



**BIODIVERSITY OFFSET MANAGEMENT
& HABITAT REHABILITATION PLAN**

**GRANTS ROAD
SAND QUARRY EXTENSION**

**NOVEMBER 2019
REF: 9045 V2**

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& HABITAT REHABILITATION PLAN**

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SAND QUARRY EXTENSION**

NOVEMBER 2019

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PREFACE

This Biodiversity Offset Management & Habitat Rehabilitation Plan has been prepared by *Conacher Consulting* to identify matters in relation to the management of the biodiversity offset areas for the Grants Road Sand Quarry Extension.

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TABLE OF CONTENTS

SECTION 1 INTRODUCTION AND BACKGROUND

1.1	INTRODUCTION.....	1
1.2	BIODIVERSITY OFFSET AREA MANAGEMENT RATIONALE.....	1
1.3	BIODIVERSITY OFFSET AREA LOCATIONS & CHARACTERISTICS.....	1
1.4	MANAGEMENT REQUIREMENTS & RESPONSIBILITIES.....	4

SECTION 2 HABITAT & REHABILITATION MANAGEMENT STRATEGIES

2.1	SOIL MANAGEMENT.....	5
2.2	WEED MANAGEMENT.....	8
2.3	REVEGETATION.....	11
2.4	ACCESS CONTROL.....	15
2.5	HABITAT ENHANCEMENTS.....	15
2.6	ABORIGINAL CULTURAL HERITAGE MANAGEMENT.....	15
2.7	BUSHFIRE MANAGEMENT.....	15

SECTION 3 IMPLEMENTATION DETAILS

3.1	MANAGEMENT OBJECTIVES AND TIMREFRAMES.....	19
3.2	PROJECT TASKS & RESPONSIBILITIES.....	19
3.3	RISKS & CONTINGENCIES.....	21
3.4	MONITORING REQUIREMENTS.....	23
3.5	REPORTING.....	24

REFERENCES

REFERENCES.....	25
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APPENDIX 1 REVEGETATION & WEED MANAGEMENT GUIDELINES

APPENDIX 2 ANNUAL MONITORING COMPLIANCE TABLE

SECTION 1

INTRODUCTION & BACKGROUND

1.1 INTRODUCTION

This Biodiversity Offset Management & Habitat Rehabilitation Plan (BOMHRP) has been prepared to address Conditions 23, 24 and 27 of Schedule 3 and Commitment 9 of the Statement of Commitments for the Grant Road Sand Quarry Extension (Mod 1), Project Approval No. 08_0099. This Plan should be read in conjunction with the Landscape and Rehabilitation Management Plan prepared for the site by *Conacher Consulting* (2019).

This Plan applies to the Biodiversity Offset Areas as amended under Modification No.1 of the project approval and identified in Figure 1.1, within Lots 1 and 2 DP 358717, Grants Road Somersby.

1.2 BIODIVERSITY OFFSET AREA MANAGEMENT RATIONAL

The Biodiversity Offset Strategy will be implemented for the life of the quarry through the actions, measures and requirements identified within this Biodiversity Offset Management and Habitat Rehabilitation Plan.

The Biodiversity Offset Area works program is to be implemented for the first 10 years of Stage 2 and is directly linked to the operational (extensions) stages of the quarry works area. The expansion of the quarry area will provide physical habitat resources (e.g. tree hollows, rocks, topsoil, overburden capping, rubble etc.) which will be used for habitat enhancement and as a planting substrate for offset areas A and B. Additionally, funding for implementing this BOMHRP will become available through quarry product sales. Ongoing maintenance actions relating to weed control in accordance with the requirements of the *Biosecurity Act* (2015) and feral animal control and maintenance of exclusion fencing is to continue for the life of the quarry.

The quarry approval has been granted to 2044 and the works undertaken within the biodiversity offset areas during the life of the quarry will be provided with ongoing maintenance funding and resources until the planned closure of the quarry in 2044.

The revegetation and habitat enhancement works required for the Biodiversity Offset Areas are independent of the rehabilitation of the worked quarry areas. Drainage from the quarry area will pass through the drainage lines of Biodiversity Offset Area B after passing through the site water management structures. In this regard the runoff water flow is integrated between the quarry areas and Biodiversity Offset Areas.

The inspections, monitoring and reporting of the tasks required in this BOMHRP will be undertaken by a qualified and experienced Project Ecologist or Site Rehabilitation Environmental Consultant in association with the landowner. *Conacher Consulting Pty Ltd* has been engaged to supervise these works and undertake the required monitoring.

1.3 BIODIVERSITY OFFSET AREA LOCATIONS & CHARACTERISTICS

The locations and areas of the approved Biodiversity Offset Areas are shown in Figure 1.1.

1.3.1 Biodiversity Offset Area A

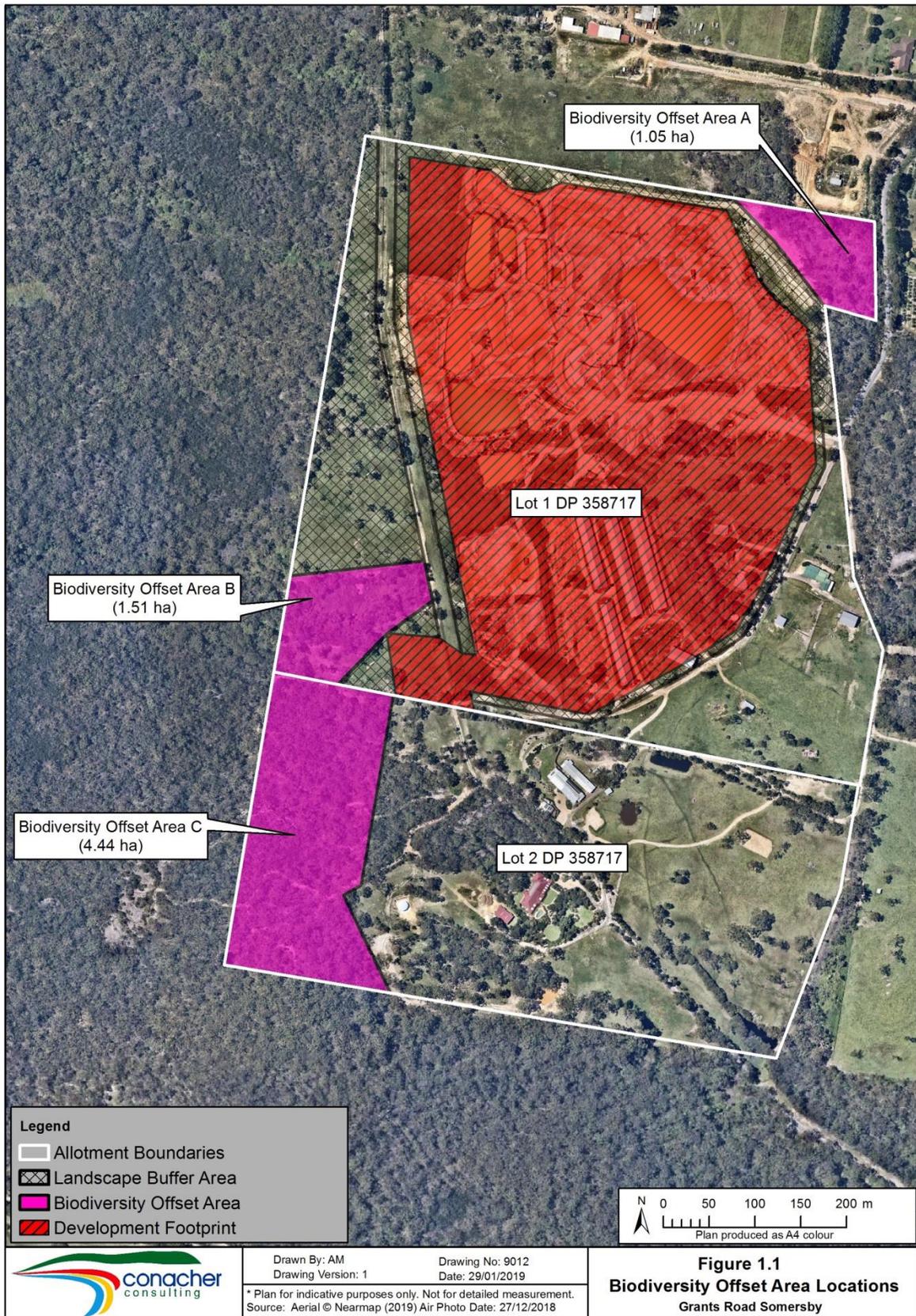
This area is 1.05 hectares in size and is located in the north-eastern section of the quarry allotment (Lot 1). This area contains Scribbly Gum Woodland vegetation with a disturbed understorey which has been subject to pasture improvement works and cattle grazing.

1.3.2 Biodiversity Offset Area B

This area is 1.51 hectares in size and is located in the south-western section of the quarry allotment (Lot 1). This area contains Scribbly Gum Woodland vegetation, with parts in good condition, and patches in disturbed condition containing high levels of exotic vegetation.

1.3.3 Biodiversity Offset Area C

This area is 4.44 ha in size and occurs in the western section of the allotment to the south of the quarry site (Lot 2). This area contains Red Bloodwood – Scribbly Gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion.



1.4 MANAGEMENT REQUIREMENTS & RESPONSIBILITIES

The management requirements for the Biodiversity Offset Areas have been separated into the following tasks:

- Soil Management
- Weed Management
- Revegetation
- Access Control
- Habitat Enhancement
- Bushfire Management
- Aboriginal Cultural Heritage Management
- Monitoring, Evaluation & Reporting

Details for the implementation for each of these tasks are provided in Section 2 of this Plan.

SECTION 2

HABITAT & REHABILITATION MANAGEMENT STRATEGIES

2.1 SOIL MANAGEMENT

2.1.1 *Soil Management Works*

Parts of Offset Areas A and B have been subject to the historical application of fertilisers, clearing, weed infestation, erosion, pasture improvement works and grazing. These areas will require soil treatment and/or stabilisation to provide a substrate which is suitable for replanting of native species.

Hand bush regeneration techniques are not likely to achieve satisfactory results within these areas and machine assisted remediation works will be required to provide a suitable substrate for native plantings. These works are to be undertaken in accordance with recognised methods as documented by Buchanan (1989; 2009). Soil treatment and stabilisation works are to consist of the following on an as-needs basis:

- Removal or flipping of topsoil containing elevated nutrient levels;
- Ripping of compacted topsoil in targeted planting areas;
- Capping of topsoil with quarry overburden over soils with elevated nutrient levels and high levels of weed propagules; and
- Reshaping and stabilisation of eroded areas to provide a suitable planting substrate.

Top soil capping should aim for a depth of 10-40cm of low fertility, acidic, sandy soil (not clayey) mixed with rock rubble to enable spaces for drainage. The soils should not be compacted, however may be covered with an approximately 50-100mm layer of weed-free eucalypt mulch to assist in water retention.

Suitable temporary fencing or delineation of areas to be retained and appropriate supervision will need to be provided by the Project Ecologist to ensure that no mature trees are removed and that soil capping does not impact the trunks of mature trees or intact vegetation.

A plan of the areas which will require soil remediation and stabilisation works is provided in Figure 2.1. An additional fine scale works plan of the areas subject to soil management works is to be prepared and implemented for soil management works.

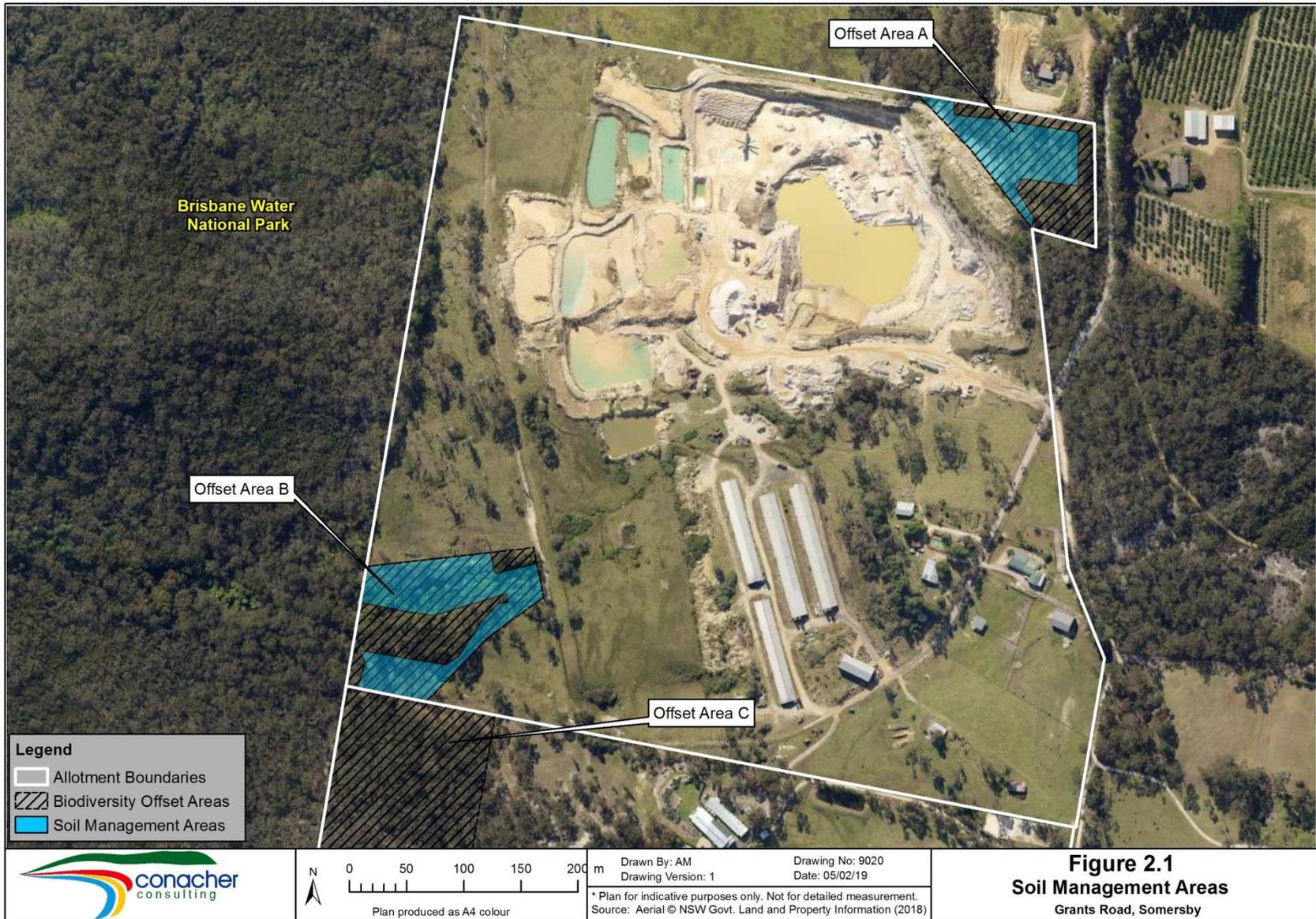
2.1.2 *Erosion & Sediment Control*

Prior to the commencement of soil management works within the Biodiversity Offset Areas, suitable erosion and sediment control measures are to be implemented. The objective of erosion and sediment controls is to avoid soil loss and adverse impacts to existing native vegetation where soil disturbance occurs as part of the weed management, revegetation or soil management.

Drainage from the quarry area will pass through the drainage lines of Biodiversity Offset Area B after passing through the site water management structures. In this regards the runoff water flow is integrated between the quarry rehabilitation area and Biodiversity Offset Area. Erosion

and sedimentation controls are to be integrated with the quarry works area to ensure no adverse impacts on the Biodiversity Offset Areas.

Stabilisation and remediation works within the drainage line which intersects Biodiversity Offset Area B will be required to rehabilitate and manage this area and allow for weed management and revegetation works to commence.



2.2 WEED MANAGEMENT

2.2.1 Weeds and Weed Sources

Weed control is to be undertaken following the completion of soil remediation and stabilisation works. The methods for initial (primary) and follow-up (secondary) weed control works are outlined as follows.

The dominate weeds present within the site and their control strategies are provided in Table 2.1. Several of the weed species listed are naturalized within the locality and occur in abundance throughout both public and private lands. Weed sources are likely to include animal, water and wind dispersed seed and landscape plantings, for this reason weed control rather than eradication has been recommended for selected species.

TABLE 2.1 TARGET WEED SPECIES FOR MANAGEMENT		
Common Name	Scientific Name	10 Year Performance Targets
Crofton Weed	<i>Ageratina adenophora</i>	Control*
Moth Vine	<i>Araujia sericifera</i>	Control*
Spear Thistle	<i>Cirsium vulgare</i>	Control*
Pampas Grass	<i>Cortaderia sp.</i>	Eradication
Lantana	<i>Lantana camara</i>	Control*
Fishbone Fern	<i>Nephrolepis cordata</i>	Eradication
Prickly Pear	<i>Opuntia sp</i>	Eradication
Fireweed	<i>Senecio madagascarensis</i>	Control*
Wild Tobacco	<i>Solanum mauritianum</i> *	Eradication
Arum Lilly	<i>Zantedeschia aethiopica</i>	Eradication
Exotic Grasses	<i>Various species.</i>	Control*
<p>Biodiversity Offset Areas A and B Control identified weeds to achieve a combined cover ratio of no greater than 50% weed cover to 50% native vegetation cover.</p> <p>Biodiversity Offset Area C Control identified weeds to achieve a combined cover ratio of no greater than 10% weed cover to 90% native vegetation cover.</p> <p>All weed management works are required to comply with the requirements of the Biosecurity Act 2015.</p>		

2.2.2 Primary Weed Control

Primary weed control works are to be undertaken progressively in tandem with revegetation works to limit areas of exposed soils and to enable an adaptive approach to be implemented if necessary.

The areas of high and high to moderate weed cover mapped in Figure 2.2 will require the application of the following weed management techniques:

- Machine removal or weeds and burial on site
- Targeted herbicide spraying

- Hand removal of weeds where machinery use has potential to adversely impact mature trees

A small digger or bobcat may be required for work around native vegetation and machinery selection and use will need to be targeted to ensure that impacts to mature trees do not occur.

The areas of low weed coverage mapped in Figure 2.2 will generally not require weed management. Where monitoring identifies that weeds are present which required management a more sensitive approach is to be applied to ensure the protection of existing native vegetation. Suitable techniques include progressive hand removal of weeds and targeted spot herbicide spraying of weeds.

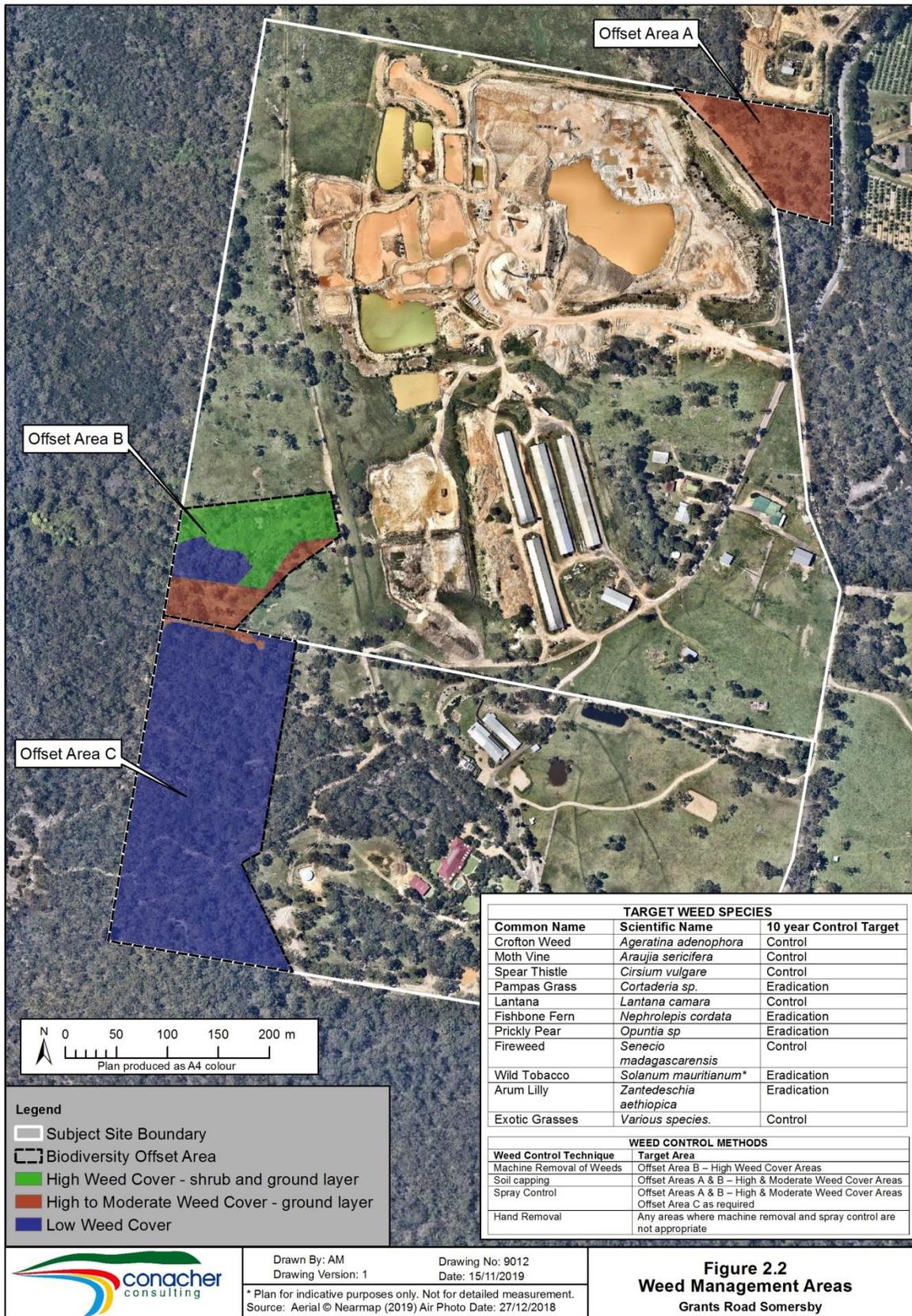
A detailed description of weed management techniques is provided in Appendix 1 of this Plan and suitable chemical control measures are outlined by the NSW Department of Primary Industries (2014).

2.2.3 Secondary Weed Control

Secondary and maintenance weed management will assist the regeneration and re-establishment of native vegetation in Biodiversity Offset Areas A & B. It will also mitigate weed invasion in Biodiversity Offset Area C.

Secondary follow-up weed control works under this plan are to be undertaken for the life of the quarry. All secondary weed control works are to comply with the requirements of the *Biosecurity Act 2015*.

The extent of weed control works and techniques required will depend on the extent of weed regrowth following primary weed control. The techniques utilised should not have an unacceptable impact on the regeneration of native flora species.



2.3 REVEGETATION

2.3.1 Revegetation Areas and Rationale

Revegetation will be required in the Biodiversity Offset Areas A & B where intensive weed management and soil remediation works are undertaken, these locations are shown in Figure 2.3. The revegetation process should be similar to natural vegetation succession with grasses and groundcovers established prior to taller trees and shrubs (Buchanan 1989). Areas of low-medium weed coverage will not require revegetation, as an adequate cover of native vegetation is present and regeneration from the natural seed bank is to be prioritised for any gaps created by the removal of exotic flora.

2.3.2 Soil Conditioning

Slow-release native fertiliser is to be incorporated into the base of the planting hole, which may be supplemented with organic compost. Weed-free eucalypt mulch is to be spread around plantings to assist with water retention.

2.3.3 Plant Selection

Flora species suitable for revegetation works are identified in Table 2.2. Planting densities have been provided for replanting in cleared areas, however should be determined on an area specific basis if revegetation is to occur where existing components of the native vegetation cover is present. Further detailed methodologies for undertaking revegetation works provided in Appendix 1.

Areas of exposed soils are to be initially revegetated with tube stock plantings of ground cover species (4 plants / m²) and a native grass mix applied at a ratio of 10kg/ha.

The tree and shrub species selection provided includes species that are currently naturally regenerating on the site and plants which are commonly recognised as hardy species, as these species are likely to provide the best results for the site conditions.

TABLE 2.2 NATIVE SPECIES FOR REVEGETATION PLANTINGS		
Scientific Name	Common Name	Planting Densities for Heavily Disturbed and Cleared Areas
Trees		1 planting per 10m ²
<i>Angophora costata</i>	Smooth-barked Apple	
<i>Corymbia gummifera</i>	Red Bloodwood	
<i>Eucalyptus haemastoma</i>	Scribbly Gum	
<i>Eucalyptus piperita</i>	Sydney Peppermint	
<i>Eucalyptus sieberi</i>	Silvertop Ash	
Shrubs		1 planting per 5m ²
<i>Acacia linifolia</i>	White Wattle	
<i>Acacia myrtifolia</i>	Myrtle Wattle	
<i>Acacia suaveolens</i>	Sweet Wattle	
<i>Acacia oxycedrus</i>	Spike Wattle	
<i>Angophora hispida</i>	Dwarf Apple	

**TABLE 2.2
NATIVE SPECIES FOR REVEGETATION PLANTINGS**

Scientific Name	Common Name	Planting Densities for Heavily Disturbed and Cleared Areas
<i>Banksia ericifolia</i>	Heath-leaved Banksia	
<i>Banksia oblongifolia</i>	Fern-leaved Banksia	
<i>Banksia robur</i>	Swamp Banksia	
<i>Banksia serrata</i>	Old-man Banksia	
<i>Lambertia formosa</i>	Mountain Devil	
<i>Leptospermum polygalifolium</i>	Tantoon	
<i>Leptospermum trinervium</i>	Flaky-barked Tea-tree	
Ground Covers		1 planting per m ²
<i>Doryanthes excelsa</i>	Gynea Lilly	
<i>Entolasia marginata</i>	Bordered Panic	
<i>Gahnia clarkei</i>	Tall Saw-sedge	
<i>Gahnia sieberiana</i>	Red-fruited Saw-sedge	
<i>Lepidosperma laterale</i>		
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	
Grasses		10kg/ha
<i>Entolasia marginata</i>	Bordered Panic	
<i>Microlaena stipoides</i>	Weeping Grass	
<i>Rytidosperma spp.</i>	Wallaby Grass	
<i>Themeda triandra</i>	Kangaroo Grass	
Note: Species listed above can be supplemented with other locally occurring native species		

2.3.4 Plant Sources and Propagation

Plantings are to be sourced from one of the following methods:

- i. A plant supplier which supplies native species, cultivated using seed or cuttings sourced from within the Catchment Management Area or adjoining Catchment Management Areas;
- ii. Plants propagated from cuttings or seed sourced from within the site;
- iii. Plants propagated from cuttings or seed sourced within a nearby area of similar native vegetation.

A qualified and experienced bushland regenerator is to be engaged for any native plant propagation works. Seed collection and propagation is to be undertaken generally in accordance with the Office of Environment and Heritage (2011b) Conservation Management Notes on Seed Collecting. Appropriate permissions for any collections undertaken and appropriate licensing under the *Biodiversity Conservation Act* (2016) will need to be obtained for any seed collected from offsite areas, this will be the responsibility of the bushland regenerator engaged to undertake the works.

2.3.5 Pest and Pathogen Management

Monitoring of new plantings is to be undertaken to ensure that pest insect attacks and pathogens are detected early and appropriate control measures can be implemented to prevent the widespread loss of plantings.

2.3.6 Mulching

Mulching of exposed soils and around plantings is permissible provided any mulch used is free from weeds and harmful pathogens. Mulch can be applied to a maximum depth of 100mm and should not be used as a planting substrate.

2.3.7 Plant Protection

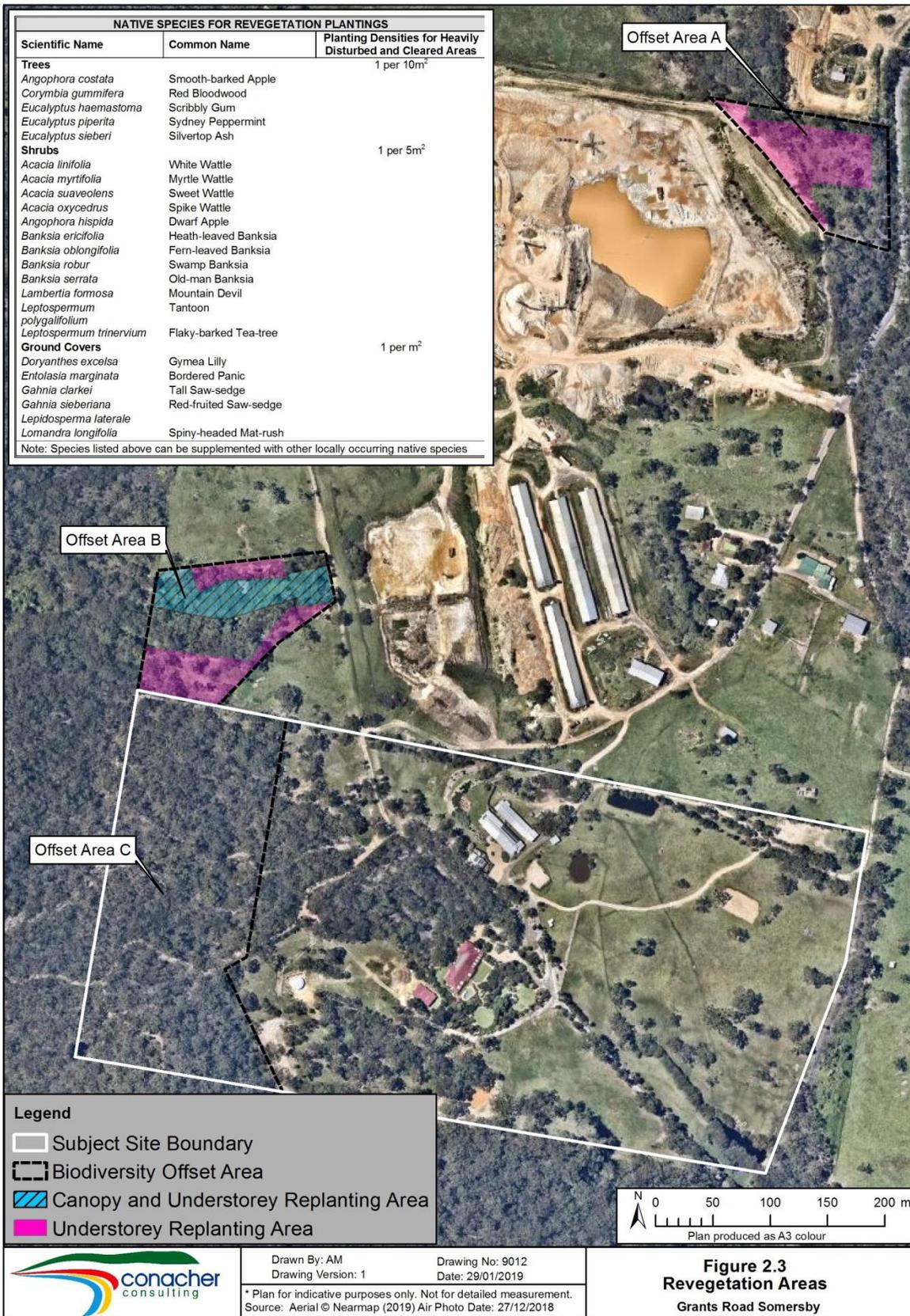
Plant stakes and guards may need to be provided for any new plantings depending on the site conditions and locations of the plantings.

2.3.8 Watering

Watering of new plantings is to be undertaken during initial planting. Additional watering is also to be undertaken during periods of prolonged dry and/or hot weather for the first three months establishment period. Ongoing watering will be subject to local rainfall and soil moisture conditions.

2.3.9 Performance Target

A performance target of 80% survival is to be achieved for plantings over the management period.



2.4 ACCESS CONTROL

Feral deer and livestock grazing is a potential threat to the ongoing successful long term revegetation and the maintenance of native vegetation within the Biodiversity Offset Areas. Fencing is to be maintained to prevent feral deer and livestock from entering the biodiversity offset areas from the quarry site and annual monitoring inspections are to be undertaken to ensure that fence condition is maintained. The locations of the fences which are to be maintained as part of the access control strategy are shown in Figure 2.4.

2.5 HABITAT ENHANCEMENTS

Fauna nest boxes are already installed within the site and will require maintenance over the period of this plan.

The locations of the initial 36 nest boxes (including two replacement boxes required) are shown in Figure 2.5.

In addition, the project conditions require the retention of 170 hollow bearing trees within the biodiversity offset areas, with any shortfall to be made up of salvaged hollows (1:1 ratio) or nest boxes (2:1 ratio). Recent surveys identified the presence of 139 hollow-bearing trees within the Biodiversity Offset Areas (78 for Areas A & B and 61 for Area C). The shortfall of 31 hollow-bearing trees will need to be addressed through the installation of salvaged logs and/or nest boxes. All additional salvaged logs and nest boxes required will be installed progressively and proportionately to hollow bearing tree removal with installation to occur within 2 months of hollow bearing tree removal. This is to allow enough time for the salvaged logs to be modified for installation.

Additional habitat enhancement measures are to be implemented as habitat resource material becomes available. Any useful materials such as tree hollows, rocks, mulch, topsoil, capping rubble from areas of quarry expansion will be relocated to the Biodiversity Offset Areas A and B for revegetation or habitat enhancement purposes.

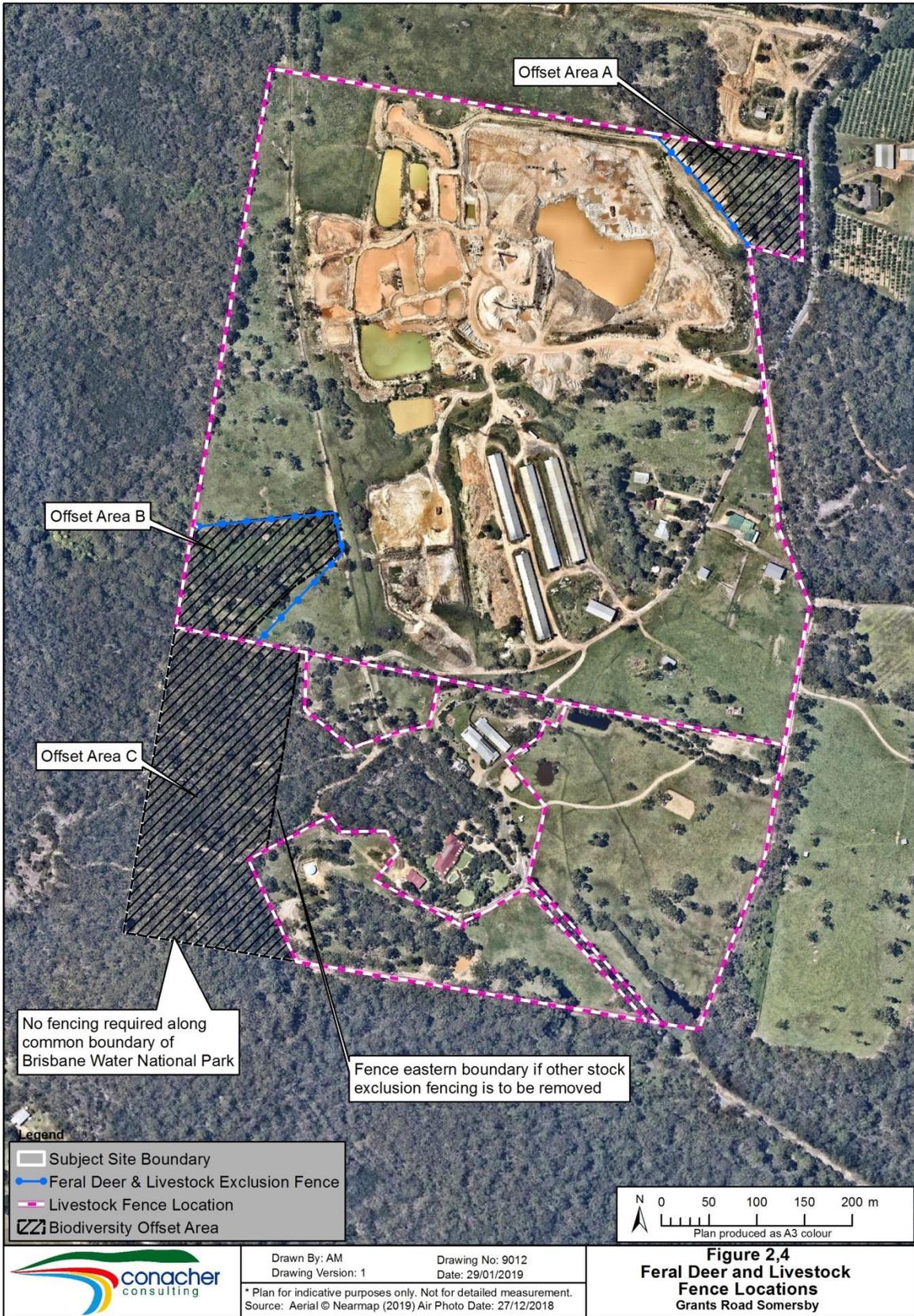
2.6 ABORIGINAL CULTURAL HERITAGE MANAGEMENT

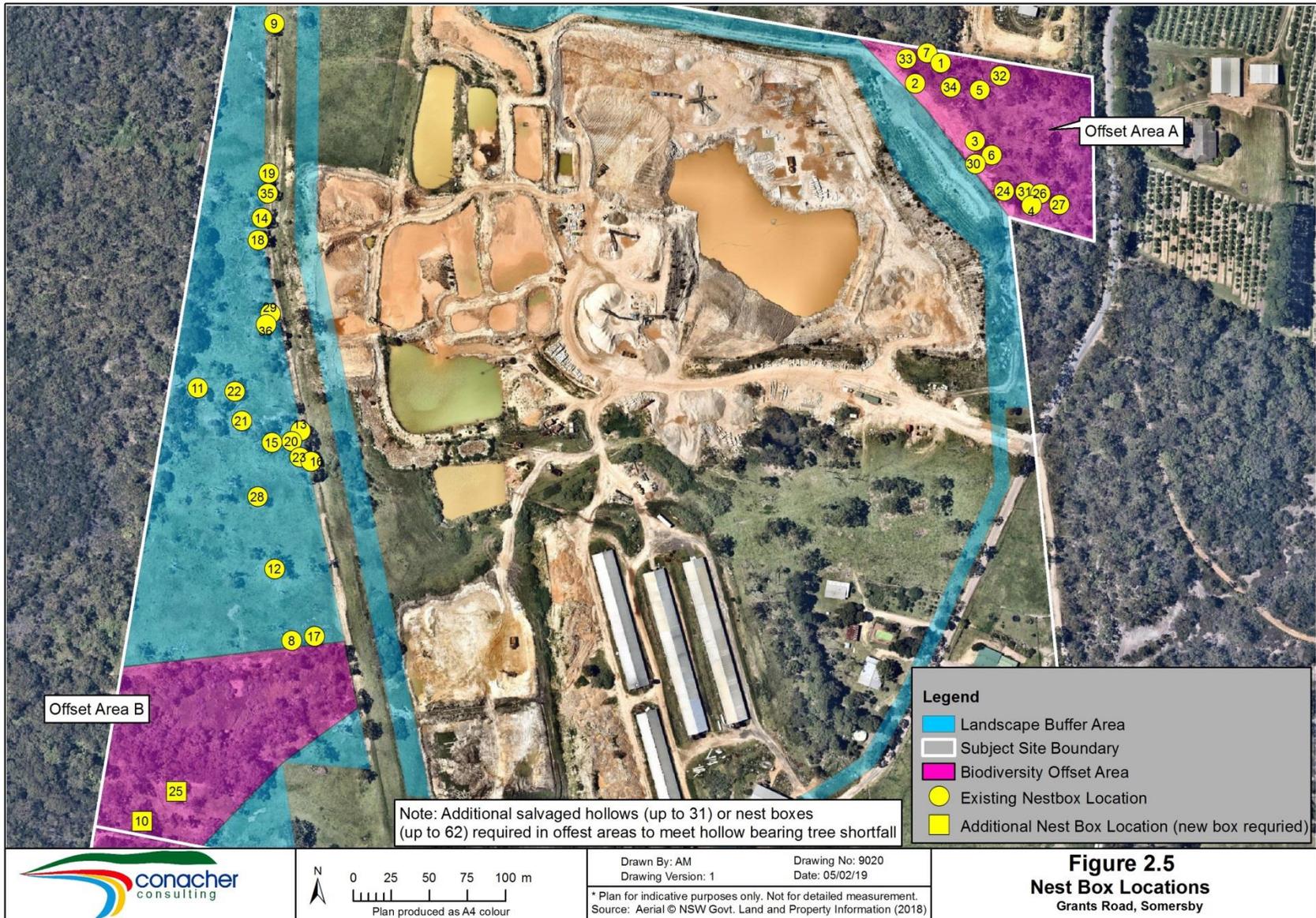
Protection, monitoring and management of Aboriginal Sites within the biodiversity offset areas are to be undertaken in accordance with the Aboriginal Cultural Heritage Management Plan for the site. The Aboriginal Cultural Heritage Management Plan may limit or impose additional requirements to this BOMHRP in order to protect Aboriginal objects or sites.

2.7 BUSHFIRE MANAGEMENT

The adjoining areas of the Brisbane Water National Park estate are subject to control burning programs. The Biodiversity Offset Areas are subject to bushfire risk. During the rehabilitation stages controlled burning is not proposed to be used as part of the rehabilitation or revegetation program. A water tanker with a water pump is available from the quarry to control the spread of a bushfire from the National Park if required. It is preferable that revegetation areas are protected from fire, where possible, until the vegetation within these areas has properly established.

Many species of native flora have adapted to bushfire disturbance and fires often promote vigorous regeneration of resilient plant communities. Areas of established native vegetation are to be left to regenerate naturally following fire disturbance.





SECTION 3

IMPLEMENTATION DETAILS

3.1 MANAGEMENT OBJECTIVES & TIMEFRAMES

This plan is required to outline the short, medium and long term measures to be implemented to manage the remnant vegetation and habitat within the Biodiversity Offset Areas and to implement the Biodiversity Offset Strategy. These tasks and the timeframe for implementation are listed in Table 3.1.

3.2 PROJECT TASKS & RESPONSIBILITIES

These works will be the responsibility of the quarry owners/operators. Where required, specialist consultants or contractors will be engaged to undertake the identified works

The works outlined within this Plan are to be implemented under the supervision and guidance of a qualified bushland regenerator or project ecologist.

TABLE 3.1 MANAGEMENT ACTIONS AND TIMEFRAME					
ACTIONS		SHORT TERM	MEDIUM TERM	LONG TERM	ONGOING
		YEAR 1-3 (2019-2021)	YEARS 4 - 6 (2022-2024)	YEARS 7 - 10 (2025-2028)	YEARS 11 - 26 (2029-2044)
SOIL MANAGEMENT	1. Install erosion and sediment controls to protect offset areas and prevent soil loss during weed control and rehabilitation activities	X			
	2. Undertake soil and landform remediation and stabilisation works for heavily disturbed areas	X			
WEED MANAGEMENT	3. Undertake Primary Weed Control Works	X			
	4. Undertake Secondary Weed Control Works		X	X	X
REVEGETATION	5. Obtain planting material (seeds / plant stock)	X	X		
	6. Undertake seeding and planting works	X	X		

**TABLE 3.1
MANAGEMENT ACTIONS AND TIMEFRAME**

ACTIONS		SHORT TERM	MEDIUM TERM	LONG TERM	ONGOING
		YEAR 1-3 (2019-2021)	YEARS 4 - 6 (2022-2024)	YEARS 7 - 10 (2025-2028)	YEARS 11 - 26 (2029-2044)
REVEGETATION	7.Maintain plantings - Watering - Herbivory protection - Mulching - Insect & pathogen control - Native plant fertiliser application	X	X		
ACCESS CONTROL	8.Install fencing to exclude livestock and deer from Offset Areas A & B	X			
	9.Maintain fencing to exclude livestock from Offset Area C	X			
	10.Maintain all exclusion fencing in working condition	X	X	X	X
HABITAT ENHANCEMENT	11.Install nest boxes and hollow logs to meet hollow tree offset requirement as clearing occurs	X	X		
	12.Salvage environmental/habitat resources where available from quarry footprint and transfer to Offset Areas A & B	X	X	X	
BUSHFIRE MANAGEMENT	13.Protect non-established plantings from bushfire	X	X		
	14.Allow natural bushfire disturbance and revegetation for areas containing established vegetation	X	X	X	X
	15.Protect nest boxes from fire and/or replace if burnt out	X	X	X	

TABLE 3.1 MANAGEMENT ACTIONS AND TIMEFRAME					
ACTIONS		SHORT TERM	MEDIUM TERM	LONG TERM	ONGOING
		YEAR 1-3 (2019-2020)	YEARS 4 - 6 (2023-2025)	YEARS 7 - 10 (2026-2028)	YEARS 10 - 26 (2029-2044)
MONITORING EVALUATION & REPORTING	16. Undertake Annual Monitoring as per the Monitoring Strategy in Section 3.4	X	X	X	X
	17.Re-assess risks to implementation of actions	X	X	X	
	18.Implement adaptive response strategies	X	X	X	
	19.Prepare annual monitoring reports	X	X	X	X

3.3 RISKS AND CONTINGENCIES

Details of the assessed risks and contingencies associated with the implementation of this Biodiversity Offset Strategy are provided in Table 3.2.

TABLE 3.2 RISK, CONTINGENCY & PERFORMANCE DETAILS				
ACTIONS		PERFORMANCE TARGETS	RISKS / TRIGGERS	CONTINGENCY
SOIL MANAGEMENT	1.Install erosion and sediment controls to protect offset areas and prevent soil loss during weed control and rehabilitation activities	No impact to offsite areas	Erosion and sediment controls fail or are not installed	Improve controls and remediate impacts
	2.Undertake soil and landform remediation and stabilisation works for heavily disturbed areas	Soil is made suitable for planting	Plantings fail due to soil issues	Re-test soil and improve for plantings
WEED MANAGEMENT	3.Undertake Primary Weed Control Works	Reduce weed cover as per requirements for target species	Weed growth is too vigorous to control	Adjust targets or control methods
	4.Undertake Secondary Weed Control Works	Reduce weed cover as per requirements for target species	Weed growth is too vigorous to control	Adjust targets or control methods
REVEGETATION	5.Obtain planting material (seeds / plant stock)	Obtain suitable planting stock to meet requirements	No planting stock is available	Engage a bush regenerator to grow stock from the site.
	6. Undertake seeding and planting works	80% survival for plantings	Poor plant growth / seed establishment	Investigate causes and adjust planting techniques or substrate
	7. Maintain plantings	80% survival for plantings	Plants die due to failure to manage	Undertake further plantings and manage until established

**TABLE 3.2
RISK, CONTINGENCY & PERFORMANCE DETAILS**

	ACTIONS	PERFORMANCE TARGETS	RISKS / TRIGGERS	CONTINGENCY
ACCESS CONTROL	8. Install fencing to exclude livestock and deer from Offset Areas A & B	Maintain existing fencing	Fencing fails	Maintain fencing
	9. Install fencing to exclude livestock from Offset Area C	Maintain existing fencing	Fencing fails	Maintain fencing
	10. Maintain all exclusion fencing in working condition	100% stock exclusion	Fencing fails to exclude deer and livestock	Improve fence design
HABITAT ENHANCEMENT	11. Install nest boxes and hollow logs to meet hollow tree offset requirement as clearing occurs	All nest boxes maintained in habitable condition	Nest boxes fail	Repair or install new nest boxes
	12. Salvage environmental/habitat resources where available from quarry footprint and transfer to Offset Areas A & B	Suitable resources within development footprint are re-used	Machine operator fails to properly retain salvaged material	Use substitute materials such as sandstone rock or nest boxes
BUSHFIRE MANAGEMENT	13. Protect non-established plantings from bushfire	80% survival	Plantings burn out	Replant and manage until established
	14. Allow natural bushfire disturbance and revegetation for areas containing established vegetation	Allow to occur	Regeneration does not occur	Undertake further plantings
	15. Protect nest boxes from fire and/or replace if burnt out	All nest boxes maintained in habitable condition	Nest boxes burn out	Replace affected nest boxes
MONITORING EVALUATION & REPORTING	16. Undertake Annual Monitoring as per the Monitoring Strategy in Section 3.4	Complete as required	Monitoring period is missed	Complete as soon as possible
	17. Re-assess risks to implementation of actions	Complete as required	Additional risks arise	Document in successive monitoring and reporting
	18. Implement adaptive response strategies	Complete as required	Adaptive strategies fail	Continue to modify strategies in successive years
	19. Prepare annual monitoring reports	Complete as required	Report is not completed on time	Submit late report as soon as possible

3.4 MONITORING REQUIREMENTS

3.4.1 General Monitoring Requirements

Monitoring of biodiversity offsets is to be undertaken on an annual basis under the approval. Each action identified in Table 3.2 will be monitored on an annual basis (for 10 years) to determine compliance with the performance targets and whether contingency actions are required. Annual monitoring evidence requirements are listed in Table 3.3.

A record of actions implemented including dates, locations and action details is to be kept for monitoring purposes.

TABLE 3.3 MONITORING EVIDENCE REQUIREMENTS	
Works Tasks	Evidence Requirements
Soil Management	Annual Monitoring Report -Annual ecologist observations -Photographs -Mapping
Weed Management	Annual Monitoring Report -Annual ecologist observations -Monitoring Plot Data -Photographs -Mapping
Revegetation	Annual Monitoring Report -Tax Invoices -Annual ecologist observations -Plot data -Photographs -Mapping
Access Control	Annual Monitoring Report -Fence mapping -Photographs
Habitat Enhancement	Annual Monitoring Report -Annual ecologist observations -Photographs
Bushfire Management	Annual Monitoring Report -Annual ecologist observations - Plot data -Photographs

3.4.1 Vegetation Plot & Photo Monitoring

Biodiversity offset areas are to be monitored annually with four fixed 20 x 20m monitoring plots. One plot is to be completed in each of Offsets Area A and B and two plots are to be completed in Offset Area C. The following is to be assessed for each of the monitoring quadrats:

- Native vegetation structure and composition; and
- Exotic vegetation structure and composition.

Inspections are to be completed for each area to provide an estimate of the following:

- Plant regeneration (percentage survival for plantings);
- Weed mapping identifying location and cover estimate for the target weed species;
- Signs of surface erosion and sedimentation;
- Signs of disturbance from feral deer; and
- Any natural disturbances;

Results of the monitoring surveys are to be provided in annual monitoring reports. Photo-point monitoring will be undertaken at each of the vegetation monitoring plots.

3.4.2 Nest Box Monitoring

The condition and use of the nest boxes will be monitored annually. Remediation of existing boxes or provision of replacement boxes will be provided for any broken boxes.

3.5 REPORTING

Monitoring reports are required to be provided annually and need to address the following:

- Monitoring data obtained from the annual monitoring surveys;
- A table providing a summary of the project's environmental performance in relation to the management of the Biodiversity Offset Areas;
- Identification of trends in the monitoring data over the life of the project; and
- Assessment of compliance with the conditions of the approval in relation to Biodiversity Offset Areas.

An Annual Monitoring Compliance Table is provided in Appendix 1 for use in future monitoring reports.

4. REFERENCES

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APPENDIX 1
REVEGETATION & WEED MANAGEMENT GUIDELINES

PART 1

WEED MANAGEMENT TECHNIQUES

1. WEED REMOVAL TECHNIQUES

Suitable hand and herbicide removal techniques for weeds following the techniques recommended by the National Trust, NSW National Parks and Wildlife Service, Australian Association of Bush Regenerators and Buchanan (2009) are provided as follows.

1.1 Weed removal techniques for woody plants

Cut and Paint (Woody weeds to 10 cm basal diameter)

- Make a horizontal cut close to the ground using a sharp blade, secateurs or a bush saw;
- Immediately apply herbicide to the exposed flat stump surface.

Considerations:

- Cuts should be horizontal to prevent herbicide from running off the stump, sharp angle cuts are hazardous;
- Herbicide must be applied immediately before the plant cells close (within 30 seconds) and translocation of herbicide ceases;
- If plants resprout cut and paint the shoots after sufficient regrowth has occurred; and
- Stem scraping can be more effective on some woody weeds.

Stem Injection

- At the base of the target tree or shrub drill holes at a 45 degree angle into the sapwood;
- Fill each hole with herbicide immediately; and
- Repeat the process at 5 cm intervals around the tree.

Frilling or Chipping

- At the base of the tree make a cut into the sapwood with a chisel or axe;
- Fill each cut with herbicide immediately; and
- Repeat the process at 5 cm intervals around the tree.

Considerations:

- Plants should be actively growing and in good health;
- Deciduous plants should be treated in spring and autumn when leaves are fully formed;
- For multi-stemmed plants, inject or chip below the lowest branch or treat each stem individually; and
- Herbicides must be injected immediately before plant cells close (within 30 seconds) and translocation of herbicide ceases.

1.2 Weed removal techniques for small hand-pullable plants

Hand Removal

- Remove any seeds or fruits and carefully place into a bag for disposal;
- Grasp stem at ground level, rock plant backwards and forwards to loosen roots and pull out; and
- Tap the roots to dislodge any soil, replace disturbed soil and pat down
- Ensure that any reproductive parts are collected and bagged for disposal.

Considerations:

- Leave weeds so roots are not in contact with the soil or remove from site.

1.3 Weed removal techniques for vines and scramblers

Hand Removal

- Take hold of one runner and pull towards yourself;
- Check points of resistance where fibrous roots grow from the nodes;
- Cut roots with a knife or dig out with a trowel and continue to follow the runner;
- The major root systems need to be removed manually or scrape/cut and painted with herbicide; and
- Any reproductive parts need to be bagged.

Stem Scraping

- Scrape 15 to 30 cm of the stem with a knife to reach the layer below the bark/outer layer; and
- Immediately apply herbicide along the length of the scrape.

Considerations:

- A maximum of half the stem diameter should be scraped. Do not ringbark;
- Larger stems should have two scrapes opposite each other; and
- Vines can be left hanging in trees after treatment.

1.4 Weed removal techniques for plants with underground reproductive structures

Hand Removal of Plants with a Taproot

- Remove and bag seeds or fruits;
- Push a narrow trowel or knife into the ground beside the tap root, carefully loosen the soil and repeat this step around the taproot;
- Grasp the stem at ground level, rock plant backwards and forwards and gently pull removing the plant; and
- Tap the roots to dislodge soil, replace disturbed soil and pat down.

Crowning

- Remove and bag stems with seed or fruit;
- Grasp the leaves or stems together so the base of the plant is visible;
- Insert the knife or lever at an angle close to the crown;
- Cut through all the roots around the crown; and
- Remove and bag the crown.

Herbicide Treatment – Stem Swiping

- Remove any seed or fruit and bag; and
- Using a herbicide applicator, swipe the stems/leaves.

Considerations:

- Further digging may be required for plants with more than one tuber;
- Some bulbs may have small bulbils attached or present in the soil around them which need to be removed;
- It may be quicker and more effective to dig out the weed;
- Protect native plants and seedlings; and
- For bulb and corm species the most effective time to apply herbicide is after flowering and before fruit is set.

Exotic vegetation should be removed and stockpiled in a clear area away from adjoining bushland. This stockpile should be removed from the site at a convenient time. As part of the regular maintenance of the restored area any regrowth of exotic plant species should be removed and disposed of appropriately.

2. USE OF HERBICIDES

There are various categories of herbicides currently used (Buchanan, 2009), specifically those that kill on contact (contact herbicides), and those that must move through the tissue of the plant (translocated herbicides). Other herbicides include those that are non-selective and those that are selective. There are also residual herbicides that remain active in the soil and give ongoing weed control for a few weeks to a few years (Buchanan, 2009). The most commonly used biodegradable herbicides by bush regenerators are those containing glyphosate.

An advantage of herbicide use is the relatively reduced amount of time taken to spray weeds as compared to physically removing them, particularly for large infestations of weeds. Another advantage is that the dead weeds may provide some measure of soil stabilisation for a short period of time.

Herbicides should not be applied prior to rain occurring. This reduces the herbicides effectiveness as well as being transported in runoff to waterbodies.

An advantage of herbicide use is the low time taken to spray weeds as compared to physically removing them, particularly for large infestations of weeds.

Herbicides should particularly be considered when:

- There are small areas of dense weeds with few or no native plants to protect;
- There are large areas of weeds;
- The weeds are growing too rapidly or are too large for physical removal; and
- The weeds are located in areas with a high potential for erosion if vegetation is removed.

The spraying of weeds must only be undertaken by experienced and qualified persons. The success of each treatment must be evaluated by the operator after a set period of time according to the labelled effectiveness for each herbicide. Care must be taken when applying herbicides near drainage lines to avoid excess use due to the sensitivity of the wetlands and waterways into which runoff will eventually flow.

PART 2 PLANTING GUIDELINES

1. SITE PREPARATION

Site preparation activities for all planting sites will include preliminary weed control and where necessary rubbish removal and soil remediation. Bare soil areas can be sown with a native grass mix nurse crop to provide temporary soil stabilisation, and (where applicable) soil erosion control measures installed.

2. PLANT MATERIAL

Plant material used for revegetation within the project area shall be sourced only from the catchment management area, with preference given to material available or able to be acquired from within local bushland areas. The Bushland Regenerator is responsible for obtaining all necessary permits and licenses. All plants are to be provided in a healthy condition. They must have good root development and a sturdy shoot system. Plant with an elongated or yellowed shoot system shall not be accepted. Planting shall be undertaken immediately after delivery. If this is not possible, the Bushland Regenerator shall be required to provide appropriate storage to keep the plants in good condition on the site, adequately protected from frost, wind, sun and vermin, and secured from vandals.

3. PLANTING GUIDELINES

3.1 Planting Densities and Niche species

The Bushland Regenerator shall be responsible for planting according a Site Planting Plan prepared in consultation with the Proponent. This Plan will detail the required species and their distribution across the planting area. The Bushland Regenerator shall be responsible for ensuring planting densities and appropriate niche species.

Only locally indigenous plants will be used, in accordance with the species list provided within this Plan. Niche preferences shall be considered in planting, with plants being placed in the correct position with regard to soil type, moisture, aspect and slope. Plantings should be at a density which will result in a near natural density once established.

3.2 Planting Methods

Planting holes shall be excavated to an appropriate depth depending on the size of the stock, this will generally be twice the size of the existing plant container. Slow release native plant fertiliser (low phosphorous formulated native plant fertiliser tablet/granules) shall be placed into the planting hole. In poorly structured soils, approximately 200 cubic centimetres of native plant soil mix is to be placed and incorporated into the planting hole with fertiliser and water storing granules. Plants must be placed into moistened soil preferably by soaking 1-2 litres of water into each hole. After planting the soil shall be replaced and carefully firmed, leaving a slight depression around each plant to allow for water collection. Soil is to be replaced in the hole so that the base of the stem is level with the soil surface, not set below the soil, or sitting above.

All plants are to be thoroughly watered before planting and again after planting. If the weather is hot, a third watering shall be carried out within two (2) days or an irrigation system may be set up to water plants on a weekly basis.

3.3 Plant Protection

The Bushland Regenerator shall be responsible for adequately protecting plant material from frost, wind, sun, vermin and animals. Plant guards (including 2 stakes) shall be around each plant and maintained throughout the maintenance period of up to 2 years. The use of Jute mats (mulch mats) or similar is required to prevent and managed weed regrowth and soil erosion.

3.4 Mulching

After planting, the exposed ground directly around each plant should be mulched with low-nutrient mulch such as weed free chipped eucalyptus recycled from the site clearing area. No exotic plant material is to be used. Pine bark is considered not to be a suitable mulch material. The provenance of all mulch material must be known and approved by the Bushland Regenerator. Mulch is not to be used in sand dunes ecosystems or bushfire inner protection areas. Care should be taken to keep mulch material away from the stems of smaller plants. Alternately, a light sowing of a suitable nurse crop can be made between plantings to provide a protective microclimate. Sowing rates to be used are those recommended by the supplier and agreed with the Bushland Regenerator.

3.5 Maintenance and Weed Control

Plantings must be suitably maintained (watering and weeding). During the maintenance phase any plant losses in excess of 20% of the total number planted must be replaced at the expense of the Bushland Regenerator.

Site maintenance shall consist of the following tasks:

- Weeding throughout the planting area;
- Watering plantings;
- Replacing lost plants (as required);
- Removing wind-blown or other rubbish from the planting area; and
- Adjusting plant guards.

APPENDIX 2
ANNUAL MONITORING COMPLIANCE TABLE

**TABLE A2.1
ANNUAL MONITORING COMPLIANCE TABLE EXAMPLE**

Unique ID	Compliance Requirement		Development Phase	Monitoring Methodology	Evidence Required	Monitoring Results	Improvement Measures Required
	Task	Description					
Condition 27 (f) Commitment 9 BOMHRP-1	Soil Management	Install erosion and sediment controls to protect offset areas and prevent soil loss during weed control and rehabilitation activities	Operation 1-3 years	Project ecologist inspection Works records	Annual Monitoring Report -Photographs		
Condition 27 (f) Commitment 9 BOMHRP-2	Soil Management	Undertake soil and landform remediation and stabilisation works for heavily disturbed areas	Operation 1-3 years	Project ecologist inspection works records	Annual Monitoring Report -Photographs -Mapping		
Condition 27 (f) Commitment 9 BOMHRP-3	Weed Management	Undertake Primary Weed Control Works	Operation 1-3 years	Project ecologist inspection Works records	Annual Monitoring Report -Monitoring Plot Data -Mapping		
Condition 27 (f) Commitment 9 BOMHRP-4	Weed Management	Undertake Secondary Weed Control Works	Operation Following primary weed control for the life of the quarry	Project ecologist inspection Works records	Annual Monitoring Report -Monitoring Plot Data -Mapping		
Condition 27 (f) Commitment 9 BOMHRP-5	Revegetation	Obtain planting material (seeds / plant stock)	Operation 1-6 years	Tax invoice records	Annual Monitoring Report -Tax Invoices		
Condition 27 (f) Commitment 9 BOMHRP-6	Revegetation	Undertake seeding and planting works	Operation 1-6 years	Project ecologist inspection	Annual Monitoring Report		

**TABLE A2.1
ANNUAL MONITORING COMPLIANCE TABLE EXAMPLE**

Unique ID	Compliance Requirement		Development Phase	Monitoring Methodology	Evidence Required	Monitoring Results	Improvement Measures Required
	Task	Description					
				Works records	-Plot data -Photos -Mapping		
Condition 27 (f) Commitment 9 BOMHRP-7	Revegetation	Maintain plantings	Operation 1-6 years	Project ecologist inspection Works records	Plot data -Photos -Mapping		
Condition 27 (f) Commitment 9 BOMHRP-8	Access Control	Install fencing to exclude livestock and deer from Offset Areas A & B	Operation 1-3 years	Project ecologist inspection	Annual Monitoring Report -Fence mapping -Photos		
Condition 27 (f) Commitment 9 BOMHRP-9	Access Control	Maintain fencing to exclude livestock from Offset Area C	Operation 1-26 years	Project ecologist inspection	Annual Monitoring Report		
Condition 27 (f) Commitment 9 BOMHRP-10	Access Control	Maintain all exclusion fencing in working condition	Operation 1-26 years	Project ecologist inspection	Annual Monitoring Report		
Condition 27 (f) Commitment 9 BOMHRP-11	Habitat Enhancement	Install nest boxes and hollow logs to meet hollow tree offset requirement as clearing occurs	Operation 1-6 years	Project ecologist inspection	Annual Monitoring Report		
Condition 27 (f) Commitment 9 BOMHRP-12	Habitat Enhancement	Salvage environmental/habitat resources where available from quarry footprint and transfer to Offset Areas A & B	Operation 1-10 years	Project ecologist inspection Works records	Annual Monitoring Report -Photos		

**TABLE A2.1
ANNUAL MONITORING COMPLIANCE TABLE EXAMPLE**

Unique ID	Compliance Requirement		Development Phase	Monitoring Methodology	Evidence Required	Monitoring Results	Improvement Measures Required
	Task	Description					
Condition 27 (f) Commitment 9 BOMHRP-13	Bushfire Management	Protect non-established plantings from bushfire	Operation 1-6 years	Project ecologist inspection	Annual Monitoring Report		
Condition 27 (f) Commitment 9 BOMHRP-14	Bushfire Management	Allow natural bushfire disturbance and revegetation for areas containing established vegetation	Operation 1-26 years	Project ecologist inspection	Annual Monitoring Report -Monitoring Plot data -Photographs		
Condition 27 (f) Commitment 9 BOMHRP-15	Bushfire Management	Protect nest boxes from fire and/or replace if burnt out	Operation 1-10 years	Project ecologist inspection	Annual Monitoring Report		
Condition 27 (f) Commitment 9 BOMHRP-16	Monitoring Evaluation & Reporting	Undertake Annual Monitoring as per the Monitoring Strategy	Operation 1-26 years	Project ecologist inspection	Annual Monitoring Report		
Condition 27 (f) Commitment 9 BOMHRP-17	Monitoring Evaluation & Reporting	Re-assess risks to implementation of actions	Operation 1-10 years	NA	Annual Monitoring Report		
Condition 27 (f) Commitment 9 BOMHRP-18	Monitoring Evaluation & Reporting	Implement adaptive response strategies	Operation 1-10 years	NA	Annual Monitoring Report		
Condition 27 (f) Commitment 9 BOMHRP-19	Monitoring Evaluation & Reporting	Prepare annual monitoring reports	Operation 1-26 years	Project ecologist reporting	Annual Monitoring Report		