing and stocking rates will vary depending on the ecological objectives and vegetation condition. Additional guidance on native vegetation management specific to the Riverina should be sought from Kent et al. (2002) (available at <http://www.csu.edu.au/faculty/science/herbarium/riverina/review.htm>.)

Should grazing for conservation be selected as a biomass and/or weed management tool, GCC should consult with the local Catchment Management Authority and/or the Office of Environment and Heritage.

4.5 WEED CONTROL

The establishment and spread of environmental weeds are a threat to native vegetation within the BOA. While the weed densities in the BOA are low, the most abundant weed species on GCC lands and adjacent properties include *Echium plantagineum* (Paterson's Curse) and *Arctotheca calendula* (Cape Weed). Other significant weeds include *Rubus fruticosus* sp agg (Blackberry), *Xanthium spinosum* (Bathurst Burr), *Alternanthera pungens* (Khaki Weed), *Marrubium vulgare* (Horehound), *Opuntia* spp. (Prickly and Tiger Pear), *Hypericum perforatum* (St. Johns Wort) and *Lycium ferocissimum* (African Boxthorn).

Weeds are a threat to native vegetation by contributing to the loss of biodiversity as a result of:

- Smothering regenerating native vegetation
- Preventing the regeneration of native vegetation
- Competing for essential resources such as light and water with native vegetation
- Displacing native fauna through the loss of habitat
- Altering ecological and physical processes.

The removal and on-going control of noxious and selected environmental weeds on the offset area is required to improve the condition of native vegetation. The control techniques will be undertaken using minimal disturbance and are outlined further in **Appendix 2**.

Upon commencement of management within the offset area, a map of the distribution and extent of all known weed species in the offset area will be prepared, in order to prioritise target species for treatment. This will also aid in the evaluation of treatment success in future years. This map will be accompanied by a constantly revised weed species list, to ensure that any weeds not previously recorded from the site or adjacent are identified and controlled before becoming a problem.

4.5.1 Weed control strategy

The weed control strategy for the BOA involves the targeted control of specific weed species, particularly Paterson's Curse, Horehound, Prickly and Tiger Pear, St. Johns Wort and African Boxthorn. A strategy has been devised for the site that will control infestations of these species and control any regrowth detailed in **Section 5**).

The proposed control strategy for the following weed species within the BOA are provided **Table 13**.

Table 13: Weed species and management actions

WEED SPECIES	MANAGEMENT ACTION
Prickly Pear	1. All plants, including seedlings, will be dug out using a shovel.
	2. All plant material is bagged and disposed of onsite buried within the overburden waste preventing the ability to regenerate from vegetative material.
African Boxthorn	1. The control of African Boxthorn greater than 0.5 m in height using the cut and paint or drill and fill method (whichever is more suitable) using a concentrated non-specific herbicide (e.g. glyphosate) during November/December when the plants have a good cover of foliage.
	2. Spot spraying of seedlings (plants <0.5m height) and regrowth using selective herbicide (Table 14) when the seedlings have a good coverage of foliage.
	3. Woody debris can be left in situ. When leaving debris in situ it should be 'rafted'; dead wood should be laid on the ground first then stacked with the cut, living material on top. This keeps the live tips off the ground, preventing them from resprouting.
Blackberry	1. Slashing of juvenile bushes where appropriate to promote regrowth.
	2. Spot spraying of seedlings (plants <0.5m height) and regrowth using selective herbicide (Table 14) when the seedlings have a good coverage of foliage
	3. Woody debris can be left in situ. When leaving debris in situ it should be 'rafted'; dead wood should be laid on the ground first then stacked with the cut, living material on top. This keeps the live tips off the ground, preventing them from resprouting.
Bathurst Burr, Paterson's Curse, Khaki Weed, Capeweed, Horehound and St. Johns Wort	1. Spot spraying infestations and individual plants of these using a selective herbicide (Table 14) prior to plants flowering.
	2. Small infestations can be dug out and bagged immediately and disposed of appropriately on site.
	3. Follow up work will be required for all species to control new growth and seedlings.

Table 14: Recommended herbicides for noxious and significant weeds in the BOA (NSW DPI 2011)

COMMON NAME	SCIENTIFIC NAME	CHEMICAL AND CONCENTRATION	RATE	COMMENTS
Khaki Weed	<i>Alternanthera pungens</i>	2,4-D 300 g/L + Picloram 75 g/L e.g. <i>Tordon® 75-D</i>	650 mL in 100 L of water	Active growth in full leaf.
Bathurst Burr	<i>Xanthium spinosum</i>	Fluroxypyr 333 g/L e.g. <i>Starane® Advanced</i>	45 mL in 100 L of water	Apply to actively growing plants
African Boxthorn	<i>Lycium ferocissimum</i>	Picloram 100 g/L + Triclopyr 300g/L + Aminopyralid 8 g/L e.g. <i>Grazon® Extra</i>	500 mL in 100 L of water	Apply when bushes have good leaf cover, growth and no leaf fall. Only apply to plants less than 2 m tall.
Blackberry	<i>Rubus fruticosus</i> spp. agg.		350 – 500mL in 100 L of water	Treat in late spring to autumn. Use an adjuvant.
Capeweed	<i>Arctotheca calendula</i>		150 mL in 100 L of water	Apply as thorough foliage spray before and during flowering.
Horehound	<i>Marrubium vulgare</i>		350 mL in 100 L of water	Apply as foliar spray pre-flowering
Paterson's Curse	<i>Echium plantagineum</i>		250 mL in 100 L of water	Spot spray from rosette to flowering plants
St. John's Wort	<i>Hypericum perforatum</i>		500 mL in 100 L of water	Foliar application from late spring to early summer, during flowering to early seed set

Note that for many of the species listed above, a number of selective and non-selective herbicides are available. The chemicals listed in **Table 14** are considered the most suitable herbicide given the available herbicide options and the current state of the site including resilience, weed invasion and dominant species. For many of the weed species listed above, a number of selective and non-selective herbicides are available. The potential use of different herbicides may be applied as the site develops over time. In addition, as new herbicides are developed or the application rates of old ones are adjusted, these changes will need to be incorporated into the management of the BOA. Any adjustments should be explained and justified as part of the monitoring and evaluation reporting required for the BOA. Finally, the land manager should keep up to date with herbicide registration and off-label permits to ensure that the chemicals in use remain valid for the control of individual species.

4.6 ECOLOGICAL FIRE MANAGEMENT

Fire is an integral part of the Australian landscape and much of Australia's flora has adapted to be able to withstand the impact of fire. Plant species respond to fire differently, including using fire to open woody seed pods or break seed dormancy, a reliance on fire at certain frequencies to provide an environment suitable for seed germination or thick bark that protects plants from heat so the plant can re-sprout vegetatively.

4.6.1 Prescribed burning regime

Fire intervals for grassy woodlands have been identified as being a minimum of eight years and a maximum of 40 years for grassy woodlands (NPWS 2004). Given the variable regeneration states of the management zones, various fire intervals within these guidelines will be required. **Table 15** identifies the various objectives for the management zones along with some areas where variability is possible. It is also important that current context is taken into account (e.g. drought, local area bushfire history, weed composition and density, condition of neighbouring properties) before embarking on ecological burns. No ecological burns will be undertaken in any zone for a period of six years from the implementation of the RBOSMP in order to better understand the regeneration response and the site context. In addition, all ecological burn regimes will be reassessed at regular intervals (**Section 5**) to ensure correct management.

In the absence of fire, high summer temperatures, grazing and natural breakdown of seed dormancy can achieve similar outcomes to fire.

Table 15: Bushfire management specifications

ZONE	DESCRIPTION	OBJECTIVES	TECHNIQUE	FREQ. (YRS)
MZ1	DNG – No established canopy or shrub layer. Diverse groundlayer.	<ul style="list-style-type: none"> Establish canopy Increase diversity Maintain existing values 	No burns for maximum interval in the first instance then re-assess based on regeneration.	40
MZ2	Open Woodland – Established canopy and shrub layer, but below benchmark. Diverse groundlayer	<ul style="list-style-type: none"> Increase diversity Maintain existing values 	Patch burning where the following conditions are highly variable <ul style="list-style-type: none"> Patch size (small/large) Patch shape (not uniform) Timing (spring/autumn) Frequency (within specified range) Intensity (hot/cool) 	8-20
MZ3	Woodland – Established canopy and shrub layer at benchmark. Diverse groundlayer.	<ul style="list-style-type: none"> Maintain existing values 		8-40

Small fire breaks will be maintained along existing and/or new fence lines installed as part of this RBOSMP. These breaks will double as access for RFS in the event of fire, and will be maintained quarterly by slashing the fire breaks.

4.6.2 Wildfire

Wildfire is considered any unplanned outbreak of fire. In the context of this site, surrounding land uses and objectives of the BOA, wildfire is undesirable. Management actions that will assist in preventing or controlling wildfire is required. Key features are to minimising access to decrease the likelihood of arson (see **Section 4.2**) and rapid suppression in the event of a wildfire. Fire breaks will be established along the southern Lot 181 and along the northern boundary of the GCC owned lands, along the fenceline of Lots 185 and 201 to prevent wildfire from leaving the property. Any wildfires that occur in the BOA in the interim will be managed through an appropriate response from the Rural Fire Service (RFS) to extinguish or contain the spread of the fire.

4.7 RETENTION OF REGROWTH AND REMNANT NATIVE VEGETATION

Retention of native vegetation and regrowth/remnant vegetation are important to maintain and improve the biodiversity value of the BOA. Over most of the site, the natural regeneration of overstorey species is occurring. This regrowth is to be retained and similar regrowth will be promoted across the BOA. The clearance of native vegetation, including regrowth, is not permitted.

Exceptions to this rule include the maintenance of fence lines and management tracks in the BOA, and thinning (**Section 4.8**). For example, if a tree or shrub is growing through or falls on the fence line this will damage the fence and potentially provide access for livestock to the offset area. This vegetation will be removed using minimal disturbance techniques. All waste from the clearance of this vegetation will remain in situ in the BOA away from any fence lines or management tracks.

4.8 THINNING OF NATIVE VEGETATION

Regeneration is a sign of healthy woodland that has the capacity to maintain itself well into the future. In the BOA, the regrowth of *Callitris glaucophylla* provides habitat for threatened and rare birds such as the Grey-crowned Babbler and the Red-capped Robin. However, while not currently an issue, this regeneration can become too successful and dense stands of *Callitris glaucophylla* can 'lock up' remnants by suppressing the regeneration of Eucalypt and understory species, that is, stop growing when only a metre or two in height (Rawlings et al. 2010).

There is potential for 'lock up' to happen within the BOA and patchy thinning in some areas may be required in the future. If this were to occur, the following management actions should be undertaken:

- Areas where the regrowth density has caused bare ground underneath should be prioritised
- When thinning, the larger and stronger saplings should be retained representative of the species diversity
- Thinning should maintain enough individuals to achieve a future density of approximately 50 trees per hectare (this means that for small trees [less than 10 cm diameter at breast height], leave at least 400 stems per hectare [approximately 5 x 5 m spacing], trees larger than this should not be thinned)
- Trees should be cut by heavy-duty brushcutter and no herbicide needs to be applied as *Callitris glaucophylla* does not re-shoot from the stump
- Thinning should be followed by weed removal and if deemed necessary revegetation
- In areas where bare ground is exposed, erosion control measures may be needed

Whilst it is noted that plot data from areas of the GCC owned lands adjacent to the site showed lower species diversity and abundance in areas of *Callitris* 'lock-up' (ELA 2011), *Callitris glaucophylla* thinning would only occur if extensive areas of 'lock up' are recorded and monitoring indicates a trajectory of decreasing species diversity. The response of vegetation to any *Callitris* thinning can be monitored through the existing monitoring program discussed in **Sections 7-9** of the LBMP.

4.9 IN FILL PLANTING

Due to historical land management practices across the offset area, much of the mature overstorey of the BOA and the surrounding land has been cleared. This is especially apparent in MZ1 and to a smaller extent MZ2. The BOA has not been subject to pasture improvement and the native vegetation of the ground layer remains largely intact, albeit modified. To restore the native overstorey it is proposed to gradually/incrementally remove livestock grazing to promote the natural regeneration of the overstorey. If overstorey species (e.g. *Eucalyptus populneus* subsp. *bimbi*) and midstorey species (e.g. Wilga) do not regenerate after ten years, in fill planting will be required to establish the overstorey.

The following specifications should be met in regards to any revegetation that may take place:

- Species selection will be dictated by the remnant vegetation community (see **Section 2.6**)
- The seed for this revegetation will be collected from the BOA, GCC lands and surrounding areas of the same community type and either propagated for planting as tube stock / hiko cells or used in direct seeding
- Planting method should be 'low impact' such as hand spot planting or mechanical auger plantings
- Planting hole should be 1.5x the depth of the rootball and at least 2x the width
- Plants to be planted with one fertiliser pellet per plant
- Plants to be planted with water crystals as per label specifications
- Plants are to be planted slightly below the surrounding surface, so that the 'dish' created around the plant collects and pools water
- Tree-guards are to be installed
- Planting to occur from autumn and early spring depending on rainfall and will require watering when planted with follow up watering as required (spring plantings may require frequent watering as temperatures increase into summer). Initial irrigation is not needed if plantings are undertaken before sufficient rainfall.

Note that growing or striking of plant stock can take up to nine (9) months before they can be planted and this needs to be factored in to project timeframes, in addition to seed collection requirements.

If natural regeneration does not occur within the management zones within the first ten years of this plan the following infill planting is recommended for the BOA (**Table 16**).

Table 16: Recommended infill requirements

MANAGEMENT ZONE	CONDITION CLASS	RECOMMENDATION
MZ1	Derived Native Grassland	Direct seeding of grass and forb species. If no response from direct seeding, tubestock planting will be required
MZ 2	Open Woodland:	Direct seeding of ground layer species incl. grasses and forbs; and tubestock for shrub and canopy species.
MZ3:	Woodland	No infill revegetation required
MZ4	Revegetation	Revegetation requirements for MZ4 are provided in Section 5

Direct seeding will be the first method of revegetation for the management zones. If the direct seeding establishes well it will reduce or negate the requirements for tubestock planting in these areas. Species that usually work best in direct seeding include wattles, peas, some eucalypts, casuarinas, grasses, daisies and 'pioneer' species (the first to come up after a disturbance in natural woodlands) (Rawlings et al. 2010). Depending on which seeds are used they can be broadcast on the surface or buried under lightly disturbed soil. Direct seeding should utilise low impact techniques such as Brush matting, niche seeding, or hand broadcasting. Seed should be distributed in clumps rather than widely scattered. These 'nodes' should contain a diverse assemblage of species.

In MZ1, groundcover species such as forbs and grasses will be planted at a density of 1 plant every 10 m² or 1,000 plants per hectare to achieve a final density of one plant per 20 m² or 500 plants per hectare (assuming up to 50% loss), to enhance species diversity and densities up to ~40%, as per the benchmark for Poplar Box Woodland vegetation type (see **Section 10**).

In MZ2, canopy species will be planted at a rate required to achieve a density of one plant per 400 m² or 25 trees per ha (assuming up to 50% loss) or a canopy cover of between 15-25%, which is within the benchmark for Poplar Box Woodland vegetation type (i.e. 14-27%) (**Section 1**). Shrub species will be planted at a rate required to achieve the final density above when taken in context with the existing vegetation (approximately 200 plants per hectare). Shrubs should be planted in clumps rather than scattered individuals. These 'nodes' should contain a diverse assemblage of species. The species to be planted and an estimate of the number required are shown in **Section 3.2**. It is assumed that propagation of seed and the raising of tubestock will occur in existing GCC facilities.

4.9.1 Seed collection

Where revegetation or direct seeding is required, seed must be collected from local provenance species. Groundcovers, shrubs and trees should be collected from within 3km of the site. Should seed not be available within 3 km, this radius can be extended to a maximum of 10 km; any further extension of the seed collection radius requires written approval from the OEH.

Native grasses typically have much larger dispersal ranges and are to be collected from within a 10 km radius of the site. Should seed not be available within this radius, OEH may provide written approval for seed supply from other areas of the Murrumbidgee CMA.

Where the species identified in this plan cannot be sourced, they may be substituted for other local endemic species as identified in BioMetric Vegetation Types database (DECCW 2010). Trees must

be substituted with trees, shrubs with shrubs, etc. Only wild native species are to be used. Plants are not to be substituted with horticultural varieties under any circumstances.

Record keeping of seed collection and planting locations is to be as per the Flora Bank guidelines (Mortlock 2000). The bush regeneration contractor is responsible for recording this information and providing it to OEH. The bush regeneration contractor must hold a Section 132C licence under the NSW *National Parks and Wildlife Act 1974* (NPW Act) will be required to undertake seed collection works.

4.10 RETENTION OF DEAD TIMBER

Dead timber refers to standing dead trees and fallen timber on the ground. Dead timber is an important habitat structure in the natural landscape. It provides essential roosting and breeding habitat for many species of fauna and can provide micro-habitats for many species of flora to germinate. Fallen logs also allow for the accumulation of leaf litter, runways for ground dwelling reptiles and mammals, perching habitat for birds, and habitat for a high numbers of insects which provide food for other fauna to forage on. Dead trees often contain tree hollows which are important roosting or breeding habitat for many species of fauna, including mammals, birds, reptiles and frogs.

All fallen timber will be retained on BOA and will not be used for any other purpose other than a habitat feature. It will not be used for the repair of fence posts or for fire wood.

Dead wood from the impact area will be distributed around the BOA as it is cleared. Trees should be left as whole as possible and scattered randomly throughout the BOA, not piled. Heavy machinery should not be used in high quality patches or when the ground is wet, and logs should be lifted rather than dragged. Only woody debris from local native species should be used and care should be taken not to introduce weeds and exotics with the timber.

4.11 NEST BOXES

Given the absence of HBTs in MZ1 and MZ4, nest boxes are recommended to supply shelter for the threatened species that are known to use the area. Nest boxes should be placed in MZ1 and MZ4 after regeneration or revegetation has progressed sufficiently to provide trees of sufficient size to hold nest boxes (approximately 10 years). Nest boxes should be placed at a density consistent with the BioMetric benchmarks:

Table 17: Nest box density requirements in MZ1 (BOA) and MZ2 (QRA)

AREA	BIOMETRIC VEGETATION TYPE	HOLLOW BEARING TREES / HA
BOA	Poplar Box Woodland	30
QRA	Dwyer's Red Gum Woodland	10

Upon installation, nest boxes will be monitored during quarterly and annual inspections of the offset area consistent with **Section 7.1**.

4.12 EROSION AND SEDIMENTATION CONTROL

Soil erosion occurs when native vegetation has been removed exposing bare soils, making them susceptible to erosion where high volumes of water are able to disperse the soil. This often occurs along creek lines but can occur in bare paddocks where vegetation clearance or over grazing exposes the soil. Bare soils are susceptible to high rainfall events where high volumes of water disperse the soil leading to severe soil erosion.

Weed removal may result in the exposure of bare earth. Any weed removal should be done in such a way so that native species are encouraged to colonise the bare earth. This means that the timing of the removal of exotic vegetation should consider what native species are likely to colonise the area and when would allow them to do so most efficiently. In addition, fire management in the future may result in the exposure of bare earth and the same considerations should apply. If rapid native colonisation of bare earth patches is unlikely then physical erosion and sediment control (e.g. coir logs, jute matting, etc.) should be considered.

A Soil and Erosion Management Plan (SEMP) should be prepared for the QRA upon closure of the mine and completion of landfilling. It is recommended that this SEMP is consistent with best practice guidelines such as Landcom (2004), and will form a component of the Landfill Closure Plan (LCP)..

4.13 RETENTION OF ROCKS

Rocks are an important habitat feature in the landscape and provide essential habitat for fauna, particularly reptiles, mammals and some birds, to roost and breed. Rocks have often been removed from the landscape as they prevent tillage of the soil for agricultural purposes. The retention of rocks or placement of rocks in the BOA is important to provide suitable habitat for the conservation of fauna species.

All rocky habitat in the BOA will be retained in the offset area and will not be removed for any purpose. Where appropriate, bush rock from the impact area can be transferred to the BOA using the same principles as the transfer of dead timber.

4.14 CONTROL OF FERAL AND OVERABUNDANT NATIVE HERBIVORES

Feral herbivores refer to species such as *Oryctolagus cuniculus* (European Rabbit) and *Capra hircus* (Feral Goat). These species have been introduced to Australia for various reasons, including hunting and agriculture. Overabundant native herbivores in the region include the *Macropus giganteus* (Eastern Grey Kangaroo). Native herbivore species have increased in the landscape due to increased watering points and suitable grazing land in the landscape.

The total grazing pressure of these species can cause significant problems for regenerating native vegetation, to the point that growth and regeneration of native vegetation can be limited or, in extreme cases, prevented. The control of these species in the BOA is required to promote the regeneration and growth of native vegetation.

Feral Goat and European Rabbit were observed on the BOA. . Control programs for these feral herbivores will be implemented.

Eastern Grey Kangaroo was also observed in moderate numbers on GCC lands. If the numbers of Eastern Grey Kangaroo increase, and monitoring indicates they are having a detrimental impact on the recovery of native vegetation, control programs will be implemented.

A strategy has been devised for the BOA that will control feral and over abundant native herbivore species. The proposed control strategy for feral and over abundant native herbivores includes:

- Closing of non-required watering points within the BOA
- Ripping of rabbit warrens if located
- Baiting European Rabbit where they are observed
- Shooting or removing (via trapping if practical) Feral Goat if they are observed on the property
- Shooting Eastern Grey Kangaroo (following obtaining the necessary permits from OEH) if monitoring indicates they are having a deleterious effect on the BOA

Specific management techniques are discussed in the sections below and in **Appendix 4**.

4.14.1 Rabbit control

Management of European Rabbits in the BOA will utilise four broad techniques. The exact management approach, which may involve one or more of the techniques outlined below, will be determined by the land manager or their representative before implementation. This final determination will consider factors such as identification of warrens, seasonal and annual Rabbit population variation, changes in vegetation due to the ongoing management of the site and changes in surrounding landuse. It is likely that over the lifetime of this RBOSMP, the exact techniques required for Rabbit control will vary. This should be addressed in the monitoring works undertaken in the BOA and new techniques introduced and justified as part of the required reporting. Consultation with the Livestock Health and Pest Authorities will be required before any Rabbit control is undertaken. Implementation of Rabbit control techniques will only be undertaken by those who possess suitable qualifications. Technical specifications for management actions described below will be as per *Managing Vertebrate Pests: Rabbits* (Williams et al. 1995) unless otherwise stated.

Management techniques for Rabbit control include:

1. Destruction of Rabbit warrens. No Rabbit warrens were identified in the BOA, however, if any warrens are found through annual and other periodic monitoring, they are to be mechanically ripped as the first preference;
2. Poised baits. This technique targets Rabbits that are feeding onsite, but can have off-target impacts (e.g. death or illness of predatory birds through bio-accumulation);
3. Rabbit proof fencing. This is a non-lethal and effective method for excluding Rabbits from the site. However, as this technique does not remove Rabbits from the surrounding area, continued maintenance of the fence is required to maintain its integrity; and
4. Opportunistic shooting. This is not effective as a stand-alone strategy, but may be useful when combined with other options as a way of eliminating individuals.

Details of the management techniques for Rabbits are provided in **Appendix 4**.

4.14.2 Feral Goat control

Where Feral Goats are observed on the property they will be controlled by shooting. Shooting must be undertaken by persons with a fire arm license, using a high powered (calibre) rifle as humanely as possible (i.e. a single shot to head).

4.14.3 Overabundant native herbivore control

Native herbivore (primarily kangaroos) control will only be undertaken when significant numbers of animals occur in the offset site and monitoring indicates they are having a deleterious effect on the BOA. Appropriate permit applications will be made to the OEH.

One of the simplest to reduce kangaroo numbers is to remove (or prevent access to) water sources. If kangaroos numbers increase to a point where they pose a threat to the conservation objectives of the BOA, this passive method of control should be implemented.

However, if this proves ineffective, then more direct methods to control native herbivores will be undertaken by shooting while spotlighting. Shooting will be required to be undertaken by persons with a fire arm license, using a high powered (calibre) rifle as humanely as possible (i.e. a single shot to head). Such control methods must be supported by scientific data identifying the impact caused by kangaroos.

4.15 VERTEBRATE PEST MANAGEMENT

Vulpes vulpes (European Red Fox) and *Felis catus* (Feral Cats) have been observed within the GCC lands and are likely to occur in the BOA. Potentially, both these species can have a detrimental effect on the biodiversity of the offset site. The European Red Fox preys on native wildlife and has the ability to cause localised extinctions of wildlife species. The European Red Fox also has the ability to spread weed propagules and has been implicated in the spread of weed species such as the African Boxthorn. The Feral Cat also preys on small mammals and reptiles and has been implicated in the decline of many species of native Australian fauna. Specific management techniques are discussed below and in **Appendix 4**.

Vertebrate pest management in the BOA over the short term will focus on European Red Fox control. Feral Cat control will be undertaken opportunistically. A strategy has been devised for the BOA that will control vertebrate pest species. The proposed control strategy for the control of vertebrate pests comprises:

- The use of 1080 poison baits for European Red Fox control; and
- Opportunistic shooting of European Red Fox and Feral Cat.

It must be noted that while the control of these species will have a significant impact on the vertebrate pest present in the BOA, without neighbouring landowners participating in similar programmes the abundance of these predators across the landscape is unlikely to be significantly affected. Integrating vertebrate pest management across several neighbouring properties will yield the greatest success.

Details of the management techniques for vertebrate pests are provided in **Appendix 4**.

5 Management implementation

The following management strategy will be implemented on the BOA. Note that management has been staged to occur in four management periods as follows:

- Management Period 1 – Years 1 to 3 (**Table 18**)
- Management Period 2 – Years 4 to 6 (**Table 19**)
- Management Period 3 – Years 7 to 9 (**Table 20**)
- Management Period 4 – Year 10 onwards (**Table 21**)

Management actions have been presented as near as possible to a chronological project staging from top to bottom. Many tasks will overlap in their predicted time-frames.

5.1 MANAGEMENT PERIOD 1 – YEARS 1 TO 3

Table 18: Management strategy Years 1 - 3

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
All	Management of human disturbance	Manage access to site, including reduction of illegal access	Appointment of position formally given the responsibility of managing the Biodiversity offset (e.g. GCC Environment Officer)	GCC Environment Officer to undertake periodic monitoring as required by this LBMP and prepare quarterly reports etc
All	Fencing and signage	Erect access fencing and gates	New fencing erected as required and gates with GCC locks.	Fencing and gates must also be suitable for stock exclusion
All		Install signage	Signage installed as per Appendix 3	
All	Management of grazing for conservation	Ensure stock proof fencing	New fencing erected as required in the first three years	
All		Maintenance of fencing	Stock proof fencing maintained	1/20 th replacement cost

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
All		Stock exclusion	Exclusion of stock for Period 1, complimented by crash grazing where necessary to reduce vegetative biomass	Stock grazing is removed for a minimum of six years from the implementation of this RBOSMP, unless deemed necessary in accordance with Section 4.4
All	Weed control	Primary treatment of weeds	Primary management of target weed species over one year.	Management as per Section 4.5.
All		Secondary treatment of weeds	Secondary management of target weed species over two years.	Management as per Section 4.5.
All	Bushfire management	Fire exclusion	No controlled burns undertaken for Period 1	
All	Infill planting	Seed collection	Collection of seed for direct seeding and propagation	Focus on over and midstorey species. Collection as per Section 4.9
MZ1	Weed management	Weed Control	Control weeds within and around the management zone to enable natural regeneration to occur within the first 5 years.	Aim is to increase ground cover to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per Section 4.5
MZ2	Weed management	Weed Control	Control weeds within and around the management zone to enable natural regeneration to occur within the first 5 years.	Aim is to increase diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per Section 4.5.

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
MZ3	Weed management	Weed Control	Control weeds within and around the management zone. No revegetation required.	Aim is to maintain diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community.
All	Retention of timber	Transfer removed timber from the impact area to the BOA	Demonstrated in photo monitoring points	To be undertaken as feasible in accordance with Section 4.10 .
All	Retention of rocks	Transfer removed rocks from impact area to BOA	Demonstrated in photo monitoring points	To be undertaken as feasible in accordance with Section 4.13 .
All		Retain all rocks on site	Demonstrated in photo monitoring points	
All	Control of feral and/or over-abundant native herbivores	Initial Rabbit control	Dramatic reduction in Rabbit numbers	Rabbit control undertaken annually in summer
All		Feral Goat control	Feral Goat control documented with numbers killed.	Undertaken as required.
All	Vertebrate pest management	1080 baiting for Fox Control	Fox baiting undertaken twice annually.	Effectiveness of baiting needs to be considered on a landscape scale.
All		Opportunistic shooting for Fox and Cat control	Fox and Cat control documented with numbers of Foxes and Cats killed.	Undertaken as required.
All	Monitoring	Establish annual monitoring programme.	Monitoring program established following guidelines in Section 7	
All		Undertake monitoring programme on an annual basis.	Monitoring undertaken and completed following guidelines in Section 7	

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
All	Reporting	Prepare annual management plan implementation and annual monitoring reports.	Quarterly and annual reports, and annual monitoring report prepared and submitted to DoP as per Section 7 .	

5.2 MANAGEMENT PERIOD 2 – YEARS 4 TO 6

Table 19: Management strategy years 4 – 6

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
All	Management of human disturbance	Regular monitoring of fencing, gates, and access	Reduction in illegal access	
All	Management of grazing for conservation	Maintenance of fencing	Stock proof fencing maintained	1/20 th replacement cost
All		Stock exclusion	Exclusion of stock for Period 2	Stock grazing is completely removed
All	Weed control	Secondary treatment of weeds.	Secondary management of target weed species over three years.	Management as per Section 4.5 .
All	Bushfire Management	Fire exclusion	No controlled burns undertaken for Period 2	All
MZ 1 and MZ 2	Infill planting if natural regeneration has not occurred within 5 years.	Seed collection	Collection of seed for direct seeding and propagation	Focus on over and midstorey species. Collection as per Section 4.9

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
MZ1	Infill planting if natural regeneration has not occurred within 5 years.	Direct seeding and tubestock planting if required.	Seeding and/or planting of groundcover species as required.	Aim is to increase ground cover to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per Section 4.5.
MZ2	Infill planting if natural regeneration has not occurred within 5 years	Direct seeding and tubestock planting if required	Seeding and/or planting of groundcover, midstorey and canopy species as required	Aim is to increase diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per Section 4.5.
MZ3	Weed management	Weed control	Control weeds within and around the management zone. No revegetation required	Aim is to maintain diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community.
All	Control of feral and/or over-abundant native herbivores	Ongoing Rabbit control	Maintenance of reduced Rabbit numbers	Rabbit control undertaken annually in summer
All		Feral Goat control	Feral Goat control documented with numbers of Feral Goats killed	Undertaken as required.

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
All	Vertebrate Pest Management	1080 baiting for Fox control	Fox baiting undertaken twice annually	Effectiveness of baiting needs to be considered on a landscape scale.
All		Opportunistic shooting for Fox and Cat control	Fox and Cat control documented with numbers of Foxes and Cats killed	Undertaken as required.
All	Retention of timber	Retain on-site timber	Demonstrated in photo monitoring points	
All	Retention of rocks	Retain all rocks on site	Demonstrated in photo monitoring points	
All	Monitoring	Undertake monitoring programme on an annual basis	Monitoring undertaken and completed following guidelines in Section 1	
All		Preparation of annual management plan implementation and annual monitoring reports	Quarterly and annual reports and annual monitoring report prepared and submitted to DoP as per Section 7	

5.3 MANAGEMENT PERIOD 3 – YEARS 7 TO 9

Table 20: Management strategy years 7 – 9

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
All	Management of human disturbance	Regular monitoring of fencing, gates, and access	Reduction in illegal access	

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
All	Management of grazing for conservation	Maintenance of fencing	Stock proof fencing maintained	1/20 th replacement cost
All		'Pulse' grazing	'Pulse' grazing undertaken as required for ecological outcomes	Management as per Section 4.4 . Stock grazing is excluded at all other times
All	Weed Control	Maintenance treatment of weeds	Maintenance management of target weed species over three years	Management as per Section 4.5
All	Bushfire Management	Preparation for controlled burns and monitoring	Control burn management plan	
All	Bushfire Management	Controlled burns	Controlled burns undertaken as required for ecological outcomes	Management as per Section 4.6
MZ 1 and MZ 2	Infill planting	Seed collection	Collection of seed for direct seeding and propagation	Focus on over and midstorey species. Collection as per Section 4.5
MZ1	Infill planting	Direct seeding and tubestock planting if required	Seeding and/or planting of groundcover species as required	Aim is to increase ground cover to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per Section 4.5

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
MZ2	Infill planting	Direct seeding and tubestock planting if required	Seeding and/or planting of groundcover, midstorey and canopy species as required	Aim is to increase diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per Section 4.5
MZ3	Weed management	Weed control	Control weeds within and around the management zone. No revegetation required	Aim is to maintain diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community
All	Retention of timber	Retain on-site timber	Demonstrated in photo monitoring points	
All	Retention of rocks	Retain all rocks on site	Demonstrated in photo monitoring points	
All	Control of feral and/or over-abundant native herbivores	Ongoing Rabbit control	Maintenance of reduced rabbit numbers	Rabbit control undertaken annually in summer
All		Feral Goat control	Feral Goat control documented with numbers of Feral Goats killed	Undertaken as required
All	Vertebrate pest management	1080 baiting for Fox Control	Fox baiting undertaken once annually as required	Effectiveness of baiting needs to be considered on a landscape scale
All		Opportunistic shooting for Fox and Cat control	Fox and Cat control documented with numbers of Foxes and Cats killed	Undertaken as required

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
All	Monitoring	Undertake monitoring programme on an annual basis	Monitoring undertaken and completed following guidelines in Section 1	
All	Reporting	Preparation of annual management plan implementation and annual monitoring reports	Quarterly and annual reports and annual monitoring report prepared and submitted to DoP as per Section 1	
All		Periodic review of this RBOSMP	Updated management actions based on the changes found in the monitoring and annual reports	Undertaken every six years, starting in Period 3

5.4 MANAGEMENT PERIOD 4 – YEAR 10 ONWARDS (PER YEAR)

Table 21: Management strategy year 10 and onwards

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
All	Management of human disturbance	Regular monitoring of fencing, gates, and access	Reduction in illegal access	
All	Management of grazing for conservation	Maintenance of fencing	Stock proof fencing maintained	1/20 th replacement cost
All		'Pulse' grazing	'Pulse' grazing undertaken as required for ecological outcomes	Management as per Section 4.4 . Stock grazing is excluded at all other times
All	Weed control	Maintenance treatment of weeds	Maintenance management of target weed species over three years	Management as per Section 4.5

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
All	Bushfire management	Controlled burns	Controlled burns undertaken as required for ecological outcomes	Management as per Section 4.6
All	Thinning of native vegetation	Thinning of <i>Callitris glaucophylla</i>	Thinning of areas of <i>Callitris glaucophylla</i> as required for ecological outcomes	Management as per Section 4.8.
MZ1	Infill planting	Revegetation	Planting of midstorey and canopy species as required for two years	Aim is to increase ground cover to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per Section 4.5
MZ2	Infill planting	Revegetation	Planting of midstorey and canopy species as required for two years	Aim is to increase diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community using appropriate species. Management as per Section 4.5
MZ3	Weed management	Weed control	Control weeds within and around the management zone. No revegetation required	Aim is to maintain diversity in the mid and overstorey to a minimum of 75% of the Biobanking benchmark for the vegetation community
MZ1	Nest boxes	Installation of nest boxes	Nest box number and location documented for one year	For one year only. As per specifications in Section 4.11.
All	Retention of timber	Retain on-site timber	Demonstrated in photo monitoring points	
All	Retention of rocks	Retain all rocks on site	Demonstrated in photo monitoring points	

MANAGEMENT ZONE	MANAGEMENT THEME	MANAGEMENT ACTION	PERFORMANCE MEASURE (BY END OF PERIOD)	COMMENTS
All	Control of feral and/or over-abundant native herbivores	Ongoing Rabbit control	Maintenance of reduced rabbit numbers	Rabbit control undertaken annually in summer
All		Feral Goat control	Feral Goat control documented with numbers of Feral Goats killed	Undertaken as required
All	Vertebrate pest management	1080 baiting for Fox Control	Fox baiting undertaken once annually as required	Effectiveness of baiting needs to be considered on a landscape scale
All		Opportunistic shooting for Fox and Cat control	Fox and Cat control documented with numbers of Foxes and Cats killed	Undertaken as required
All		Cat control	Implementation and maintenance of a long-term cat control program	To be undertaken in concert with broader cat control on GCC lands
All	Monitoring	Undertake monitoring programme on an annual basis	Monitoring undertaken and completed following guidelines in Section 1	
All	Reporting	Preparation of annual management plan implementation and annual monitoring reports	Quarterly and annual reports and annual monitoring report prepared and submitted to DoP as per Section 1	
All		Periodic review of this RBOSMP	Updated management actions based on the changes found in the monitoring and annual reports	Undertaken every six years

6 Cost to implement RBOSMP

Based on a site inspection during September 2011, the management actions, frequency, intensity and duration required to meet the CoA as outlined in **Section 4** and **Section 5**, were costed at the commercial rates of implementation.

To assist in determining the management requirements, large scale, high resolution maps of the BOA were prepared to provide information on the surrounding land use, length of site perimeter, the length of tracks and trails and the area of each vegetation condition class.

The costing for the improvement works for the BOA have been based on the assumption that the completion criteria (**Section 10**) will have been achieved in 10 years subject to satisfactory regeneration of the tree-less areas and weed problems being controlled to a maintenance level. Costs for works undertaken as part of the impact site works (e.g. costs of transferring timber and rocks removed from the new quarry site to the BOA) have not been included.

The cost to implement this management plan will be the responsibility of GCC and are estimated to total approximately **\$550,000** over the first 9 years during the active management phase (including Quarterly and Annual Reporting and the Flora & Fauna Monitoring Program **Section 7**) and then approximately **\$45,000** per year thereafter until 'completion' (**Section 10**).

GCC have also planned the future management of the BOA after Year 10 in **Table 14** when it is expected that the completion criteria has been achieved. Additionally, the obligation to maintain the boundary fences in stock proof condition would be the joint responsibility of the GCC and neighbouring land owners.

6.1 FENCING AND SIGNAGE

Stock proof fencing as per the existing external fence has been costed at \$13,000 per km. This expense will be incurred in the first year. Fence maintenance is assumed to be required on an annual basis whereby the entire fence is replaced once in every 20 years.

If Rabbit-proof fencing were to be installed as per **Section 4.14.1** then there would be additional expense. The materials alone for a Rabbit-proof fence have been estimated to cost \$4,000 - \$6,000 per kilometre (Long & Robley 2004). With labour, these costs would likely be in the vicinity of \$20,000-\$30,000 per km. These expenses have not been incorporated in the schedule of costs provided.

6.2 MANAGEMENT OF GRAZING FOR CONSERVATION

Costs for stock proof fencing have been incorporated into **Section 6.1**, above. Costs for 'pulse' grazing have been included starting in Period 3, as per **Section 4.4**. Costs for this management action have been estimated at \$1,000 per hectare for MZ1 and \$100 per hectare for MZ2. This difference is due to increased use of this management action in MZ1 over MZ2. The costs include the installation and movement of temporary fences, the movement of stock, and the wear and tear on existing fence lines and infrastructure.

6.3 WEED CONTROL

Bush regeneration contractors or suitably qualified GCC staff will implement the weed control works outlined in **Section 4.5**. These works have been calculated at \$1,680 for a team of four bush regenerators per day. The cost of bush regeneration works includes the costs of herbicide, vehicles and equipment which are required to implement weed control works.

6.4 BUSHFIRE MANAGEMENT

The costs of bushfire management as outlined in **Section 4.6** have been estimated to be \$10,000 every five years in the form of a donation to the RFS starting in Period 3. An additional \$1,000 at the same time has been budgeted to prepare for the controlled burns and monitor afterwards.

6.5 THINNING OF NATIVE VEGETATION

If required, thinning of *Callitris glaucophylla* should be undertaken by bush regeneration contractors or suitably qualified GCC staff as per the specifications in **Section 4.5** and the costs shown in **Section 6.3**. The total for these works is \$5,040 to be undertaken every three years starting in Period 4.

6.6 REVEGETATION TREATMENTS

Bush regeneration contractors or suitably qualified GCC staff will implement the infill planting works. Budget for the collection of seed from the site and surrounding area has been included for Period 1 - 3. These costs do not include the propagation of these seeds for revegetation in Period 4, which are included in the revegetation costs. Costs for direct seeding have been estimated at \$2,000 per hectare for MZ1 and \$1,000 per hectare for MZ2, given the different density requirements. These costs are based on the use of a 'niche seeder' and include site preparation.

Costs for revegetation have been budgeted at \$2,800 per hectare for MZ1 and \$460 per hectare in MZ2 to achieve the densities required in outlined in **Section 4.9**. This rate includes planting, tree guards, water crystals and initial watering for overstorey species. A total of 1,480 plants will be required in MZ1 at a cost of \$4,000. A total of 12,743 plants will be required for MZ2 at a cost of \$28,000. These costs include provision for 30% replacement plantings in MZ1 and 10% in MZ2. Costs for both have been spread over two years (Period 4).

6.7 NEST BOXES

Arborists or suitably qualified bush regenerators / GCC staff will implement the nest box works. It has been estimated that nest boxes will cost \$200 to supply and install and will be installed at a density of 30/ha in MZ1 in Period 4 and 10/ha in MZ4, ~10 years rehabilitation of the post mine/landfill landform.

6.8 CONTROL OF FERAL AND OVERABUNDANT NATIVE HERBIVORES

Feral pest management will be undertaken by suitably qualified staff only. The costs for Rabbit control have been estimated to be \$5,000 per year in Period 1 and \$2,500 per year in Periods 2-4. The cost of Feral Goat control has been estimated to be \$1,000 per year.

6.9 VERTEBRATE PEST MANAGEMENT

Feral pest management will be undertaken by suitably qualified staff only. The costs for Fox control has been estimated at \$3,000 per baiting session to be conducted twice per year in Periods 1-2 and once per year in Periods 3-4. The cost of opportunistic shooting of Foxes and Cats has been

estimated at \$1,000 per year. The cost of a cat control program, the exact form to be determined later has been very roughly estimated at \$5,000 per year starting in Period 4.

6.10 FLORA AND FAUNA MONITORING PROGRAM

Bush regeneration contractors, ecologists or suitably qualified GCC staff will implement the flora and fauna monitoring program (**Section 7**) as per the rates shown in **Section 6.3**. The costs to develop the annual monitoring program has been estimated at \$5,000 in Period 1. The recurring costs to implement the annual monitoring program are estimated to be \$25,000-\$30,000 per year in Periods 1-4.

6.11 ANNUAL BOA AND REHABILITATION REPORT

Bush regeneration contractors, ecologists or suitably qualified GCC staff will implement the flora and fauna monitoring program (**Section 7**). The costs to prepare quarterly and annual monitoring reports have been estimated at \$6,000 per year for Periods 1-4. A periodic review of the RBOSMP every 6 years starting in Period 3 has been estimated at \$5,000.

7 Flora and fauna monitoring program

This section of the Management Plan provides an overview of the flora and fauna monitoring requirements in accordance with CoA 49. The completion criteria (**Section 10**) have been aligned to this monitoring program and made consistent across both the BOA and QRA.

The objective of the monitoring program is to evaluate the restoration progress of the BOA and QRA towards fulfilling successful vegetation restoration objectives and completion criteria. The purpose of monitoring activities across BOA and QRA are to ensure the sustainable management of native flora and fauna, and to guide continual improvement in practices and the management of rehabilitation and biodiversity offset areas.

The monitoring program is, in general, consistent with the standard flora and fauna assessment guidelines (DECC 2004), and has been refined considering the potential future vegetation monitoring requirements outside of the current BOA, should any additional areas of GCC lands be offset in the future to maintain a consistent monitoring methodology)

The monitoring program is broken up into the following components of Quarterly Visual Inspections, Annual Flora Monitoring, and Annual Fauna Monitoring.

7.1 QUARTERLY VISUAL INSPECTIONS

Visual monitoring is a field based rapid assessment tool that provides an assessment of various landscape contributors and associated remedial actions. Visual inspections will be undertaken by the appropriately qualified GCC staff and include:

- Fence maintenance requirements
- Condition of fire breaks
- Disturbance factors including fire and unauthorised access e.g. rubbish dumping, off-road vehicle access, shooting, etc
- Presence/mapping of exotic weed and feral animals species including wandering stock
- Vegetation components (overstorey, understorey and ground cover where applicable)
-
- Monitoring of any nest boxes installed for the presence of feral honey bees (*Apis mellifera*) and/or introduced birds such as Starlings (*Sturnus vulgaris*) or Common Myna's (*Acridotheres tristis*)
- Surface stability and erosion issues
-

Any areas of high erosion risk will be visually monitored on a regular basis and particularly after high rainfall events. The Quarterly Visual Inspection template is included in **Appendix 5**. This template is a working document and modifications to this template should be made as considered appropriate by the land manager to include additional observation or remove tasks.

7.2 FLORA MONITORING

Vegetation monitoring will utilise the Biobanking Assessment Methodology (BAM) to monitor the trajectory of each management zone towards the benchmarks for each vegetation type. Vegetation plots undertaken for the BOS targeted land to the north of the final BOA, and as such a baseline dataset will need to be established within the BOA. These sites should be:

- A minimum of two plots in each vegetation condition class (i.e. management zone) for patches greater than 5 ha as mapped within BOA and one plot in management zones <5 ha (the number of vegetation monitoring replicates has been refined considering the potential future vegetation monitoring requirements outside of the current BOA, should any additional areas of GCC lands be offset in the future to maintain a consistent monitoring methodology)
- Permanently marked by a star picket at the start and end of a 50 m transect established perpendicular to the contour, preferably in an east west or north south orientation.

As a number of vegetation plots have already been established and marked in the northern portion of the GCC lands, three of the plots located within the climax state of each vegetation type should be utilised as a reference site (for baseline BioMetric data and location of these plots see BOS, ELA 2011).

For each transect, flora monitoring will enable a comparative measurement of the vegetation status against the completion criteria in **Section 10**. Using the starting point of each transect, components of the BAM will measure the status of vegetation condition for each replicate against the completion sub-criteria 2.2 to 2.5 in **Table 16** from **Section 10**. The additional monitoring using the BAM will be:

- Native plant species number and cover per 400 m² (20 m x 20 m quadrat)
- Overstorey cover range measured at 10 points along a 50 m transect
- Midstorey cover range measured at 10 points along a 50 m transect
- Groundcover measured at 50 points along a 50 m transect

Figure 11 presents the BioMetric plot formation for the collection of the above outlined data.

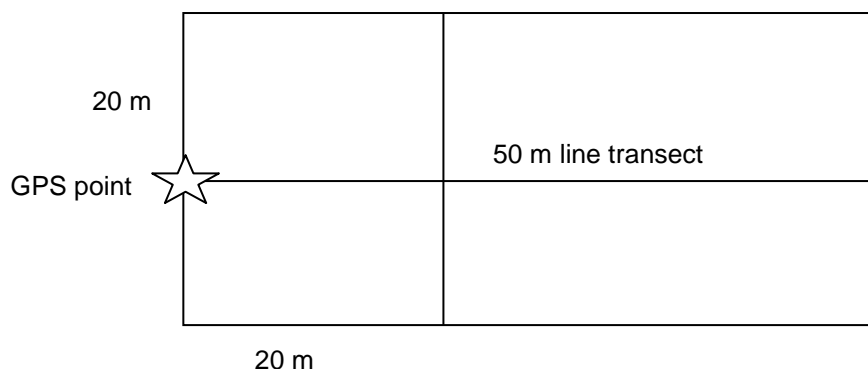


Figure 11: Vegetation assessment plot

The results of monitoring activities across the BOA site are to ensure sustainable management of native flora communities, and to guide the continuous improvement of management strategies. Data

can also be used to inform the need for changes to grazing management through changes in vegetation cover and diversity. Where necessary, rehabilitation and biodiversity offset area restoration practices will be amended, or as more data becomes available regarding analogue sites or the targeted vegetation type benchmarks; completion criteria can be updated to ensure rehabilitation and biodiversity offset areas are improving on the right trajectory. A Vegetation Monitoring Database will be developed and include a flora species register of potential and recorded species in the BOA and QRA. The condition of the biodiversity offset area and rehabilitated vegetation identifies any deterioration or improvement in habitat quality will assist in the targeting of resources towards:

- Native seed collection
- Habitat enhancement
- Noxious and environmental weed control
- Vertebrate pest control

The monitoring results will identify particular vegetation components that may not be tracking towards specific closure criteria (**Section 10**). This will allow the GCC to prioritise specific management actions to address deficiencies and/or amend procedures.

7.3 FAUNA MONITORING

Fauna monitoring will be undertaken by a person appropriately trained and qualified for bird and microbat survey. Surveys will specifically target threatened species previously recorded, or with potential to occur within the area (**Table 5**). The targeted fauna monitoring is directed by the previous fauna survey work with sufficient data indicating that there is limited presence of native ground and arboreal mammals, with no threatened species of these fauna groups considered likely to occur in the BOA or QRA. As such, annual fauna monitoring surveys will target woodland birds and microbats, which represent all of the threatened species previously recorded onsite. These species will provide information on the progress of woodland restoration, particularly in the first 10 years of restoration activity. Group size of bird species will be monitored where possible to determine changes in abundance, with priority given to capturing group size in threatened avifauna.

The first year of monitoring will establish baseline data sets for ongoing comparison (i.e. ongoing data collected will be directly comparable using the same methodology). GCC will maintain a fauna species register based on the likelihood that a species would be present and documenting from previous monitoring programs species recorded onsite.

As with the fauna survey, the number of fauna monitoring replicates has been refined considering the potential extant vegetation monitoring requirements (outside of the current BOA) to maintain a consistent monitoring methodology should the additional areas of GCC lands be utilised as an offset in the future.

Fauna surveys will occur across all condition classes (i.e. management zones), with 2 replicates for each condition class with patches greater than 5 ha in area and one for vegetation condition classes with patches less than 5 ha in area (due to the standard timed/area monitoring methods (DECC 2004 and (**Table 22**), and the mobility of fauna species, it is not possible to replicate monitoring sites in vegetation condition classes where patches of vegetation are only 2-3 ha in size. Similarly, for nocturnal bird monitoring, the standard survey methodology requires separation of 1 km between sites).

Table 22: Fauna monitoring methods and intensity in each vegetation community/condition class

METHOD	DETAIL	REQUIREMENT PER SITE	FREQUENCY	SEASON
Nest box inspections	Inspection: Upon installation nest boxes will each require a one off inspection to check for use and if possible identify what species are using them.	Inspect nest boxes to be established in rehabilitation areas.	Annually	Early Spring – ideally September each year when the use of boxes by bird species can be detected.
Bat detection	Echolocation recordings to identify microbat species occurring on site. Two nights at each site	One detector for two nights in each management zone, set for a minimum of 4 hrs	Annually	Spring.
Bird survey	Timed, fixed area surveys for diurnal birds, observing and listening, capturing population scores where possible.	20 minutes / 2 ha count morning and dusk over 2 days	Annually	Spring.
Collection of scats	Collect scats and send to laboratory for analysis of predator and prey species.	Opportunistic	In line with other activities	Year round.

* Lower frequency for the time taken for habitat development following vegetation establishment (hollows, logs and litter on ground) and slow response time of ground mammalian fauna.

The results of monitoring activities across the BOA are to ensure sustainable management of native fauna communities, and to guide the continuous improvement of management strategies. Where necessary, rehabilitation and biodiversity offset area restoration practices will be amended, or as more data becomes available regarding analogue sites or the vegetation benchmarks; completion criteria can be updated to ensure rehabilitation and biodiversity offset areas are improving on the right trajectory. Fauna surveys aim to target threatened species previously recorded, or with potential to occur within the area. The results of monitoring will be analysed and compared to previous survey results to determine general population trends. In the event that negative trends are identified indicating the decline of particular threatened species, appropriate amelioration measures must be recommended.

If new populations of threatened species or additional threatened species are identified through the course of monitoring or other observations, records will be assessed by a qualified ecologist to advise if any changes to the management of the offset area are required. This may result in:

- Certain planned activities being postponed or modified
- Modification of the monitoring program

- Immediate survey and assessment of the new record, and an assessment of the impact of the proposed activity on it.

If further threatened species or significant new records of existing threatened species are collected, the significance of such records will be reviewed, as will the likely impact of existing or proposed management activities, and any options for minimising impacts on these species.

All fauna records from the annual monitoring program will be submitted to the OEH Atlas of NSW Wildlife consistent with standard conditions of Scientific licences.

7.4 GRAZING MONITORING

When grazing is used as a management tool for conservation purposes, the impact of grazing will require monitoring. Grazing should occur for short periods with high numbers of stock (crash grazing) to avoid stock selectively grazing more palatable species.

No single grazing strategy can be developed for all situations. Rather, objectives must be set for each grazing event and then monitored accordingly. Grazing objectives may influence the type of stock used for grazing, numbers of stock, area in which stock can graze and duration. Grazing objectives may include reduce grass biomass (tonnes/ha), reduce the abundance of an introduced species (e.g. clover), increase native forb cover. However, the overriding conservation objective remains constant.

Maintaining accurate records is important to evaluate grazing success. Things to note are:

- Type of stock
- Numbers of stock used
- Paddock name/number and size subject to grazing
- Calculate grazing pressure in DSE
- Measure average grass height and percent cover of grasses, herbs, bare ground, litter, other.

Frequent monitoring of stock impact (twice weekly) should be undertaken to avoid possible overgrazing.

8 Annual BOA and rehabilitation report

The annual BOA report will consist of two parts:

- Summary of the implementation of management actions within the RBOSMP including inspection results and review findings
- The results of the flora and fauna monitoring program.

8.1 RBOSMP IMPLEMENTATION

The annual RBOSMP implementation report will provide a summary of all the actions implemented during the previous year, documented from the Property Managers Quarterly Inspections (**Appendix 5**). Any significant events that occurred during the year (e.g. wild fire, outbreak of any weeds or incidence of any new threats) and any recommended changes to the management actions, their duration, intensity or relative priority identified through the annual review (**Section 9**) will be included.

8.2 FLORA AND FAUNA MONITORING REPORTING

8.2.1 Flora

Annual vegetation monitoring reporting is to include a written summary of the methodology and the current year's findings for each vegetation plot, including the average results of each variable recorded. Photo monitoring records of each vegetation transect and field data sheets will be included in an appendix. A flora species list with corresponding plot numbers where species were recorded is to be included in an appendix.

A discussion section is to be included that compares the results from the current monitoring year with previous years either through actual annual records or a mean value where several previous years are being compared. The annual report is to include statistical graphs illustrating changes in diversity and cover/abundance of each attribute recorded within each condition zone.

8.2.2 Fauna

The report is to include methods and results of fauna monitoring and significant findings, including any new records of threatened species. A fauna species list with corresponding transect numbers/survey site numbers where species were recorded will be included as an appendix.

A discussion section will be included that compares the species diversity results, as absolute numbers and grouped into various guilds representing the diversity of habitat types present from the current monitoring year with previous years. The annual report will include graphs and tables illustrating changes in the nocturnal birds, bats, diurnal birds and reptiles' abundance and diversity over time. As discussed in **Section 7.4**, the key species groups targeted to be monitored includes:

Bats

Bat diversity will be measured in three different groups:

- Megachiropteran (i.e. Flying-foxes);

- Microchiropteran (micro bats) that forage in the sub canopy; and
- Microchiropteran that are canopy or above canopy foragers.

Graphs or tables that illustrate changes in bat diversity in each of these three groups are to be developed for each monitoring plot.

Birds

Bird diversity is to be measured in three different groups:

- Raptors or birds of prey including nocturnal and diurnal;
- Ground and shrub guild, including woodland birds such as finches, wrens and warblers; and
- Generalists such as parrots and honeyeaters.

Graphs or tables that illustrate changes in avian diversity in each of these three groups are to be developed for each zone.

As it is uncertain whether abundance scores will be achievable for avifauna, bird species abundance will be captured where possible and compared over time if it is determined that sufficient data exists for comparison. Population counts will be prioritised to capture data on threatened avifauna, particularly the Grey-crowned Babbler.

Feral and native herbivores

Annual monitoring report shall include the requirement to report on numbers/trends in population size of feral and native herbivores, total grazing pressure and any pulse grazing undertaken (timing, duration, numbers/type of stock, grazing intensity in dry sheep equivalent [DSE]).

8.3 REPORT RECOMMENDATIONS AND CONCLUSION

A concluding section within the Annual Report that highlights and describes significant findings, either positive or negative, is to be prepared. Changes to any management recommendations for the following year will also be suggested.

A more comprehensive review of the RBOSMP will be conducted every six years starting in year 7. This will reflect on the effectiveness of previous management actions and recommend changes and adjustments for the next period, such as the potential cessation of monitoring in areas that have achieved completion criteria or are determined to be at a stable state (e.g. fauna diversity/abundance neither increasing nor decreasing).

8.4 SUBMISSION OF ANNUAL REPORTS TO DP&I, OEH AND CMA

GCC will submit copies of this report to DP&I, OEH and the CMA (if interested).

9 Annual review and auditing

CoA 49(d) requires GCC to annually review performance against the RBOSMP and, if necessary, revise the BOS/RBOSMP to the satisfaction of the Director-General. To facilitate the annual review, a review protocol has been developed in **Appendix 6** to be completed by the Property Manager. Annual reviews are conducted to assess the effectiveness of management strategies against the objectives of this RBOSMP. A review protocol for the RBOSMP will be completed annually in March of each year. The findings of the annual review of the RBOSMP will be reported to management and in the annual report, and, if required, the RBOSMP will be updated for DP&I approval.

In general, the RBOSMP will be revised due to:

- Deficiencies being identified
- Outcomes from the Annual Review
- Recommendations from the Annual Report
- Changing environmental condition (e.g. wet/dry years etc)
- Improvements in knowledge or new technology becomes available.

10 Completion criteria

GCC have defined the rehabilitation and biodiversity offset area completion criteria to comply with the CoA detailed in **Table 1** to monitor woodland restoration performance against the criteria outlined in **Table 23**. The completion criteria have been aligned and made consistent across both the QRA and BOA

The GCC completion criteria aim to achieve the following:

- The ongoing refinement of completion criteria and monitoring programs that will facilitate lease relinquishment following mine closure
- Alignment with Rehabilitation and Biodiversity Offset Area objectives
- Facilitate continuous improvement in restoration management practices of the rehabilitation and biodiversity offset areas.

The completion criteria have been aligned to objectives for the rehabilitation and biodiversity offset areas. Each year the annual report will assess if the standard is met for each sub-criteria within the categories of Integrated Landscapes, Sustainable Growth and Development and Land Use. The completion criteria is considered to have been successfully achieved for each rehabilitation and biodiversity offset area if each sub-criteria standard is reached for each monitoring plot, therefore, a sustainable final woodland community land use achieved. If the standard is not met for each sub-criteria, the remedial action will be implemented as soon as practical by the Property Manager within budgetary limitations. **Table 23** has been adapted specifically for Woodland Ecological Communities to be restored across GCC rehabilitation and BOA.

Table 23: GCC Completion Criteria for Woodland Ecological Communities (BOA specific)

CRITERIA AND INTENT	MEASURE	STANDARD	REMEDIAL ACTION
1.0 INTEGRATED LANDSCAPES			
1.2 Does the area represent an erosion hazard?	Quarterly visual inspection by GCC staff	Erosion should not exceed 0.3 m (gully) deep (natural drainage lines exempt)	Undertake maintenance rehabilitation by additional shaping of surface to repair gully erosion
2.0 SUSTAINABLE GROWTH AND DEVELOPMENT – WOODLAND ECOLOGICAL COMMUNITIES			
2.1 Is there appropriate native plant species richness for the restored Ecological Community (EC)?	Vegetation monitoring by ecologist or appropriately qualified person will determine native plant species richness	Native plant species numbers (per 400 m ²) reaches benchmark based on DECCW 2008 Biobanking Vegetation Benchmarks Database	Undertake maintenance rehabilitation by re-sowing / replanting missing plant species to achieve desired species richness

CRITERIA AND INTENT	MEASURE	STANDARD	REMEDIAL ACTION
2.2 Is there an appropriate density/structure of native overstorey species?	Vegetation monitoring by ecologist will determine native plant species cover	Overstorey cover range measured at 10 points along a 50 m transect reaches lower benchmark based on DECCW 2008 Biobanking Vegetation Benchmarks Database	Undertake maintenance rehabilitation by re-sowing / replanting missing plant species to achieve desired species richness
2.3 Is there an appropriate density/structure of native midstorey species?	Vegetation monitoring by ecologist will determine native plant species cover	Midstorey cover range measured at 10 points along a 50 m transect reaches lower benchmark based on DECCW 2008 Biobanking Vegetation Benchmarks Database	Undertake maintenance rehabilitation by re-sowing / replanting missing plant species to achieve desired species richness
2.4 Is there appropriate native groundcover?	Vegetation monitoring by ecologist will determine native plant species cover	Groundcover range measured at 50 points along a 50 m transect reaches lower combined benchmark for each groundcover types (grasses, shrubs, other) based on DECCW 2008 Biobanking Vegetation Benchmarks Database	Undertake maintenance rehabilitation either apply mulch and/or by re-sowing / replanting missing plant species to achieve desired coverage
3.0 LAND USE			
3.1 Is the area and sustainability (quality) consistent with intended land use?	RBOSMP monitored annually to measure trajectory to benchmarks outlined above	BOA established to land use consistent with RBOSMP	Undertake required areas of rehabilitation/restoration to achieve final land use
3.2 Are there any potential hazards not consistent with intended land use?	Quarterly visual inspection by Environmental Officer	The site is free of safety or environmental hazards within the area including: • Holes, tunnels or unstable areas; • Quarrying and landfill infrastructure or debris; or • Hazardous materials	All safety or environmental hazards are to be removed as required
3.3 Is exotic/weed vegetation competing or impacting on intended land use?	Quarterly visual inspection by Environmental Officer	Noxious weeds are not present within rehabilitation or biodiversity offset areas	Undertake weed management strategies in LMP/RBOSMP
3.4 Are feral pests impacting on intended land use?	Quarterly visual inspection by Environmental Officer	Impacts of feral pests considered negligible or at maintenance level	Undertake pest management strategies in QRA and BOA

11 Long term management strategy

As per CoA 50, the Long Term Management Strategy must:

- (a) Define the objectives and criteria for quarry closure post extraction management*
- (b) Be prepared in consultation with DECCW, NOW and DII*
- (c) Investigate and/or describe options for the future use of the site*
- (d) Describe the measures that would be implemented to minimise or manage the environmental effects of the project and*
- (e) Describe how the performance of these measures would be monitored over time*

The objectives and criteria for quarry closure post extraction management and infilling are outlined in **Section 10**. The BOS was been developed in consultation with OEH (formerly DECCW), and a draft of the LBMP has been provided to OEH for comment on 17 October 2012 and 14 February 2013. All comments received from 17 October 2012, were incorporated into the report submitted 14 February 2013, and no further comments were provided to this version.

Future landuse of the BOA and QRA will be for conservation as outlined in **Sections 1-4**, and management and monitoring measures are outlined in **Section 5-9** of this document.

References

- Balance Consulting Australia 2009 *Tharbogang Quarry and Landfill Expansion, Volume 1: Part 3A Environmental Assessment Report*. Prepared for Griffith City Council, Griffith
- Barlow, Tim. 1998. *Grassy Guidelines: How to manage native grasslands and grassy woodlands on your property*. Published April 1998 by Trust for Nature (Victoria). Melbourne, VIC.
- J.S. Benson 2009. New South Wales Vegetation Classification and Assessment: Part 2 Plant communities of the NSW South-western Slopes Bioregion and update of NSW Western Plains plant communities, Version 2 of the NSWVCA database. *Cunninghamia* 10(4): 599-673
- Buchanan R.A 2000. *Bush regeneration: recovering Australian landscapes*. 2nd edn, TAFE NSW, Sydney.
- Coffey Geotechnics 2007. *Groundwater Investigation for extension of Tharbogang Landfill*. Draft report GEOTLCOV23247AA-AH, Lane Cove West.
- DECC 2008 NSW Biometric Vegetation Types database, accessed at:
<http://www.environment.nsw.gov.au/projects/biometrictool.htm>
- DEH 2004. *Cost effective feral animal exclusion fencing for areas of high conservation value in Australia*. Commonwealth Department of the Environment and Heritage, Canberra.
- Denny EA and Dickman CR 2010. *Review of Cat Ecology and Management Strategies in Australia*, Invasive Animals Cooperative Research Centre, Canberra.
- Dixon, Bob. 2005. *Control of Sharp Rush, Juncus acutus*. From the proceedings of 'Managing Sharp Rush', a workshop held at Wollaston College Conference Centre, Mt. Claremont by the Western Australia Department of Environment and Conservation. August 2006. Perth, Western Australia.
- Eco Logical Australia (ELA) 2011. *Biodiversity Offset Strategy*. Prepared for CPE Associates P/L, on behalf of Griffith City Council. Eco Logical Australia, Sutherland.
- Ecosurveys 2006. *Draft Targeted Flora and Habitat Feature Survey for the Proposed Extension of Tharbogang Quarry/Landfill (Lot 201)*. Report prepared for Griffith City Council, Griffith, NSW.
- Ecosurveys 2009. *Targeted Diurnal Avifauna Survey of Proposed Tharbogang Quarry/Landfill Extension (Lot 201) for Griffith City Council*. Report prepared for Griffith City Council, Griffith, NSW.
- Eldridge, David. 2002. *Condition and Biodiversity of Vegetation Remnants in the Murrumbidgee Irrigation Area*. Centre for Natural resources, Department of Land and Water Conservation. NSW.
- Ettamogah Research Consultants (ERC) 2002. *Proposed expansion of Tharbogang landfill and quarry*, via Griffith NSW. Species Impact Statement, vol 2 – Appendices. Ettamogah Research Consultants, prepared for Griffith City Council, Griffith, NSW.
- Ettamogah Research Consultants (ERC) 2003. *Species Impact Statement for the proposed expansion of Tharbogang Landfill and Quarry*, vol. 1 – Final Report. Ettamogah Research Consultants, prepared for Griffith City Council, Griffith, NSW

GHD 2007. Report for Flora and Fauna Assessment of Alternative Quarry Sites. Prepared for Griffith City Council, NSW.

Kent, K., Earl, G., Mullins, B., Lunt, I. and Webster, R. 2002. Native vegetation guide for the Riverina – notes for land managers on its management and revegetation. Charles Sturt University, Wagga Wagga.

Long, K and Robley, A. 2004. *Cost Effective Feral Animal Exclusion Fencing for Areas of High Conservation Value in Australia*. Prepared by the Arthur Rylah Institute for Environmental Research, Victoria Department of Sustainability and Environment, Heidelberg, Melbourne for the Department of the Environment and Heritage.

Muyt, A. 2001. *Bush Invaders of South-East Australia*. R.G. & F.J. Richardson. Meredith, Victoria

NSW Department of Primary Industries (NSW DPI) 2011. *Noxious and environmental weed control handbook – A guide to weed control in non-crop, aquatic and bushland situations* 5th Edition. Published October 2011 by the Department of Primary Industries, a part of the Department of Department of Trade and Investment, Regional Infrastructure and Services. Orange, NSW.

NSW National Parks and Wildlife Service (NPWS) 2004. *Guidelines for Ecologically Sustainable Fire Management*. Prepared by the Bushfire Research Unit, Biodiversity Research & Management Division, NPWS Hurstville, NSW.

Pogson, D.J., Etherington, G., Hitchins, B.L. and West, J.L. 1977. *Narrandera 1:250 000 Geological Series Map Sheet SI 55-10*. NSW Department of Mines, Sydney.

Rawlings, Kimberlie; D. Freudenberger; D. Carr. 2010. *A Guide to Managing Box Gum Grassy Woodland*. Published 2010 by Department of the Environment, Water, Heritage and the Arts. Canberra, A.C.T.

Reid, J.R.W. 1999. Threatened and declining birds in the New South Wales Sheep-Wheat Belt: I. Diagnosis, characteristics and management. Consultancy report to NSW National Parks and Wildlife Service. CSIRO Wildlife and Ecology, Canberra. Saunders, G. and McLeod, L. 2007. *Improving management strategies in Australia*. Bureau of Rural Sciences, Canberra.

Saunders, G., Coman, B., Kinnear, J. and Braysher, M. 1995. *Managing Vertebrate Pests: Foxes*. Australian Government Publishing Service, Canberra.

Sutherland Shire Council 2008. *Weed Facts Fact Sheet – Pampas Grass* [http://www.sutherland.nsw.gov.au/ssc/rwpattach.nsf/viewasattachmentPersonal/Weed+Fact+2008+Pampas+Grass.pdf/\\$file/Weed+Fact+2008+Pampas+Grass.pdf](http://www.sutherland.nsw.gov.au/ssc/rwpattach.nsf/viewasattachmentPersonal/Weed+Fact+2008+Pampas+Grass.pdf/$file/Weed+Fact+2008+Pampas+Grass.pdf)

Williams, C.K., Parer, I., Coman, B.J., Burley, J. and Braysher, M.L. 1995. *Managing Vertebrate Pests: Rabbits*. Bureau of Resource Sciences/CSIRO Division of Wildlife and Ecology, Australian Government Publishing Service, Canberra.

Appendix 1: Flora and fauna

EXOTIC FLORA IN GCC LANDS

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	ANNUAL/ PERENNIAL	FAMILY	NOXIOUS	ELDRIDGE 2002	ERC 2003	ECOSURVEYS 2006	ELA 2011
<i>Acetosa</i> sp.	Dock	Vine	Perennial	Polygonaceae					X
<i>Ageratina adenophora</i>	Crofton Weed	Herb	Perennial	Asteraceae			X		
<i>Aira elegantissima</i>	Delicate Hair Grass	Grass	Annual	Poaceae				X	
<i>Aira</i> sp.		Grass	Annual	Poaceae					X
<i>Alternanthera pungens</i>	Khaki Weed	Herb	Perennial	Amaranthaceae	4		X		
<i>Amaranthus</i> sp.		Herb	A & P	Amaranthaceae			X		
<i>Ambrosia artemisiifolia</i>	Annual Ragweed	Herb	Annual	Asteraceae			X		
<i>Anagallis arvensis</i>	Scarlet Pimpernel, Blue Pimpernel	Herb	A & P	Myrsinaceae					X
<i>Anthoxanthum odoratum</i>	Sweet Vernal Grass	Grass	Perennial	Poaceae			X		
<i>Arctotheca calendula</i>	Cape Weed, African Marigold, Cape Dandelion	Herb	Annual	Asteraceae		X		X	BOA

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	ANNUAL/ PERENNIAL	FAMILY	NOXIOUS	ELDRIDGE 2002	ERC 2003	ECOSURVEYS 2006	ELA 2011
<i>Avena fatua</i>	Wild Oats	Grass	Annual	Poaceae			X		
<i>Axonopus fissifolius</i>	Carpet Grass	Grass	Perennial	Poaceae			X		
<i>Bidens pilosa</i>	Cobbler's Pegs	Herb	Perennial	Asteraceae			X		
<i>Brassica juncea</i>	Mustard	Herb	Annual	Brassicaceae			X		
<i>Briza maxima</i>	Quaking Grass	Grass	Annual	Poaceae			X		
<i>Bromus catharticus</i>	Prarie Grass	Grass	A & P	Poaceae			X		
<i>Bromus rubens</i>	Red Brome	Grass	Annual	Poaceae			X	X	X
<i>Carduus nutans</i>	Nodding Thistle	Herb	Biennial	Asteraceae			X		
<i>Carthamus lanatus</i>	Saffron Thistle	Herb	Annual	Asteraceae			X		X
<i>Centaurium tenuiflorum</i>	Branched Centaury	Herb	Annual	Gentianaceae			X		
<i>Chloris gayana</i>	Rhodes Grass	Grass	Perennial	Poaceae		X			
<i>Chloris virgata</i>	Feathertop Rhodes Grass	Grass	A & P	Poaceae			X		
<i>Chondrilla juncea</i>	Skeleton Weed	Herb	Perennial	Asteraceae			X		
<i>Cichorium intybus</i>	Chicory	Herb	Perennial	Asteraceae			X		
<i>Cirsium vulgare</i>	Spear Thistle	Herb	Annual	Asteraceae			X		X
<i>Citrullus lanatus</i>	Watermelon	Vine	Annual	Cucurbitaceae					X

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	ANNUAL/ PERENNIAL	FAMILY	NOXIOUS	ELDRIDGE 2002	ERC 2003	ECOSURVEYS 2006	ELA 2011
<i>Citrullus</i> sp.		Vine	A & P	Cucurbitaceae			X		
<i>Conyza bonariensis</i>	Flaxleaf Fleabane	Herb	Annual	Asteraceae			X		X
<i>Conyza</i> sp.	Fleabane	Herb	Annual	Asteraceae					BOA
<i>Conyza sumatrensis</i>	Tall Fleabane	Herb	Annual	Asteraceae			X		
<i>Cortaderia selloana</i>	Pampas Grass	Grass	Perennial	Poaceae			X		
<i>Crepis capillaris</i>	Smooth Hawksbeard	Herb	A & P	Asteraceae			X		
<i>Cucumis myriocarpus</i>	Paddymelon	Herb	Annual	Cucurbitaceae			X		X
<i>Cynara cardunculus</i>	Cardoon	Herb	Perennial	Asteraceae			X		
<i>Cynodon dactylon</i>	Couch Grass	Grass	Perennial	Poaceae			X		
<i>Cyperus eragrostis</i>		Sedge	Perennial	Cyperaceae			X		
<i>Echinochloa crus-galli</i>	Barnyard Grass	Grass	Annual	Poaceae			X		
<i>Echium plantagineum</i>	Paterson's Curse	Herb	Annual	Boraginaceae		X	X	X	BOA
<i>Echium vulgare</i>	Viper's Bugloss	Herb	Biennial	Boraginaceae			X		
<i>Eragrostis</i>	Stinkgrass	Grass	Annual	Poaceae			X		

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	ANNUAL/ PERENNIAL	FAMILY	NOXIOUS	ELDRIDGE 2002	ERC 2003	ECOSURVEYS 2006	ELA 2011
<i>cilianensis</i>									
<i>Erodium botrys</i>	Long Storksbill	Herb	Annual	Geraniaceae			X		
<i>Erodium cicutarium</i>	Common Storksbill	Herb	Annual	Geraniaceae					X
<i>Erodium</i> sp.	Storks Bill	Herb	Annual	Geraniaceae					BOA
<i>Euphorbia peplus</i>	Petty Spurge	Herb	Annual	Euphorbiaceae			X		
<i>Foeniculum vulgare</i>	Fennel	Herb	A & Biennial	Apiaceae			X		
<i>Gomphrena celosiodes</i>	Gomphrena Weed	Herb	A & P	Amaranthaceae			X		
<i>Heliotropium europaeum</i>	Common Heliotrope	Herb	Annual	Boraginaceae			X		
<i>Hordeum leporinum</i>	Barley-grass	Grass	Annual	Poaceae		X	X	X	X
<i>Hydrocotyle</i> sp.	Pennywort	Herb	Perennial	Apiaceae			X		
<i>Hypericum perforatum</i>	St. John's Wort	Herb	Perennial	Clusiaceae			X		X
<i>Hypochaeris glabra</i>		Herb	Annual	Asteraceae			X		X
<i>Hypochaeris radicata</i>	Catsear, Flatweed	Herb	Perennial	Asteraceae			X		X
<i>Hypochaeris</i> sp.		Herb	Perennial	Asteraceae					BOA
<i>Juncus acutus</i>	Spiny Rush	Sedge	Perennial	Juncaceae			X		

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	ANNUAL/ PERENNIAL	FAMILY	NOXIOUS	ELDRIDGE 2002	ERC 2003	ECOSURVEYS 2006	ELA 2011
<i>Lactuca saligna</i>	Willow Leaf Lettuce	Herb	A & Biennial	Asteraceae			X		
<i>Lactuca serriola</i>	Prickley Lettuce	Herb	Biennial	Asteraceae			X		
<i>Lamarckia aurea</i>	Goldentop	Herb	Annual	Poaceae		X			
<i>Lepidium africanum</i>		Herb	A & P	Brassicaceae		X	X		
<i>Lepidium</i> sp.	Peppercress	Herb	A & P	Brassicaceae				X	BOA
<i>Lolium perenne</i>	Perennial Ryegrass	Grass	Perennial	Poaceae			X		X
<i>Lolium rigidum</i>	Ryegrass	Grass	Annual	Poaceae					BOA
<i>Lolium</i> sp.		Grass	A & P	Poaceae		X			
<i>Lycium ferocissimum</i>	African Boxthorn	Shrub	Perennial	Solanaceae	4		X	X	
<i>Malva parviflora</i>	Small-flowered Mallow	Herb	Annual	Malvaceae		X	X		X
<i>Marrubium vulgare</i>	Horehound	Shrub	Perennial	Lamiaceae	4		X	X	
<i>Medicago lacinata</i>	Cut-leaved Medic	Herb	Annual	Fabaceae					BOA
<i>Medicago minima</i>	Little Medic	Herb	Annual	Fabaceae				X	BOA
<i>Medicago polymorpha</i>	Burr Medic	Herb	Annual	Fabaceae		X			
<i>Medicago</i> sp.	Medic	Herb	A & P	Fabaceae			X		BOA

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	ANNUAL/ PERENNIAL	FAMILY	NOXIOUS	ELDRIDGE 2002	ERC 2003	ECOSURVEYS 2006	ELA 2011
<i>Medicago truncatula</i>	Barrel Medic	Herb	Annual	Fabaceae					X
<i>Mentha pulegium</i>	Pennyroyal	Herb	Perennial	Lamiaceae			X		
<i>Opuntia aurantiaca</i>	Tiger Pear	Succulent	Perennial	Cactaceae	4		X		
<i>Oxalis pes-caprae</i>		Herb	Perennial	Oxalidaceae			X		
<i>Papaver somniferum</i>	Opium Poppy	Herb	Annual	Papaveraceae				X	
<i>Paspalum dilatatum</i>	Paspalum	Grass	Perennial	Poaceae			X		X
<i>Pennisetum clandestinum</i>	Kikuyu	Grass	Perennial	Poaceae			X		
<i>Phalaris aquatica</i>	Phalaris	Grass	Perennial	Poaceae			X		
<i>Plantago lanceolata</i>	Plantain	Herb	A & Biennial	Plantaginaceae			X		
<i>Poa annua</i>	Winter Grass	Grass	Annual	Poaceae			X		
<i>Portulaca oleracea</i>	Pigweed	Herb	A & P	Portulacaceae			X		
<i>Ricinus communis</i>	Castor Oil Plant	Shrub	Perennial	Euphorbiaceae			X		
<i>Rosa rubiginosa</i>	Sweet Briar	Shrub	Perennial	Rosaceae			X		
<i>Rubus fruticosus</i> spp. agg.	Blackberry	Shrub	Perennial	Rosaceae	4 - WONS		X		

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	ANNUAL/ PERENNIAL	FAMILY	NOXIOUS	ELDRIDGE 2002	ERC 2003	ECOSURVEYS 2006	ELA 2011
<i>Salvia verbenaca</i>	Wild Sage, Vervain	Herb	Perennial	Lamiaceae					X
<i>Senecio</i> sp.		Herb	A & P	Asteraceae			X		
<i>Setaria pumila</i>	Pale Pigeon Grass	Grass	Annual	Poaceae			X		
<i>Silybum marianum</i>	Vareigated Thistle	Herb	Biennial	Asteraceae			X		X
<i>Sisymbrium erysimoides</i>	Smooth Mustard	Herb	Annual	Brassicaceae		X		X	
<i>Sisymbrium orientale</i>	Hedge Mustard	Herb	A & Biennial	Brassicaceae				X	
<i>Sisymbrium</i> sp.		Herb	Annual	Brassicaceae					X
<i>Solanum nigrum</i>	Blackberry Nightshade	Herb	Perennial	Solanaceae			X		BOA
<i>Sonchus oleraceus</i>	Common Sowthistle	Herb	Annual	Asteraceae			X	X	BOA
<i>Taraxacum officinale</i>	Dandelion	Herb	Perennial	Asteraceae			X		
<i>Trifolium arvense</i>	Hare's-foot Clover	Herb	Annual	Fabaceae		X			X
<i>Trifolium repens</i>		Herb	Perennial	Fabaceae			X		
<i>Vulpia bromoides</i>	Squirrel Tail Fescue, Silver Grass	Grass	Annual	Poaceae					X
<i>Vulpia myuros</i>	Rat-tail Fescue	Grass	Annual	Poaceae				X	
<i>Vulpia</i> sp.	Silvergrass	Grass	Annual	Poaceae					BOA

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	ANNUAL/ PERENNIAL	FAMILY	NOXIOUS	ELDRIDGE 2002	ERC 2003	ECOSURVEYS 2006	ELA 2011
<i>Xanthium spinosum</i>	Bathurst Burr	Shrub	Perennial	Asteraceae	4		X		X

THREATENED FAUNA

SCIENTIFIC NAME	COMMON NAME	RECORDED ON SITE*	RECORDED IN PROXIMITY TO SITE+	PREDICTED BY BIOBANKING CREDIT CALCULATOR	SUITABLE HABITAT PRESENT^
Amphibia					
<i>Litoria raniformis</i>	Growling Grass Frog	No	Yes (PM Search)	-	-
Aves					
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill#	Yes (ERC 2000, 2003; Ecosurveys 2006, 2009)	-	-	Yes
<i>Anseranas semipalmata</i>	Magpie Goose	No	Yes (Atlas records)	-	-
<i>Aphelocephala leucopsis</i>	Southern White Face#	Yes (Ecosurveys 2006)	-	-	Yes
<i>Ardeotis australis</i>	Australian Bustard	No	Yes (PM Search)	-	-
<i>Artamus cyanopterus</i>	Dusky Woodswallow#	Yes (ERC 2003, Ecosurveys 2009)	-	-	Yes

SCIENTIFIC NAME	COMMON NAME	RECORDED ON SITE*	RECORDED IN PROXIMITY TO SITE+	PREDICTED BY BIOBANKING CREDIT CALCULATOR	SUITABLE HABITAT PRESENT^
<i>Botaurus poiciloptilus</i>	Australasian Bittern	No	Yes (Atlas Record)	-	-
<i>Burhinus grallarius</i>	Bush Stone-curlew	No	Yes (Atlas records)	Yes	-
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	Yes (Ecosurveys 2006)	Yes (Atlas records)	Yes	Yes
<i>Calyptorhynchus lathami</i>	Glossy Black-cockatoo	Adjacent (ERC 2003)	Yes (Atlas records)	-	Yes
<i>Certhionyx variegatus</i>	Pied Honeyeater	No	Yes (Atlas records)	Yes	Yes
<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush	No	Yes (ERC 2003)	-	Yes
<i>Circus assimilis</i>	Spotted Harrier	No	Yes (Atlas records)	-	-
<i>Climacteris affinis</i>	White-browed Treecreeper	No	Yes (ERC 2003)	Yes	Yes
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	Yes (ERC 2003)	Yes (Atlas records)	-	-
<i>Daphoenositta chrysoptera</i>	Varied Sittella	No	Yes (Atlas records)	-	-
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	No	Yes (Atlas records)	-	-
<i>Epthianura albifrons</i>	White-fronted Chat	No	Yes (Atlas records)	-	-
<i>Falco hypoleucos</i>	Grey Falcon	Adjacent (ERC 2003)	Yes (Atlas records)	-	Yes
<i>Grantiella picta</i>	Painted Honeyeater	Adjacent (ERC 2003)	Yes (Atlas records)	Yes	Yes

SCIENTIFIC NAME	COMMON NAME	RECORDED ON SITE*	RECORDED IN PROXIMITY TO SITE+	PREDICTED BY BIOBANKING CREDIT CALCULATOR	SUITABLE HABITAT PRESENT^
<i>Grus rubicundus</i>	Brolga	No	Yes (ERC 2003)	-	-
<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle	No	Yes (PM Search)	-	-
<i>Hieraaetus morphnoides</i>	Little Eagle	Yes (ERC 2000)	Yes (Atlas records)	-	-
<i>Hirundapus caudacutus</i>	White-throated Needletail	Yes (ERC 2003)	Yes (PM Search)	-	-
<i>Hylacola cautus</i>	Shy Heathwren	No	-	Yes	No
<i>Lathamus discolor</i>	Swift Parrot	No	Yes (ERC 2003)	-	Yes
<i>Leipoa ocellata</i>	Malleefowl	No	Yes (PM Search)	Yes	No
<i>Limosa limosa</i>	Black-tailed Godwit	No	Yes (Atlas records)	-	-
<i>Lophoictinia isura</i>	Square-tailed Kite	No	Yes (ERC 2003)	-	Yes
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	No	Yes (Atlas records)	-	Yes
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	No	Yes (ERC 2003)	-	Yes
<i>Merops ornatus</i>	Rainbow Bee-eater	Yes (ERC 2003)	Yes (PM Search)	-	-
<i>Neophema pulchella</i>	Turquoise Parrot	No	Yes (ERC 2003)	Yes	Yes
<i>Ninox connivens</i>	Barking Owl	Adjacent (ERC 2003)	Yes (ERC 2003)	Yes	Yes
<i>Oxyura australis</i>	Blue-billed Duck	No	Yes (Atlas records)	-	-

SCIENTIFIC NAME	COMMON NAME	RECORDED ON SITE*	RECORDED IN PROXIMITY TO SITE+	PREDICTED BY BIOBANKING CREDIT CALCULATOR	SUITABLE HABITAT PRESENT^
<i>Pachycephala inornata</i>	Gilbert's Whistler	No	Yes (ERC 2003)	Yes	Yes
<i>Pachycephala rufiventris</i>	Rufous Whistler#	Yes (Ecosurveys 2006)	-	-	Yes
<i>Pedionomus torquatus</i>	Plains Wanderer	No	Yes (PM Search)	-	-
<i>Petroica goodenovii</i>	Red-capped Robin#	Yes (ERC 2000; 2003; Ecosurveys 2006, 2009, ELA 2011)	-	-	Yes
<i>Petroica phoenicea</i>	Flame Robin	No	Yes (Atlas records)	Yes	-
<i>Polytelis swainsonii</i>	Superb Parrot	Adjacent (ERC 2003)	Yes (PM Search and Atlas Records)	Yes	Yes
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	Yes (ERC 2000, 2003; Ecosurveys 2006, 2009; ELA 2011)	Yes (On site)	Yes	Yes
<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	No	Yes (Atlas records)	Yes	Yes
<i>Rostratula benghalensis</i>	Painted Snipe	No	Yes (PM Search and Atlas Records)	-	-
<i>Stagonopleura guttata</i>	Diamond Firetail	No	Yes (Atlas records)	Yes	Yes
<i>Stictonetta naevosa</i>	Freckled Duck	No	Yes (Atlas records)	-	-
<i>Tyto novaehollandiae</i>	Masked Owl	No	Yes (ERC 2003)	-	Yes

SCIENTIFIC NAME	COMMON NAME	RECORDED ON SITE*	RECORDED IN PROXIMITY TO SITE+	PREDICTED BY BIOBANKING CREDIT CALCULATOR	SUITABLE HABITAT PRESENT^
Mammalia (Chiroptera)					
<i>Chalinolobus picatus</i>	Little Pied Bat	Yes (ERC 2003)	Yes (Atlas records)	-	Yes
<i>Myotis macropus</i>	Southern Myotis	Yes (ERC 2003)	Yes (Atlas records)	-	-
<i>Nyctophilus timoriensis</i>	Greater Long-eared Bat (south eastern form)	No	Yes (PM and Atlas records)	Yes	Yes
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat	No	Yes (ERC 2003)		Yes
<i>Vespadelus baverstocki</i>	Inland Forest Bat	Yes (ERC 2003)	Yes (Atlas records)		Yes
Reptilia					
<i>Tiliqua occipitalis</i>	Western Blue-tongues Lizard	No	Yes (ERC 2003)	-	Yes

* Species was recorded within the GCC lands during surveys including ERC 2000, 2003; Ecosurveys 2006, 2009, ELA 2011. 'Adjacent' indicates the species was found within 5km of the site.

^Where suitable habitat was found the impact area it has been included in this column given the similarity between sites. However where suitable habitat was not found in the impact area or the habitat potential of the BOA for that species has not been assessed a dash (-) indicates that no answer is given.

+ Including NSW Wildlife Atlas records (Atlas Records) within and EPBC Protected Matters Search (PM Search). Note that Fish, Marine, Migratory Marine and Migratory Wetland species have been excluded given the lack of any appropriate habitat onsite. A dash (-) indicates that the species is present on site but no records about proximity exist.

Species not listed as threatened or endangered under State or Commonwealth legislation, but identified as declining woodland bird species in south-western NSW (Reid 1999).

THREATENED FLORA

SCIENTIFIC NAME	COMMON NAME	RECORDED ON SITE*	RECORDED IN PROXIMITY TO SITE+	PREDICTED BY BIOBANKING CREDIT CALCULATOR	SUITABLE HABITAT PRESENT^
<i>Acacia curranii</i>	Curly-bark Wattle	No	Yes (ERC 2003)	-	Yes
<i>Austrostipa metatoris</i>		No	Yes (ERC 2003, PM Record)	-	Yes
<i>Austrostipa wakoolica</i>		No	Yes (ERC 2003)	-	-
<i>Brachyscome papillosa</i>	Mossgiel Daisy	No	Yes (ERC 2003, PM Record)	-	-
<i>Caladenia arenaria</i>	Sand-hill Spider Orchid	No	Yes (ERC 2003)	-	Yes
<i>Diuris tricolor</i> (syn <i>D. sheaffiana</i>)	Painted Diuris	No	Yes (ERC 2003)	-	Yes
<i>Grevillea ilicifolia</i> subsp. <i>ilicifolia</i>	Holly-leaf Grevillea	No	Yes (Atlas Record)	-	-
<i>Lepidium aschersonii</i>	Spiny Peppercress	No	Yes (ERC 2003)	-	Yes
<i>Lomandra patens</i> #	Irongrass	Adjacent (ERC 2003)	Yes (ERC 2003)	-	Yes
<i>Swainsona murrayana</i>	Slender Darling-pea	No	Yes (ERC 2003, PM Record)	-	-
<i>Swainsona sericea</i>	Silky Swainsona-pea	No	Yes (ERC 2003)	-	Yes

Species not listed as threatened or endangered under State or Commonwealth legislation, but is a Rare Or Threatened Australian Plant (ROTAP) species.

Appendix 2: Weed control techniques

Details of specific weed control techniques to be used such as cut and paint, scrape and paint, herbicide spraying and hand weeding are provided in Muyt (2001) and are summarised below. The principles of bush regeneration and techniques to promote natural regeneration will follow the Bradley Method and use other techniques described in Buchanan (2000). Techniques of primary weed control particularly for woody weeds will use techniques that will not encourage flushes of secondary weed growth following primary work. Given the low densities of weeds, hand pulling and spot spraying will enable minimal disturbance. Spot spraying techniques will be as per the *Noxious and Environmental Weed Control Handbook* (NSW DPI 2011). Hand pulling will be undertaken by:

- Selecting the most appropriate tool for the weed being removed (if required);
- Minimise soil disturbance by controlling weeds when the soil is moist;
- Control plants before fruits or other propagules develop;
- Remove excess soil from the root system when there is no risk of spreading vegetative material;
- Cover disturbed soil or gaps with leaf litter and twigs;
- Ensure bulbs, corms, tubers, rhizomes or stolons are carefully dug out; and
- Bag all propagules before removing them off-site (Muyt 2001).

The preferred treatment for significant weeds is outlined in **Section 4.5** and

Table 14. However alternatives are provided below, and the most appropriate method to be used will be determined by the bush regeneration contractor.

WOODY WEEDS

All woody weeds will be controlled by the cut and paint or drill and fill method using a non-specific herbicide, unless otherwise noted below or in **Section 4.5**. All seedlings of woody weeds will be hand pulled or spot-sprayed with a non-specific herbicide.

Lycium ferocissimum (African Boxthorn), a Class 4 noxious weed, has been observed within GCC lands. Seedlings of this species will be controlled by hand pulling, with any mature plants being controlled by the cut and paint or drill and fill methods.

For the cut and paint method, the plant needs to be actively growing with green foliage present. African Boxthorn usually begins actively growing in September and fruiting occurs in autumn and winter. Control will be undertaken during summer months prior to fruiting occurring. The plant needs to be cut horizontally as close to the base as possible and below any branches. A chainsaw, handsaw or secateurs can be used to make the cut, depending on the size of the plant. Remove any dirt from the stump and immediately apply the appropriately mixed herbicide directly to the stump using a dabber bottle or brush. Plants may re-sprout and follow up work maybe required.

The 'drill and fill' method is more suitable for the control of large African Boxthorn. The drill and fill method involves drilling a hole into the base of a tree below any branches with a hand held drill and a 9 or 10mm drill bit at an angle of 40-60°. The hole should only penetrate through the sap wood and not through to the heart wood (**Figure 12**). The hole should then be filled immediately with the appropriately mixed herbicide. An eye dropper or a squeeze bottle with a narrow nozzle can be used to fill the hole. If the plant re-sprouts follow up work will be required.

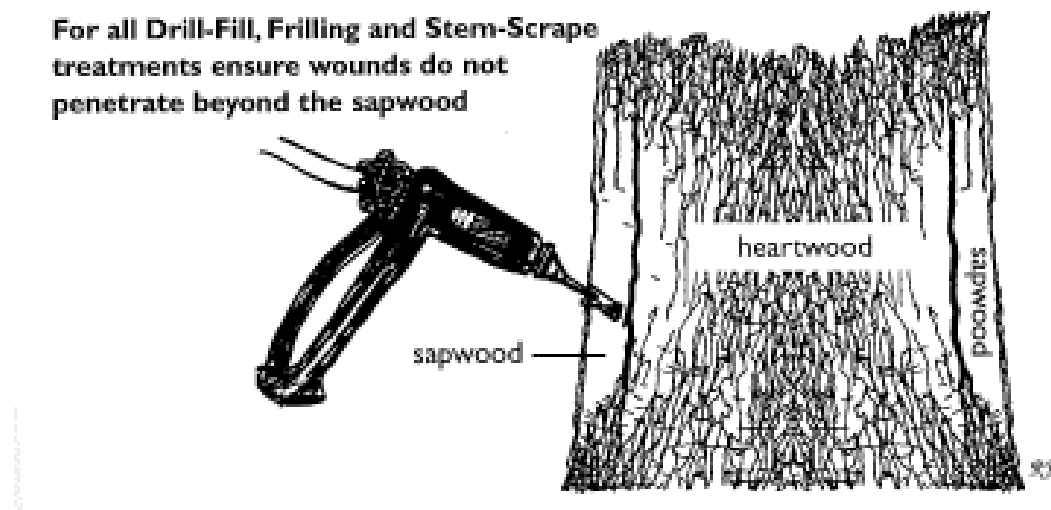


Figure 12: The drill and fill technique (Muyt 2001)

The cut and paint and drill and fill method can be used for any woody weeds, and the cut and paint method can even be used for climbers and large herbaceous weed if required.

CREEPERS/CLIMBERS

The control of creepers depends on the species being controlled. For the most part, seedlings will be hand pulled, while mature plants can be controlled by the stem-scrape method or spot spraying using a non-specific herbicide. The method to be used will be determined by the bush regeneration contractor.

Rubus fruticosus sp. agg. (Blackberry), a class 4 Noxious weed, will be controlled by spot spraying using a dicot specific herbicide (i.e. Grazon®) when it is actively growing, prior to fruits being developed (December). If the plant is in among native species then it should be scraped along the stem and with non-specific herbicide. Alternately, the roots can be hand removed and elevated to dry the plant out. If this technique is used all seeds need to be removed, bagged, and properly disposed of. Seedlings will either be dug out or controlled by spot spraying.

ANNUAL GRASSES

Concentrations of annual grasses such as *Avena fatua* (Wild Oats), *Briza maxima* (Quaking Grass), *Eragrostis ciliaris* (Stinkgrass), *Hordeum leporinum* (Barley-grass) and *Lolium rigidum* (Ryegrass), may be brush cut in late spring to early summer, after flowering, but prior to seed set. Slashing prior to this will promote vigorous growth. However, brush cutting may not be practical in some areas due to dangers such as uneven terrain, hidden holes and debris such as timber and rocks. In these areas, best results may be obtained from spraying with a monocot specific herbicide (e.g. Fusilade®) at the onset of spring when the plant is actively growing and just about to flower. Monitoring of these species will occur and if new growth occurs, the same treatment will be applied to the new growth to prevent seed production. Individual plants should be hand removed, bagged and disposed of appropriately offsite.

Some annual grasses can grow and produce seed at any time of the year dependent on climatic conditions such as high rainfall and warm temperatures. Therefore, monitoring of these species is crucial and plants need to be treated if flowering is observed.

PERENNIAL GRASSES

Perennial grasses, including *Cortaderia selloana* (Pampas Grass), *Phalaris aquatic* (Phalaris), *Chloris gayana* (Rhodes Grass) and *Pennisetum clandestinum* (Kikuyu), will be slashed prior to seed production in spring or summer (depending on the growth cycle of the species) and the regrowth will be spot sprayed 2-3 weeks later when it is actively growing and approximately 10 cm in length.

Pampas Grass, a significant environmental weed, will be dealt with swiftly, as each flower head can produce up to 100,000 seeds and disperse up to 25 km (Sutherland Shire Council 2008). If flowers are present, each flower head will be deseeded and disposed off-site. Plants can be brush-cut or sawed, and undiluted non-specific herbicide applied to the stump.

A grass specific herbicide (e.g. Fusilade®: active ingredient Fluazifop-P) will be used to control all perennial grass weeds across the BOA. Care will be required when spot spraying is being undertaken to prevent native grasses from being killed by the spot spraying process. If weedy grasses are found in the vicinity of native grasses they will be hand pulled to prevent off target damage to native species from occurring.

It is recommended that *Cynodon dactylon* (Couch) should only be managed if it begins to smother native vegetation or dominates large areas. If necessary to control it should be sprayed with a monocot specific herbicide (e.g. Fusilade®) between September and March.

HERBACEOUS WEEDS

Opuntia aurantiaca (Tiger Pear), a class 4 Noxious weed, should be controlled by hand removal. As this plant reproduces vegetatively, all material should be bagged and taken off site. In addition, the use of *Cochineal* and *Cactoblastis* biological control agents suited to the variety of pear is a very effective management practice (NSW DPI 2011).

Xanthium spinosum (Bathurst Burr) should be controlled by slashing the adult plants prior to flowering and hand pulling or spot spraying regrowth with a specific or non-specific herbicide.

Marrubium vulgare (Horehound) should be controlled by spraying with a specific or non-specific herbicide. Small infestations can be hand removed, but great care needs to be taken to ensure that seeds do not stick to clothing or equipment and are transferred to other areas. If particularly dense, infestations can also be cut, stacked and burned.

Where individual plants of other herbaceous weeds, such as *Bidens pilosa* (Cobblers Peg), *Plantago lanceolata* (Plantain), *Senecio* sp. (Fireweed,) and *Conyza* sp. (Fleabane), are found, they will be hand pulled prior to flowering. Where large swaths of these species occur they will be sprayed using a non-specific herbicide. If high densities of mature stands occur, weeds may be slashed first using a brush cutter and any subsequent regrowth sprayed. Regular monitoring of these species will be required to prevent seed production. *Cirsium vulgare* (Spear Thistle) and *Carthamus lanatus* (Saffron Thistle) will not be hand-pulled due to its thorns and instead will be spot sprayed using a non-specific herbicide. All vegetative material that is pulled out and has the potential to regrow if deposited on ground will be bagged and removed from site.

SEDGES

Sedges found on site (e.g. *Cyperus eragrostis*) should be hand removed or spot sprayed with a non-specific herbicide. *Juncus acutus* (Spiny Rush) should be carefully hand removed when small. When large, this species can be sprayed with a non-specific herbicide with a penetrant added (e.g. Pulse®) (Dixon 2005). Spraying should not be undertaken over free water, and conducted in the summer months to ensure maximum dryness.

MANAGEMENT OF WEED WASTE

It is appropriate to leave all woody weed waste in situ, provided that any fruits are bagged, taken off site and disposed of appropriately. When leaving debris in situ it should be 'rafted'; dead wood should be laid on the ground first then stacked with the cut, living material on top. This keeps the live tips off the ground, preventing them from re-sprouting. All other weed waste will be bagged, taken off site and disposed of at a site licensed to receive green waste.

Appendix 3: Example of Biodiversity Offset Area property signage

Tharbogong Landfill Biodiversity Offset Area



All access to be authorised by Property Manager

Appendix 4: Feral animal control techniques

PESTICIDE BAITING

Pesticide Control Orders (PCOs) exist for the use of each of 1080 under Part 4 of the NSW *Pesticides Act 1999* and associated regulations. These PCOs stipulate that only Authorised Control Officers are authorised to implement the use of concentrated 1080 baits, although ready-made baits can be used by landowners/managers. Furthermore, as of 1 September 2005, training in the use of pesticides has been compulsory if pesticides are used in a job or business (including farming).

The following is a broad outline of the process for using each chemical, notwithstanding the requirement for the operator to be trained in the use of these chemicals. Advice should be sought from OEH as to the most effective methods to minimise off-target kills and animal ethics in relation to the disposal of un-used bait and carcasses.

It is highly recommended that any baiting that takes place within the BOA is supported by a strategic off-site baiting program with cooperation from adjacent landowners.

All stock should be removed from the site prior to baiting program (note that no domestic stock are allowed in the BOA before Period 3 (year 7)).

1080 baits (Rabbits)

- Under take baiting in summer or when there is limited green feed on the BOA;
- Select appropriate sites – it is recommended to locate sites near known Rabbit harbour;
- Acquire 1080 baits (mixing of 1080 concentrate must be carried out by an Authorised Control Officer);
- 'Free feed' Rabbits on non-toxic bait prior to baiting commencing;
- Scatter bait in selected locations and repeat dose three to four days apart for the entirety of the baiting treatment period; and
- If possible destroy warrens once a kill of the Rabbit population has been assured. This prevents recolonisation of warrens.

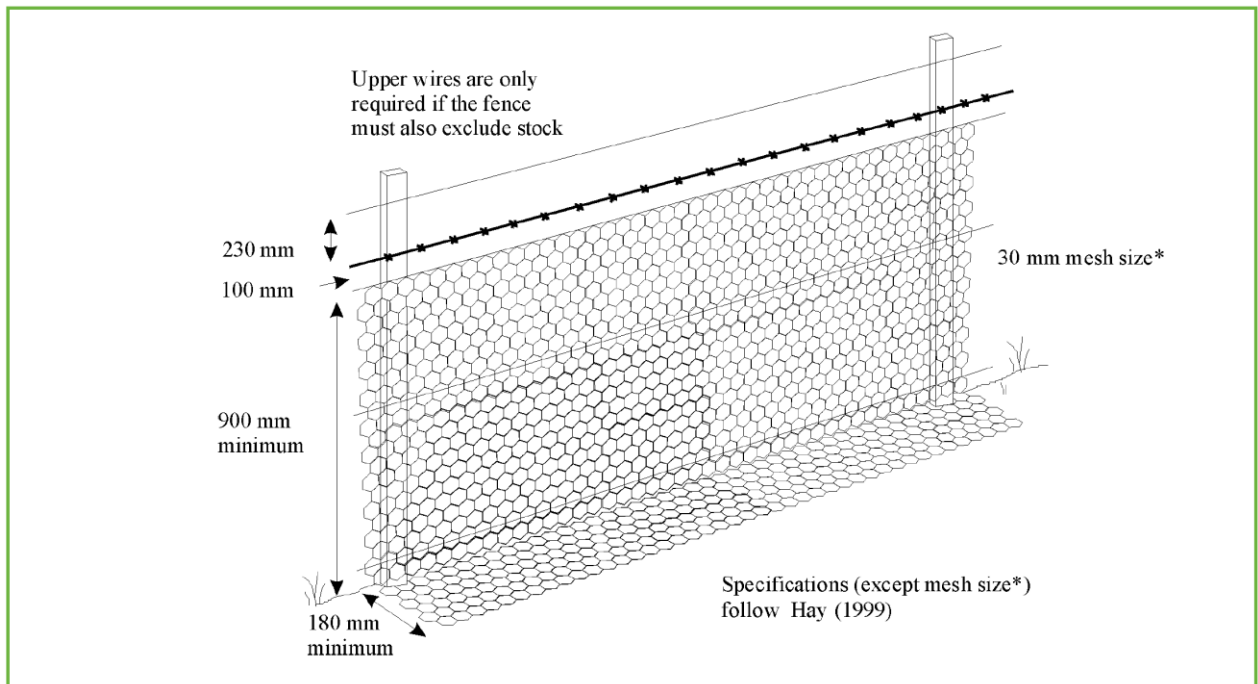
1080 baits (Foxes)

- Seek approval from relevant agencies (e.g. RLPB, Dept Agriculture) for baiting program;
- Notify neighbours;
- Erect signage;
- Acquire 1080 Fox baits;
- Foxes using guidelines developed by DECCW (2008):
 - Bury baits 8-10 cm below the surface.
 - Place baits at least 500 metres apart or 1 per 10 ha (e.g. ~10 baits for the BOA).

- Conduct baiting in autumn (juveniles dispersing) and spring (breeding season) during Periods 1-2
- Conduct baiting in spring (breeding season) during Periods 3-4
- Check baits regularly and replace taken baits during treatment.
- Collect and dispose of unused baits after treatment.

RABBIT FENCE SPECIFICATIONS

Source: *Cost effective feral animal exclusion fencing for areas of high conservation value in Australia* (Department of the Environment and Heritage 2004)



Appendix 5: BOA Quarterly Visual Inspection proforma

Note: This proforma is a working document and modifications to this template should be made as considered appropriate by the land manager to include additional observation or remove tasks.

Who:

Date of Inspection:

INSPECTION ITEM	PHOTO NO.	GPS CO-ORDINATES	COMMENT	ACTION COMPLETED
BIODIVERSITY OFFSET AREA: MZ1				
Evidence of erosion (e.g. sheet, rilling, gullying etc.)				
Stability and function of erosion and sediment control structures				
Presence of undesirable vegetation cover (e.g. weeds)				
Evidence of plant mortality or dieback				
Presence of overstorey species (Y/N)				
Presence of mid-storey species (Y/N)				
Presence of understorey species (Y/N)				

INSPECTION ITEM	PHOTO NO.	GPS CO-ORDINATES	COMMENT	ACTION COMPLETED
Evidence of reproductive potential include presence of buds, flowers, fruits, juveniles and second generations				
Evidence of biological nutrient cycling include the presence of puffballs, toadstalls and bracket fungi				
Evidence of feral animals and pests				
Biodiversity Offset Area: MZ2				
Visual assessment of surface materials (e.g. rocky substrate, topsoil cover, presence of chitter etc.)				
Evidence of erosion (e.g. sheet, rilling, gullyng etc.)				
Stability and function of erosion and sediment control structures				
Presence of undesirable vegetation cover (e.g. weeds)				
Growth rates				
Evidence of plant mortality or dieback				
Species diversity (e.g. evidence of target species present)				
Presence of mid-storey species (Y/N)				
Presence of understorey species (Y/N)				

INSPECTION ITEM	PHOTO NO.	GPS CO-ORDINATES	COMMENT	ACTION COMPLETED
Evidence of reproductive potential include presence of buds, flowers, fruits, juveniles and second generations				
Evidence of biological nutrient cycling include the presence of puffballs, toadstalls and bracket fungi				
Evidence of feral animals and pests				
Biodiversity Offset Area: MZ3				
Evidence of soil profile development (e.g. leaf litter, decomposition, pedality etc.)				
Visual assessment of surface materials (e.g. rocky substrate, topsoil cover, presence of chitter etc.)				
Evidence of erosion (e.g. sheet, rilling, gullying etc.)				
Stability and function of erosion and sediment control structures				
Presence of undesirable vegetation cover (e.g. weeds)				
Growth rates				
Evidence of plant mortality or dieback				
Species diversity (e.g. evidence of target species present)				
Presence of mid-storey species (Y/N)				
Presence of understorey species (Y/N)				

INSPECTION ITEM	PHOTO NO.	GPS CO-ORDINATES	COMMENT	ACTION COMPLETED
Evidence of reproductive potential include presence of buds, flowers, fruits, juveniles and second generations				
Evidence of biological nutrient cycling include the presence of puffballs, toadstalls and bracket fungi				
Evidence of feral animals and pests				

Signed:

Date:

Appendix 6: Annual review protocol

RBOSMP SECTION	CLAUSE	COMPLIANT	EVIDENCE/COMMENT	RECOMMENDATION
4.2	Manage human disturbance Rubbish dumping			
4.3	Fencing and signage Fence maintenance			
4.4	Management of grazing for conservation			
4.5	Weed control MZ1 MZ2 MZ3			
4.6	Bushfire management Prescribed burning regime			
4.7	Retention of regrowth and remnant vegetation			
4.8	Thinning of native vegetation (if required)			

RBOSMP SECTION	CLAUSE	COMPLIANT	EVIDENCE/COMMENT	RECOMMENDATION
4.9	In fill plantings MZ1 MZ2			
4.10	Retention of dead timber			
4.11	Nest boxes			
4.12	Erosion and Sedimentation Control (if required)			
4.13	Retention of rocks			
4.14	Control of feral and overabundant native herbivores Rabbits Goats Kangaroos (under Licence)			
4.15	Vertebrate pest management Foxes Cats			

Appendix 7: Appropriately qualified person letter from DP&I



**Planning &
Infrastructure**

Contact: Haley Rich
Phone: 9228 6516
Fax: 9228 6466
Email: haley.rich@planning.nsw.gov.au

Mr John Roser
Griffith City Council
PO Box 485
GRIFFITH NSW 2680

Dear Mr Roser

**Tharbogang Quarry and Landfill (06_0334)
Condition 48(a) of Schedule 3**

I refer to your letter of 9 August 2011. I wish to advise you that I approve the appointment of Ecological Australia, in particular Bruce Mullins, Robert Humphries Lucas McKinnon and Andrew Whitford, to prepare the Biodiversity Offset Strategy and the Landscape and Biodiversity Offset Plan, in accordance with Condition 48(a) of Schedule 3 of the project approval 06_0334.

If you have any enquiries about this, please contact Haley Rich on the above details.

Yours sincerely

David Kitto 18/8/11

David Kitto
Director
Mining & Industry Projects

As delegate of the Director-General

Bridge St Office 23-33 Bridge St SYDNEY NSW 2000 GPO Box 39 SYDNEY NSW 2001
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Appendix 9 – Cost to implement spreadsheet

Total Fund Deposit worksheet (Part A costs)

This template should be used for estimating the Total Fund Deposit and preparation of the payment schedule

Site location	Tharbagang landfill and quarry
Site owner	Giffith City Council
Are you registered for GST/do you have an ABN?	Yes
ABN	

Add row for management action cost

Add row for other recurring cost

Real cost discount
5.00%

Management action costs	Timing			Estimated annual cost (\$)	Year																				Present value of payments for first 10 yrs	Present value of payments after 10 yrs	Present value of all payments				
	Start year	End year	Frequency		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20							
4.3 FENCING AND SIGNAGE					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Erect stock proof fencing - Period 1 - 0.86km @ \$130/m	1	1		11,180	11,180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11,180	0	11,180		
Install Gates - Period 1 - Four gates @ \$214/yr	1	1		8,000	8,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8,000	0	8,000		
Install Signage - Period 1 - Seven gates	1	1		2,000	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	0	2,000		
Maintain stock proof fencing - Period 1/2/3/4 - 4.77km @ 1/20th replacement costs	1			3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	40,564	24,536	45,100		
Maintain gates - Period 1/2/3/4 - 9 @ 1/20th replacement costs	1			900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	11,777	7,123	18,900		
4.4 MANAGEMENT OF GRAZING FOR CONSERVATION					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Erect and maintain stock proof fencing and gates (see 4.3 above)					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Manage 'pulse' grazing - Period 3/4 - MZ1 - 1.41ha @ ~\$11/ha	7		2	1,410	0	0	0	0	0	0	1,410	0	1,410	0	1,410	0	1,410	0	1,410	0	1,410	0	1,410	0	1,410	0	5,601	5,716	11,317		
Manage 'pulse' grazing - Period 3/4 - MZ2 - 60.68ha @ ~\$100/ha	7		2	6,068	0	0	0	0	0	0	6,068	0	6,068	0	6,068	0	6,068	0	6,068	0	6,068	0	6,068	0	6,068	0	24,105	24,599	48,704		
4.5 WEED CONTROL					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Management Period 1 - Primary Works - All Zones - 95.31ha - 6 days @ \$1,680 per day	1		3	10,080	10,080	10,080	10,080	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28,823	0	28,823		
Management Period 1 - Secondary Works - All Zones - 95.31ha - 4 days @ \$1,680 per day	1		3	6,720	6,720	6,720	6,720	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19,215	0	19,215		
Management Period 2 - Secondary Works - All Zones - 95.31ha - 4 days @ \$1,680 per day	4		6	6,720	0	0	6,720	0	6,720	6,720	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16,599	0	16,599		
Management Period 3 - Maintenance Works - All Zones - 95.31ha - 3 days @ \$1,680 per day	7		9	5,040	0	0	0	0	0	0	5,040	5,040	5,040	0	0	0	0	0	0	0	0	0	0	0	0	0	10,754	0	10,754		
Management Period 4 - Maintenance Works - All Zones - 95.31ha - 3 days @ \$1,680 per day	10			5,040	0	0	0	0	0	0	0	0	0	5,040	5,040	5,040	5,040	5,040	5,040	5,040	5,040	5,040	5,040	5,040	5,040	0	28,335	29,890	68,225		
4.6 BUSHFIRE MANAGEMENT					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Preparation for controlled Burns - Period 3 - All Zones - 95.31ha	7		4	1,000	0	0	0	0	0	0	1,000	0	0	1,000	0	0	1,000	0	0	1,000	0	0	1,000	0	0	0	2,281	1,328	4,209		
Controlled Burns - Period 3/4 - All Zones - 95.31ha (Donation to RFS)	7		4	10,000	0	0	0	0	0	0	10,000	0	0	10,000	0	0	10,000	0	0	10,000	0	0	10,000	0	0	0	22,807	19,281	42,088		
4.8 THINNING OF NATIVE VEGETATION					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Thinning of <i>Gillies glaucophylla</i> - Period 4 - All Zones - 95.31ha	10		3	5,040	0	0	0	0	0	0	0	0	0	5,040	0	0	5,040	0	0	5,040	0	0	5,040	0	0	0	10,574	13,286	23,860		
4.9 INFILL PLANTING					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Seed Collection - Period 1/2/3 - All Zones (and GCC lands) 6 days @ \$1,680 per day	1		9	10,080	10,080	10,080	10,080	10,080	10,080	10,080	10,080	10,080	10,080	10,080	0	0	0	0	0	0	0	0	0	0	0	0	0	75,229	0	75,229	
Direct Seeding - Period 1/2/3 - MZ1 - 1.41ha @ \$210/ha = \$2,954	1		9	313	313	313	313	313	313	313	313	313	313	313	0	0	0	0	0	0	0	0	0	0	0	0	0	2,336	0	2,336	
Direct Seeding - Period 1/2/3 - MZ2 - 60.68ha @ \$10/ha = \$6,068	1		9	6,742	6,742	6,742	6,742	6,742	6,742	6,742	6,742	6,742	6,742	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50,317	0	50,317	
Revegetation - Period 4 - MZ1 - 1.41ha @ ~\$2.81/ha = \$4,000	10		11	2,000	0	0	0	0	0	0	0	0	0	2,000	2,000	0	0	0	0	0	0	0	0	0	0	0	0	2,517	0	2,517	
Revegetation - Period 4 - MZ2 - 60.68ha @ ~\$440/ha = \$26,692	10		11	14,000	0	0	0	0	0	0	0	0	0	14,000	14,000	0	0	0	0	0	0	0	0	0	0	0	0	17,619	0	17,619	
4.11 NEST BOXES					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Installation of nest boxes - Period 4 - MZ1 - 1.41ha @ ~\$460 (avg. 3 nest boxes per ha)	10		11	846	0	0	0	0	0	0	0	0	0	846	846	0	0	0	0	0	0	0	0	0	0	0	0	1,065	0	1,065	
4.14 CONTROL OF FERAL AND OVERABUNDANT NATIVE HERBIVORES					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Initial Rabbit Control - Period 1 - All Zones	1		3	5,000	5,000	5,000	5,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14,297	0	14,297	
Ongoing Rabbit Control - Period 2/3/4 - All Zones	3			2,500	0	0	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	0	27,932	19,787	47,619	
Feral Goat Control - Period 1/2/3/4 - All Zones - 95.31ha	1			1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	0	13,085	7,915	21,000	
4.15 VERTEBRATE PEST MANAGEMENT					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1080 baiting for Fox control - Period 1/2 - All Zones - 95.31ha - \$3k per session @ 2x per year	1		6	6,000	6,000	6,000	6,000	6,000	6,000	6,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31,977	0	31,977
1080 baiting for Fox control - Period 3/4 - All Zones - 95.31ha - \$3k per session @ 1x per year	7			3,000	0	0	0	0	0	0	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	0	23,268	23,744	47,012	
Opportunistic Shooting for Foxes and Cats - Period 1/2/3/4 - All Zones - 95.31ha	1			1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	0	13,085	7,915	21,000	
Cat control program - Period 4 - All Zones - 95.31ha	10			5,000	0	0	0	0	0	0	0	0	0	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	0	28,111	39,573	67,684	
7 FLORA AND FAUNA MONITORING PROGRAM					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Establish Annual Monitoring Program - Period 1	1		1	5,000	5,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,000	0	5,000	
Undertake Annual Monitoring Program - Period 1/2/3/4	1			25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	0	327,133	197,867	525,000	
8 ANNUAL BOA AND REHABILITATION REPORT					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Preparation of Quarterly and Annual Monitoring Reports - Period 1/2/3/4	1			6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	0	78,512	47,488	126,000	
Periodic review of RBOSMP - Period 3/4	7		6	3,000	0	0																									

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