



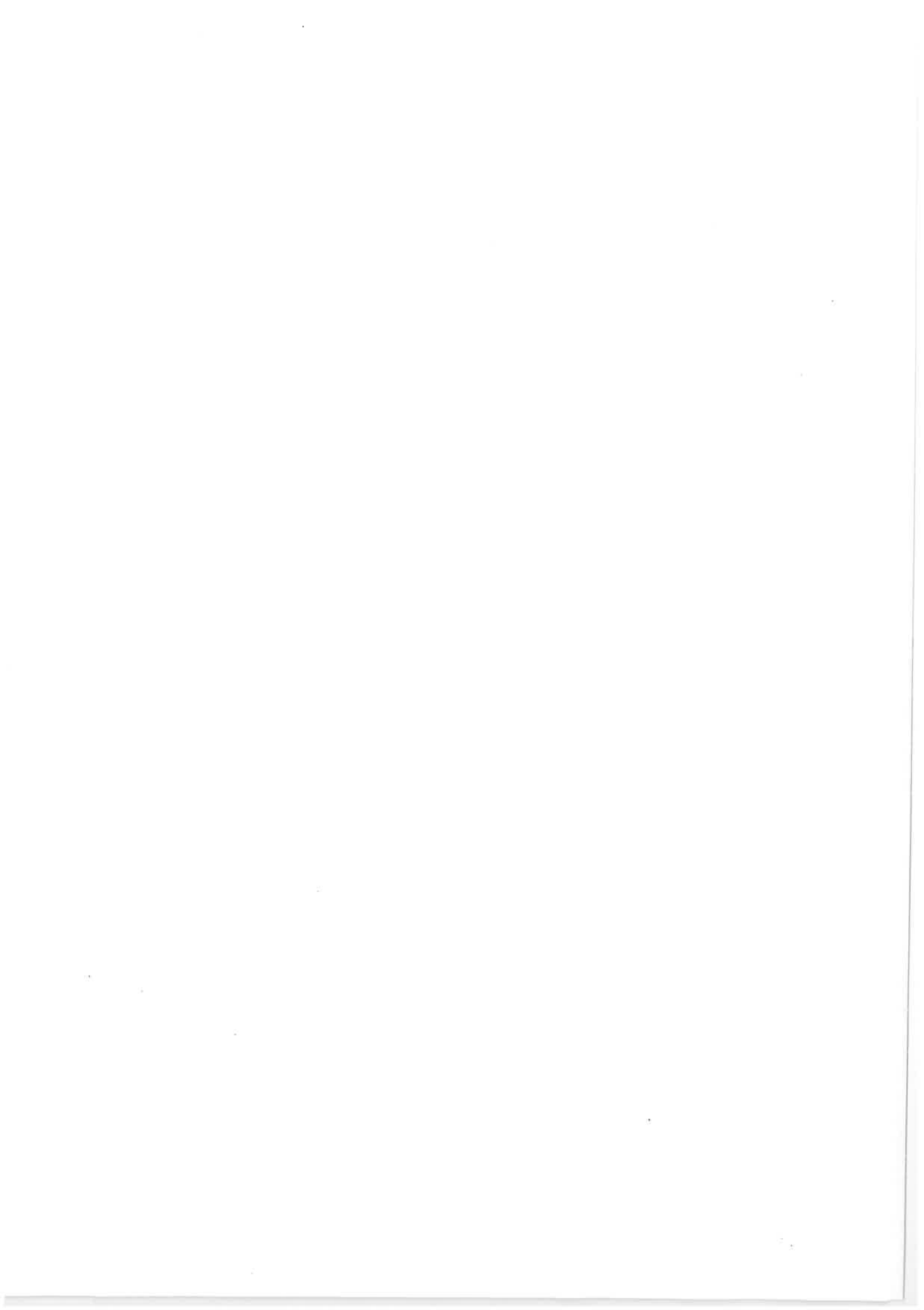
Landscape Management Plan – Tanilba Northern Dune Extension



Sibelco Australia Limited

Tanilba Northern Dune Extension
Oyster Cover Road, Tanilba Bay, NSW
2318

January 2014



Landscape Management Plan – Tanilba Northern Dune Extension

Tanilba Northern Dune Extension
Oyster Cover Road, Tanilba Bay, NSW 2318

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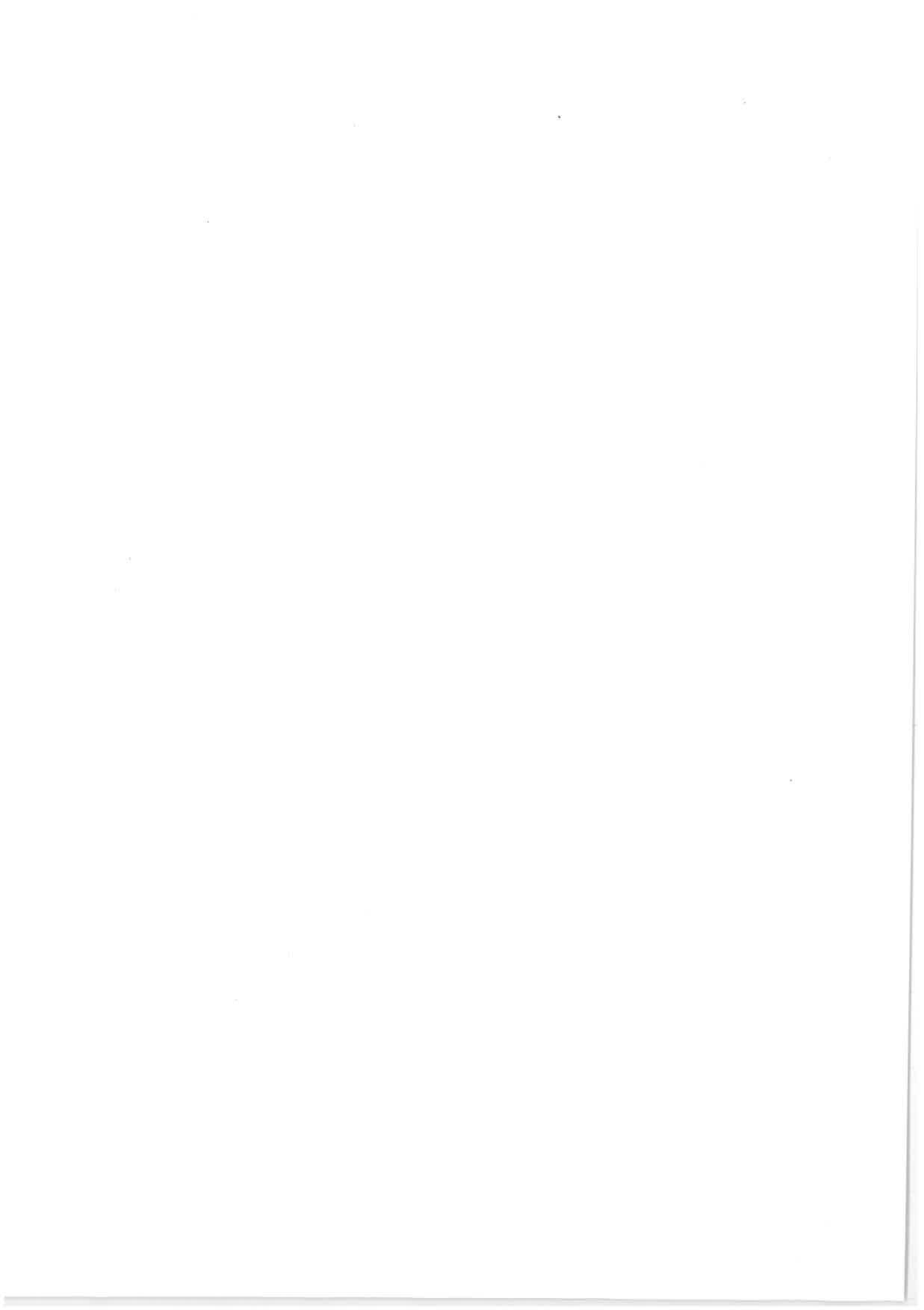
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ABBREVIATIONS

AEMR	Annual Environmental Management Report
BMP	Biodiversity Management Plan
CKPoM	Comprehensive Koala Plan of Management
DP	Deposited Plan
DP&I	Department of Planning and Infrastructure
EEC	Endangered Ecological Community (category of Threatened Ecological Community)
EMP	Environmental Management Plan
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GIS	Geographic Information System
GPS	Global Positioning System
ha	hectare
HWC	Hunter Water Corporation
LGA	Local Government Area
LMP	Landscape Management Plan
LTMS	Long Term Management Strategy
OEH	Office of Environment and Heritage (NSW)
PSC	Port Stephens Council
RMP	Rehabilitation Management Plan
SEPP 44	State Environmental Planning Policy 44 – Koala Habitat Protection
Sibelco	Sibelco Australia Limited
TSC Act	<i>Threatened Species Conservation Act 1995</i>

1. INTRODUCTION

1.1 BACKGROUND

Sibelco Australia (Sibelco) has an existing consent to extract white silica sand from the Tanilba Northern Dune located in the Oyster Cove area, in the Port Stephens Council (PSC) Local Government Area (LGA). The sand extraction area is situated on either side of Oyster Cove Road, on an elevated sand dune known as the Tanilba Northern Dune, Oyster Cove, in the Port Stephens Council LGA, in the Hunter Region of New South Wales.

Approval has been granted by the Minister for Planning and Infrastructure (DP&I) to extend the quarrying activities by 9 ha in an area to the north of the existing extraction operations. The extension project was a Major Project assessment and is considered under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This project is labelled the Tanilba Northern Dune Extension Project, and located within Lots 11, 12 and 13 DP 601306; Lot 408 DP 1041934; and Lots 1 and 2 DP 408240 (**Figure 1**).

This Landscape Management Plan (LMP) has been prepared to satisfy Schedule 3, Condition 17 of the Tanilba Northern Dune Extension Project Approval (MP 09_0091) dated 8th March 2013 (the Project Approval – DP&I, 2013).

1.2 SCOPE AND OBJECTIVES

This LMP is one of many integrated management plans and monitoring programs that have been developed to support the overriding Environmental Management Plan (EMP).

This LMP provides a framework for the management of impacts on flora and fauna during clearing, the rehabilitation of the extraction area and long term monitoring and management of the site. The core objectives for the plan are to comply with Condition 16 of the Project Approval that requires Sibelco to implement a LMP that must:

- a) Be prepared:
 - o By a suitably qualified person(s), approved by the Director-General; and

- o In consultation with Council and Hunter Water Corporation (HWC).
- b) Be submitted to the Director-General for approval prior to commencing quarrying operations; and
- c) Include:
 - o A Rehabilitation Management Plan; and
 - o A Long Term Management Strategy.

The Project Approval also requires the preparation of a Biodiversity Management Plan (BMP), which requires similar management actions as this LMP. For operational and administrative simplicity, these plans apply to the site as follows:

- Management measures for the extraction area (disturbance area within the application area) will be addressed in this LMP; and
- Management of the approved Biodiversity Offset Areas will be addressed in the BMP.

A reference for where specific consent conditions are addressed is outlined in **Appendix 1**.

This LMP contains the following sections:

- **Statutory requirements:** This sections outlines the approvals and legislative requirements of the Tanilba Northern Dune Extension Project that are relevant to this LMP;
- **Existing environment and potential impacts:** A background of the ecological values that were identified within the extraction area and surrounding lands and the potential impacts that the project will have on these issues;
- **Rehabilitation Management Plan:** This chapter outlines the management actions required to be undertaken within the extraction area prior to, during and post operations, including rehabilitation monitoring methodologies, completion criteria for the rehabilitation and an assessment of potential risks to successful rehabilitation;
- **Long Term Management Strategy:** The objectives and management strategies for the extraction area post-operations;
- **Reporting framework:** A summary of the reporting requirements set out by this LMP; and
- **Review and Performance:** Triggers for review of this LMP and responsibilities implementation of this plan.

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- Study Area
- Northern Biodiversity Offset Area
- Southern Biodiversity Offset Area
- Project Application Area
- Extraction Area (Tanilba Northern Dune Extension)
- Approved Extraction Area (Tanilba Northern Dune)
- Haul Route
- Sub-arterial Road
- Local Road
- Track
- State Conservation Area

Metres

0 75 150 300 450 600 750

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Tanilba Northern Dune Extension

Sibelco
Tanilba Northern Dune Extension
Oyster Cover Road, Tanilba Bay NSW

FIGURE:
1

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1.3 CONSULTATION AND PLAN DEVELOPMENT

As per Condition 17(a) of the Project Approval, this LMP has been developed by Kleinfelder in consultation with Port Stephens Council (PSC) and the Hunter Water Corporation (HWC). Consultation documentation is included in **Appendix 2**.

2. STATUTORY REQUIREMENTS

2.1 STATUTORY APPROVALS

Table 1 details the statutory approvals and licences relevant to the LMP for the Tanilba Northern Dune Extension.

Table 1: Statutory approvals for the Tanilba Northern Dune Extension relevant to this LMP.

Project Number	Approval Description	Date Approved	Legislation	Authority
MP 09_0091	Tanilba Northern Dune Extension Project	8 th March 2013	Part 3A EP&A Act	DP&I

The relevant conditions to this LMP of the Project Approval (MP09_0091) are detailed in **Appendix 1**, and included:

- Condition 17 – Landscape Management Plan;
- Condition 18 – Rehabilitation Management Plan;
- Condition 19 – Long Term Management Strategy; and
- Condition 20 – Rehabilitation Bond.

In addition to the conditions above Sibelco made a series of commitments in relation to rehabilitation and biodiversity. These commitments are included within **Appendix 3**, with resulting actions incorporated within the management procedures detailed within **Section 4.3**.

2.2 LEGISLATIVE REQUIREMENTS

Key legislative requirements applicable to the project are presented in **Table 2**.

Table 2: Statutory approvals for the Tanilba Northern Dune Extension relevant to this LMP.

Legislation/ Policy	Relevance
NSW EP&A Act	Project Approval granted under Part 3A of the EP&A Act.
NSW <i>Threatened Species Conservation Act 1995</i> (TSC Act)	Impact to species listed under Schedules 1 and 2 of the TSC Act were considered within the assessment and approval of the project.

Legislation/ Policy	Relevance
NSW <i>Native Vegetation Act 2003</i> (NV Act)	Pursuant to Section 75U of the EP&A Act, authorisations to clear native vegetation is not required as approval is granted by the Minister for Planning under Part 3A.
NSW <i>Noxious Weeds Act 1993</i>	Noxious weed species have been identified within the Extension Area. These weeds will be treated in accordance within their Class under the act.
State Environmental Planning Policy 44 Koala Habitat Protection	Two feed trees listed under Schedule 2 of SEPP 44 were identified within the Study Area (Extension Area and surrounds). Potential Koala habitat was identified outside the disturbance area and will not be directly impacted on by the operations.
Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	The project was referred to the Minister for the Environment on 2 nd August 2012 (Ref. No. 2012/6492). The project was deemed 'not controlled action', and can proceed provided it is carried out in accordance with the referral

3. EXISTING ENVIRONMENT & POTENTIAL IMPACTS

3.1 LOCAL SETTING

The Tanilba Northern Dune Extension Project comprises land owned by the Crown, the Hunter Water Corporation and Sibelco, located on the Tilligerry Peninsula. The site comprises part of an elevated dune system known as the Tanilba Northern Dune. This dunal system is located to the south and east of Oyster Cove (Oyster Cove Road passes through the original dune system) and to the west of the township of Tanilba Bay (Figure 1). The Environmental Assessment Report (ERM, 2012) provides a detailed description of the site.

3.2 ECOLOGICAL VALUES

Kleinfelder (formerly Ecobiological) carried out an ecological assessment of the lands associated with the Tanilba Northern Dune Extension and surrounding areas (study area shown in Figure 1) in 2007 and 2009.

3.2.1 Vegetation Communities

A total of eight vegetation communities and two variations were mapped within the study area (extraction area, northern offset and additional areas to the west).

Vegetation communities within the study area are outlined in Table 3, Figure 2, and are discussed in the following sections.

Table 3: Vegetation communities within the study area (surveyed by Kleinfelder, 2007 and 2009 as part of Flora and Fauna Impact Assessment)

Vegetation Community	Area (ha)			
	Extraction Area	Northern Offset	Additional Lots within Study Area	Total
Coastal Sand Apple – Blackbutt Forest	2.7 ha	0.8 ha	0.4 ha	3.9 ha
Coastal Sand Apple – Blackbutt Forest – Degraded	1.4 ha	-	-	1.4 ha
Coastal Sand Wallum Woodland – Heath	3.8 ha	0.3 ha	0.2 ha	4.3 ha
Swamp Mahogany – Paperbark Swamp Forest	-	8.0 ha	4.7 ha	12.7 ha

Vegetation Community	Area (ha)			
	Extraction Area	Northern Offset	Additional Lots within Study Area	Total
Swamp Mahogany – Paperbark Swamp Forest - Regenerating	-	7.2 ha	0.2 ha	7.4 ha
Swamp Oak Rushland Forest	-	0.2 ha	-	0.2 ha
Regenerating Grassland – Heath	-	1.1 ha	2.4 ha	3.5 ha
Exotic Grassland/ Weed Infestation in Cleared	0.6 ha	-	2.2 ha	2.8 ha
Cleared	-	0.7 ha	0.5 ha	1.2 ha
Coastal Teatree Scrub	-	-	3.8 ha	3.8 ha
Total per area	8.5 ha	18.3 ha	14.4 ha	

3.2.1.1 Coastal Sand Apple – Blackbutt Forest

This community is located on the higher dunes within the proposed extraction area. It is a tall open forest to 25-30 m, with dense shrubby layer to 3-4 m, and the herbaceous ground stratum is sparse.

Angophora costata (Smooth-barked Apple) and *Eucalyptus pilularis* (Blackbutt) co-dominant canopy layer, merging with a higher abundance of *Corymbia gummifera* (Red Bloodwood) closer to the Coastal Sand Wallum Woodland – Heath ecotones. The shrubby mid stratum is dominated by *Montoca elliptica* (Tree Broom-heath), *Leptospermum trinervium* (Flaky-barked Tea Tree) and *Banksia serrata* (Old-man Banksia), and common shrub species include *Acacia ulicifolia* (Prickly Moses), *Acacia longifolia* (Sydney Golden Wattle), *Dillwynia retorta* and *Leucopogon* species. The ground layer was sparse and typically comprised *Pteridium esculentum* (Common Bracken), *Dianella caerulea* (Blue Flax-lily), *Eriostemon australasius* and scattered *Gonocarpus teucroides* (Raspwort) and *Hibbertia* species.

Areas of the Coastal Sand Apple – Blackbutt Forest were mapped separately as degraded due to the high level of disturbance and weed abundance within these areas.

3.2.1.2 Coastal Sand Wallum Woodland – Heath

This community is found along the southern lower lying parts of the extraction area. This community varied from low woodland (to 8 m tall) with a dense shrubby mid stratum consisting of heath species to 3 m and an open shrub layer to 1 m. The ground stratum was moderate to sparse throughout. The Wallum Heathland had similar composition without the Woodland tree canopy.

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- Vegetation Community**
- Coastal Tealree Scrub
 - Coastal Sand Apple Blackbutt Forest
 - Coastal Sand Apple Blackbutt Forest - Degraded
 - Coastal Sand Wallum Woodland - Heath
 - Swamp Mahogany - Paperbark Swamp Forest
 - Swamp Mahogany - Paperbark Swamp Forest - Regenerating
 - Swamp Oak Forest
 - Regenerating Grassland - Heath
 - Exotic Grassland / Weed Infestation in Cleared
 - Cleared

- Study Area
- Northern Biodiversity Offset Area
- Extraction Area (Tanilba Northern Dune Extension)
- Sub-arterial Road
- Local Road
- Track



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 LPI - 2009
 NearMap - 2011

Vegetation Communities Within the Study Area (Extraction Area & Northern Offset)

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 Tanilba Northern Dune Extension
 Oyster Cover Road, Tanilba Bay NSW

FIGURE:
2

The canopy species include *Eucalyptus piperita* (Sydney Peppermint) and *Corymbia gummifera* (Red Bloodwood). The dominant mid stratum species are *Banksia aemula* (Wallum Banksia), *Leptospermum trinervium* (Flaky-barked Tea Tree), *Monotoca elliptica* (Tree Broom-heath) and *Xanthorrhoea glauca* with *Melaleuca nodosa* (Prickly-leaved Tea Tree) becoming more common in the low heath. The wallum community has a low heathy shrub stratum dominated by scattered regrowth of *B. aemula* and *L. trinervium*, with a moderate ground cover of *Leucopogon* species, *Woolisia pungens*, Fabaceae species (*D. retorta*, *Aotus ericoides* and *Acacia suaveolens* (Sweet Wattle)) and sedges including *Caustis recurvata*, *Hypolaena fastigiata* and *Leptocarpus tenax*.

3.2.1.3 Swamp Mahogany – Paperbark Swamp Forest

This vegetation community occurs across the majority of the offset area to the north of the extraction area.

The community is dominated by *Eucalyptus robusta* (Swamp Mahogany) and *Melaleuca quinquenervia* (Broad-leaved Paperbark) in the canopy with a dense groundcover of *Pteridium esculentum* (Common Bracken) and *Imperata cylindrica* (Blady Grass) on the higher grounds, where recent fires have occurred, and a higher abundance of ferns on the wetter areas, including *Blechnum indicum* (Swamp Water Fern) and *Hypolepis muelleri* (Hard Ground Fern). Some areas had semi-permanent water holes and subsequently had reeds and other water specific species.

A large area of regenerating Swamp Mahogany – Paperbark Swamp Forest occurs in the central section of the study area where sand extraction has historically occurred.

This community forms part of the *Swamp Sclerophyll Forest of Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions* EEC, listed under the TSC Act

3.2.1.4 Swamp Oak Forest

A small area of this community is located in the north eastern corner of the study area; within in the northern biodiversity offset area. This community is dominated by *Casuarina glauca* (Swamp Oak) with *Parsonia straminea* (Common Silkpod) vine. The mid layer was absent and the ground cover had a dense layer of *Kennedia rubicunda* (Dusty Coral Pea) and *P. esculentum*. The sedges, herbs, grasses and ferns associated with this vegetation

community were typical salt tolerant species including *Juncus kraussii* subsp. *australiensis* (Sea Rush).

This community forms part of the *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions* EEC, listed under the TSC Act.

3.2.1.5 Regenerating Grassland – Heath

Within the study area where sand extraction has historically occurred and the native regrowth is not in high abundance, these areas tended to be dominated by grass species including *Eragrostis curvula* (African Lovegrass), *Poa labillardieri* (Tussock), *Melinis repens* (Red Natal Grass) and *Digitaria sanguinalis* (Summer Grass). Some scattered trees included *A. costata*, *Leptospermum laevigatum* (Coast Teatree) and *Banksia integrifolia* (Coast Banksia). Few shrub species were found in the grassland areas.

3.2.1.6 Exotic Grassland / Weed Infestations in Cleared Areas

A portion of the proposed extraction area in the north-west has been disturbed as a result of previous construction for former dwellings on Lots 12 and 13 and a maintenance shed on Lot 11 used in association with strip mining on adjoining lands to the north.

The weed composition is typical of disturbance with exotic tussocks in the grasslands, and a pine plantation extending into the Apple Blackbutt community. The weed composition in the disturbed areas is outcompeting native regrowth.

3.2.1.7 Coastal Teatree Scrub

Coastal Teatree Scrub community located adjacent to Oyster Cove Road is dominated by *L. laevigatum* with some scattered *B. integrifolia* and *A. longifolia*. This section of the study area is outside the extraction area and will not be in the offset strategy.

3.2.2 Fauna Habitat

A range of habitat types have been identified within the extension area, including the following:

- **Woodland and Heath Vegetation:** The majority of the Coastal Sand Apple – Blackbutt community appears to be a remnant, while only a portion of the Coastal Sand Wallum Woodland – Heath appears to be remnant. Both communities are structurally diverse

with three to four habitat layers present and a high presence of Hollow-bearing Trees which provide foraging and breeding habitat for a range of amphibian, reptile, mammal and bird species;

- **Swamp Vegetation:** The remnant Swamp Mahogany – Paperbark Swamp Forest in the north of the study area is structurally diverse with three to four habitat layers, a dense ground cover and multiple Hollow-bearing Trees. The regenerating area of Swamp Forest has a sparser vegetation cover, lacks dense ground cover and hollow-bearing trees. These areas provide a range of foraging and breeding habitats for common and threatened species that occur in the locality;
- **Hollow-bearing Trees:** A total of 36 Hollow-bearing Trees were identified within the study area (**Figure 3**), within the extraction area:
 - There are a total of 17 Hollow-bearing Trees with 38 hollows (20 small; 16 medium and two large);
 - Hollow-bearing Trees 16, 17, 18 and 20 (**Figure 3**) will be retained within the extraction area, these trees contain 12 hollows (seven small, four medium and one large); and
 - Total hollows to be removed from the extraction area is 26 (13 small, 12 medium and one large) within 13 trees.
- **Koala Habitat:** Vegetation mapping confirmed the vegetation running along the northern boundary of the study area (outside extraction area) as preferred Koala habitat as defined under SEPP 44 (**Figure 4**). Preferred Koala feed trees were also recorded within the regenerating Swamp Mahogany Paperbark – Swamp Forest and in a small patch of Swamp Mahogany forest to the south of the existing powerline easement. The Coastal Sand Apple – Blackbutt Forest was determined to represent Supplementary Koala habitat and the Coastal Sand Wallum Woodland Heath community, marginal habitat (Port Stephens Koala Habitat Mapping; Port Stephens Council, 2007). Historical records from the NPWS Atlas suggest that the proposed extraction area forms part of a movement corridor and it has therefore been mapped as Preferred Linking Habitat over Supplementary and Marginal Habitat. There are no preferred Koala food trees within the proposed extraction area; and
- **Wallum Froglet Habitat:** Large areas of habitat contain calling Wallum Froglets occurs within the study area. One area was identified in the north within Swamp Mahogany Paperbark – Swamp Forest around Big Swan Bay, and a second area within the Swamp Mahogany Paperbark – Swamp Forest (regenerating and remnant) on either side of Rutile Road (**Figure 4**). Buffers of approximately 50 m will be retained between the extraction area and these areas of habitat within the offsets (with the inclusion of the visual amenity buffer).

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- Study Area
- Extraction Area (Tanilba Northern Dune Extension)
- Northern Biodiversity Offset Area
- Sub-arterial Road
- Local Road
- Track
- Retained Hollow-bearing Tree (Labelled - Hollow-bearing trees to be retained within the Extraction Area)

- Hollow-bearing Tree - Species**
- *Angophora costata*
 - *Corymbia gummifera*
 - *Eucalyptus pilularis*
 - *Eucalyptus robusta*
 - Dead Stag



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 DATA SOURCE: LPI - 2009, NearMap - 2011

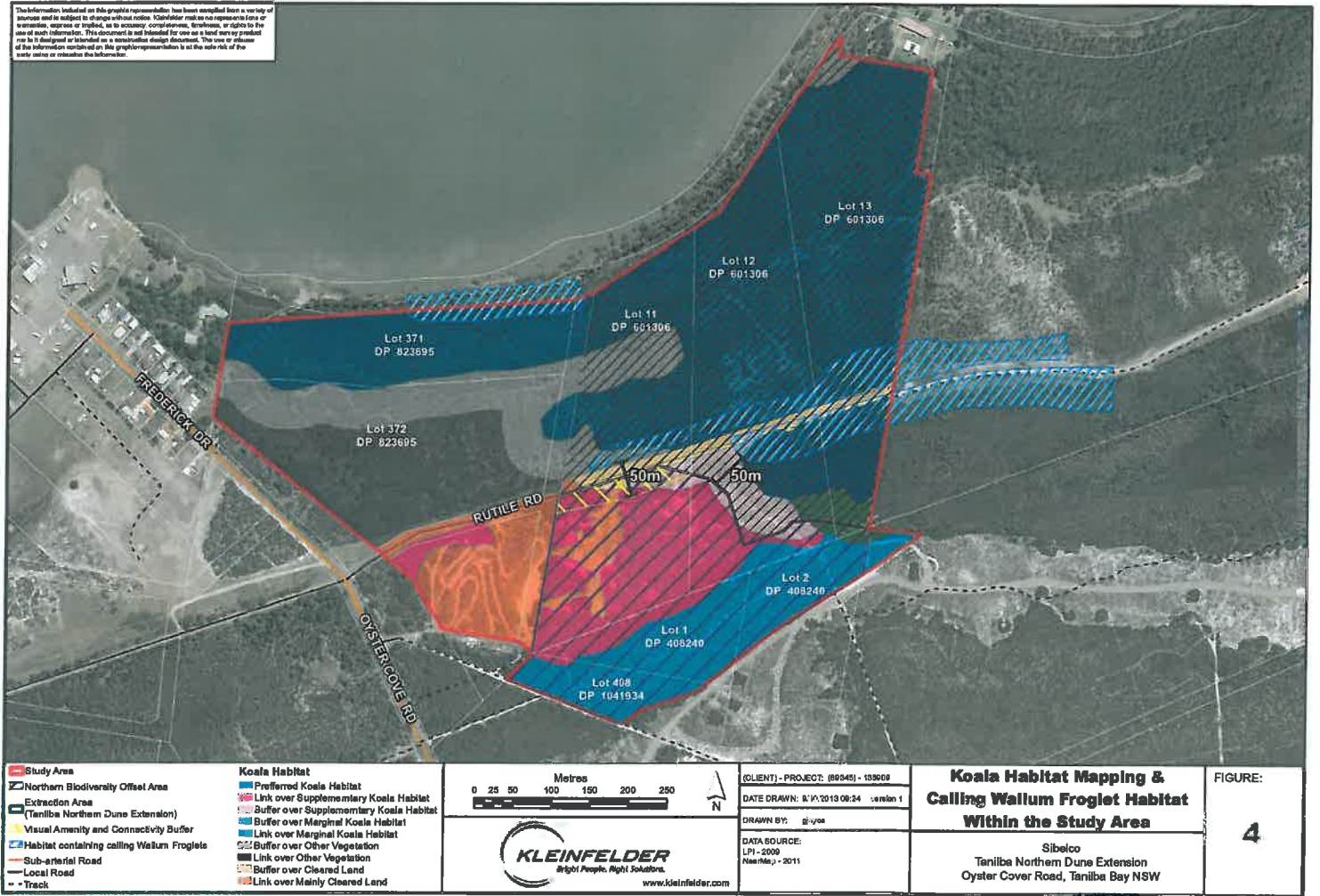
Hollow-bearing Trees Within the Study Area

Sibeco
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 Oyster Cove Road, Tanilba Bay NSW

FIGURE:
3

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3.2.2.1 Threatened and Migratory Species

No threatened flora species were recorded within the Tanilba Northern Dune Extension.

A total of 11 threatened fauna species were recorded during field surveys in 2007 and 2009 within the study area (Table 4 and Figure 5). Three migratory terrestrial species with suitable habitat within the extraction area listed under the EPBC Act were recorded in the study area; *Monarcha melanopsis* (Black-faced Monarch), *Rhipidura rufifrons* (Rufous Fantail) and *Haliaeetus leucogaster* (White-bellied Sea-Eagle).

Table 4: Threatened fauna species recorded during 2007 and 2009 field surveys

Scientific Name	Common Name	TSC Act	EPBC Act
Amphibians			
<i>Crinia tinnula</i>	Wallum Froglet	V	-
Birds			
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-
Mammals			
<i>Miniopterus australis</i>	Little Bentwing-bat	V	-
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	-
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V	-
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-
<i>Phascolarctos cinereus</i>	Koala	V; EP*	V
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V
<i>Pteropus poiiocephalus</i>	Grey-headed Flying-fox	V	V
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-
E = Endangered, V = Vulnerable, EP = Endangered Population			

* Koalas are listed as Vulnerable throughout NSW under the TSC Act, the Koala population at Hawks Nest and Tea Gardens (including the Northern Dune site) is listed as an Endangered Population under the Act.

A previously undescribed amphibian species (*Uperoleia sp. nov.*) was captured in the extraction area during fauna surveys within Coastal Sand Apple – Blackbutt Forest. Genetic tests confirmed that the specimens belonged to an undescribed species (Clulow 2008). A separate study and report (Clulow 2009) was commissioned by Sibelco (formerly Unimin Australia Ltd) to determine a preliminary distribution of the species in the Tomago and Myall Lakes Sandbed systems (which are local to where the species was discovered). This study found that this species is well distributed throughout the Tomago and Tomaree sandbeds, and that it appears to be reasonably abundant where it occurs.

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- Threatened Fauna**
- ★ New Holland Mouse
 - ★ Varied Sittella
 - Eastern Bentwing-bat
 - Eastern Freetail-bat
 - Greater Broad-nosed Bat
 - Grey-headed Flying-fox
 - ⊕ Koala
 - ▲ Little Bentwing-bat
 - ▲ Little Lorikeet
 - Squirrel Glider
 - Uperoleia sp. nov
 - ⊕ Wallum Froglet
 - ▲ SAT Test Location (Koala Activity %)
 - Habitat containing calling Wallum Froglets

- Study Area
- Project Application Area
- Northern Biodiversity Offset Area
- Extraction Area (Tanilba Northern Dune Extension)
- Sub-arterial Road
- Local Road
- Track



(CLIENT) - PROJECT: 88348 - 135008
 DATE DRAWN: 9/10/2019 08:21 Version 1
 DRAWN BY: gjoyce
 DATA SOURCE:
 LPI - 2008
 NearMap - 2011

**Threatened Fauna Species
 Within the Study Area**

Sibelco
 Tanilba Northern Dune Extension
 Oyster Cover Road, Tanilba Bay NSW

FIGURE:
5

3.3 POTENTIAL IMPACTS TO BIODIVERSITY

3.3.1 Direct Impacts

Direct impacts of sand extraction within the Tanilba Northern Dune Extension Area are summarised in Table 5. As the extraction will not remove sand greater than 0.7 m above the predicted water table, it has been determined that there will not be direct impact to groundwater quality or to the hydrology of the surrounding area.

Table 5: Summary of direct impacts of the Tanilba Northern Dune Extension sand extraction project

Impact	Threatened and significant species directly affected
<p>Clearing of 8.2 ha of native vegetation which comprises:</p> <ul style="list-style-type: none"> • Coastal Sand Apple – Blackbutt Forest (4.2 ha) and Coastal Sand Wallum Woodland – Heath (4 ha); • Removal of 13 Hollow-bearing Trees; • Koala Habitat: <ul style="list-style-type: none"> ○ Supplementary Koala Habitat (Coastal Sand Apple – Blackbutt Forest); ○ Marginal Koala Habitat (Coastal Sand Wallum Woodland – Heath); and ○ 0.5 ha of Koala Habitat Buffer. 	<p>Species recorded within the extraction area:</p> <ul style="list-style-type: none"> • Koala (from scats); • Squirrel Glider; • Insectivorous bats (four species); • <i>Uperoleia sp. nov.</i>; and • Varied Sittella. <p>Migratory species recorded within the extraction area:</p> <ul style="list-style-type: none"> • Black-faced Monarch. <p>Additional species recorded within study area:</p> <ul style="list-style-type: none"> • Koala (sighted); • New Holland Mouse; • Grey-headed Flying-fox; • Little Lorikeet; and • Wallum Froglet. <p>Additional migratory species recorded within study area:</p> <ul style="list-style-type: none"> • Rufous Fantail; and • White-bellied Sea-Eagle
<p>Short to medium term interruption to existing wildlife corridor</p>	<p>Species likely to be impacted are:</p> <ul style="list-style-type: none"> • Koala; • Squirrel Glider; • <i>Uperoleia sp. nov.</i> ; • Insectivorous bats; • Varied Sittella; and • Migratory species with suitable breeding and foraging habitat within the proposed extraction area (i.e. Black-faced Monarch, Rainbow Bee-eater, Rufous Fantail, Satin Flycatcher).

3.3.2 Indirect Impacts

Potential indirect impacts of the sand extraction project within the extension area include:

- Loss of breeding opportunities;
- Loss of shade/ shelter;
- Erosion, sedimentation;
- Weed invasion and biotic edge effects;
- Use of biocides, pollution (oil/chemical spills); and
- Rubbish dumping and increased human activity.

4. REHABILITATION MANAGEMENT PLAN

4.1 REHABILITATION OBJECTIVES

The objective of this Rehabilitation Management Plan (RMP) is to progressively re-establish original vegetation community types after sand extraction and completion of landform rehabilitation. The plan sets out to achieve a standard of tree and shrub growth, and recovery in species richness and abundance, as close as possible to that of the original vegetation, within the limits of current best practice techniques, final landform and a reasonable period of post-extraction monitoring.

To achieve this stated objective the RMP will aim at re-establishing:

- Stable and sustainable native vegetation cover, free of erosion;
- The original vegetation community types, although at different proportions due to lowered post-extraction landform;
- The structural components and dominant species of vegetation, comparable with pre-extraction vegetation at similar elevations; and
- Similar species composition to pre-extraction at similar elevations.

Efforts will also be made to re-establish all other structural components of the vegetation including canopy, sub-canopy, understorey, groundcover, and litter, though not necessarily in the same proportions as pre-extraction vegetation at similar elevations, and within the above limits.

4.2 REHABILITATION PLAN

4.2.1 Stages of Rehabilitation

The quarrying within the Tanilba Northern Dune Extension would utilise the progressive rehabilitation methods that are being implemented within the previously approved extraction area to the south of the site. This would involve direct topsoil onto exhausted areas to aid in

revegetation from the topsoil seedbank and stabilise disturbed areas (outlined in **Section 4.3.5**).

The quarrying plan involves a maximum of three hectares of disturbance at any one time; one hectare undergoing sand extraction, a second hectare undergoing clearing and the third undergoing rehabilitation

4.2.2 Final Landform and Vegetation

Due to the lowering of the final landform of the disturbance area, the majority of the site will be returned to Coastal Sand Wallum Woodland – Heath. There may be some scope for rehabilitation of the Coast Sand Apple – Blackbutt community (that also occurs within the disturbance area) in areas that have a higher final landform; also areas of this community may be retained within vegetation islands (patches of retained vegetation within the extraction area; see **Section 4.3.2**).

The final land use plan of the extraction area, including the offset immediately to the north of the site is shown in **Figure 6**.

The final revegetation plan will incorporate as many mature trees as possible. This will occur through the retention of a visual amenity barrier along the north of the disturbance area (six large trees to be retained), the retention of Hollow-bearing trees 16, 17, 18 and 20 (**Figure 3**) within the site, and where possible mature trees will be retained within vegetation islands (outlined in **Section 4.3.2**).

Vegetation within the north east of the application area are too close to the watertable and do not contain any significant silica resources. These areas of remnant vegetation will be retained within the Northern Biodiversity Offset and managed in accordance with the BMP.

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Vegetation Community	
[Pink]	Coastal Sand Apple Blackbutt Forest
[Light Pink]	Coastal Sand Apple Blackbutt Forest - Degraded
[Light Blue]	Coastal Sand Wallum Woodland - Heath
[Light Green]	Regenerating Grassland - Heath
[Dark Green]	Swamp Mahogany - Paperbark Swamp Forest
[Light Green]	Swamp Mahogany - Paperbark Swamp Forest - Regenerating
[Dark Green]	Swamp Oak Forest
[Yellow]	Cleared
[Light Blue]	Coastal Sand Wallum Woodland Heath Rehabilitation

[Red]	Study Area	[Green]	State Conservation Area
[Blue Hatched]	Northern Biodiversity Offset Area	[Yellow]	Visual Amenity and Connectivity Buffer
[Blue Hatched]	Extraction Area (Tanilba Northern Dune Extension)	[Yellow Circle with Cross]	Retained Hollow-bearing Tree (Labelled)
[Red Dashed]	Sub-arterial Road	[Green Circle]	Trees to be retained
[Black Dashed]	Local Road		
[Grey Dashed]	Track		



(CLIENT) - PROJECT: (69345) - 136608
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 DRAWN BY: gjoyce
 DATA SOURCE:
 LPI - 2009

Final Landform & Vegetation

Sibelco
 Tanilba Northern Dune Extension
 Oyster Cover Road, Tanilba Bay NSW

FIGURE:
6

L:\318 FOL\2000 CLIENT FILES\69345_Urbn\In-Australia\136608_ManagementPlan\136608_Fig6_LMP_FinalBiodiversityOffset.mxd

4.3 MANAGEMENT MEASURES

Management measures for the successful rehabilitation of the Tanilba Northern Dune Extension Area are outlined in Table 6. Sibelco will appoint a Safety and Environment Coordinator who will be responsible for ensuring that all management measures required for the rehabilitation management plan are implemented.

Table 6: Management measures and responsibilities for the rehabilitation of Sibelco Northern Dune Extension Area

Item	Action	Trigger/ Timing	Reporting
4.3.1 General Management Measures			
A.	<p>Inductions</p> <p>The site induction will include the following:</p> <ul style="list-style-type: none"> All people entering the site will be made aware of environmentally sensitive habitat and surrounding vegetation and that access to these areas is limited to authorised people only; Procedures to reduce weed spread; and General fire awareness and response procedures. 	During site inductions for staff and contractors	Nil
B.	<p>Controlling Site Access</p> <ul style="list-style-type: none"> Only authorised personnel are allowed to enter the site; all contractors must undergo site induction prior to entering the site; Road access to the extension area will occur via the existing haul road to the Tanilba Northern Dune site off Oyster Cove Road. When truck hauling operations are not being conducted this access point is locked; and The boundaries of the extraction area will be protected through installing locked gates (or similar) at access points, delineation barriers (felled trees, sand mounds, fencing) and the retention of vegetation along boundaries to control access to the area. Monitoring and maintenance of this boundary will occur during regular inspections of the site (bi-annual monitoring, Section 4.6.1). 	At all times	Nil
C.	<p>Hydrocarbon Spills</p> <p>The procedure for handling hydrocarbon spills is outlined in the EMP and is in line with procedures in place within the existing approved Northern Tanilba Dune (to the south of the extension area). The plan provides for an emergency response strategy to effectively minimise, manage, record and remediate any hydrocarbon spills, so as to minimise environmental impacts.</p>	In the event of a hydrocarbon spill	AEMR

Item	Action	Trigger/ Timing	Reporting
4.3.2 Pre-clearing Protocol			
A.	<p>Targeted surveys for <i>Uperoleia sp. nov.</i></p> <p>Prior to the commencement of operations targeted surveys for the novel species of <i>Uperoleia</i> will occur within the extraction area. Surveys will include:</p> <ul style="list-style-type: none"> Active searches (transects and meanders) for two person hours on two separate nights (total four person hours). <p>Ideally, surveys will be conducted in spring, summer or autumn after a suitable rain event (> 50 mm in 48 hours). During the surveys if <i>Uperoleia sp. nov.</i> is identified the following will occur:</p> <ul style="list-style-type: none"> Record habitat type in which the species is identified; Call will be recorded or the individuals will be photographed for positive identification; and The individual will be relocated to an area of similar habitat outside the extraction area. 	In spring, summer or autumn after suitable rain (> 50 mm in 48 hours) prior to operations	AEMR
B.	<p>Fauna Habitat</p> <p>At least one week prior to any vegetation clearing a survey of habitat trees will be conducted in the planned clearing area:</p> <ul style="list-style-type: none"> Habitat trees (containing hollows or nests) will be clearly marked using flagging tape or spray paint and watched at dusk to determine whether any of the hollows are in use by fauna. Any occupied trees will be marked accordingly to indicate the presence of fauna species; Hollow-bearing Trees 16, 17, 18 and 20 (Figure 3) are being retained (preferably within vegetation islands; see Item C below), these trees will be marked to allow easy identification; and Pre-clearing surveys will also be conducted to check for the presence of any Koalas within the proposed extraction area, any trees that Koalas are identified in will be marked to indicate occupation. 	At least one week prior to clearing	AEMR
C.	<p>Weeds</p> <p>During pre-clearing surveys, areas of weed infestation will be delineated to allow for separate stockpiling of this soil.</p>	Prior to clearing	Nil
D.	<p>Protection of Retained Vegetation</p> <ul style="list-style-type: none"> The Operational Area: The extraction area boundary will be surveyed and clearly marked prior to clearing: <ul style="list-style-type: none"> This boundary will also include a five metre buffer of screening vegetation along the northern perimeter of the extension area along Rutile Road to reduce the visual impacts to the north (towards Oyster Cove); and Plant operators and all required site personnel will be made aware of where the boundary is and instructed not to clear outside the boundary to protect surrounding vegetation. 	Prior to clearing	Nil

Item	Action	Trigger/ Timing	Reporting
	<ul style="list-style-type: none"> • Vegetation Islands: Patches of natural vegetation (approximately 10 m x 10 m) will be maintained in shallow mining areas (sand depths less than two metres) at the edges of deeper sands. These areas will be identified and marked prior to clearing based on the following criteria: <ul style="list-style-type: none"> o The islands will represent a range of community types within the extension area; o The vegetation will include significant botanical or ecological attributes such as older Grass Trees, mature canopy species, less common species and species that are difficult or slow to re-establish; o At a minimum Hollow-bearing Trees 16, 17, 18 and 20 will be retained within the extraction area (Figure 3), preferably within vegetation islands. Where possible other habitat trees will also be retained within the vegetation islands; o Their location will be scattered throughout the extraction area, although limited to areas of sand depths less than two metres; and o The total area of retained vegetation will be no less than 2% of the total extension area, to achieve this patches will be retained at an average density of not less than two per hectare. 	Prior to clearing	AEMR
E.	<p>Seed Harvesting</p> <ul style="list-style-type: none"> • Seed Collection: Collection of seed by hand should be conducted prior to vegetation clearing within the disturbance area and surrounds to utilise available seed resources; and • Brush Matting: Where possible, individual plant species (especially <i>Leptospermum</i>, <i>Melaleuca</i> and <i>Eucalyptus</i> species) within the disturbance area will be harvested when they are bearing mature seed (rather than immediately prior to clearing). <p>See Section 4.4 for details of seed harvesting and utilisation.</p>	Up to 12 months prior to clearing (dependent upon species)	AEMR
4.3.3 Vegetation Clearing Protocol			
A.	<p>An area of up to two hectares will initially be cleared of vegetation to provide adequate area in advance of the mining face to permit sand extraction.</p> <p>Clearing of additional areas will be subject to the availability of exhausted areas for rehabilitation. At any one time the area undergoing clearing, sand extraction and rehabilitation will be approximately 3 ha, this will limit topsoil loss and duration of topsoil stockpiling.</p>	During vegetation clearing	AEMR

Item	Action	Trigger/ Timing	Reporting
B.	<p>Protection of Threatened Fauna</p> <p>As multiple threatened species have been identified within the surrounding the study area the following measures will be implemented to minimise impacts to these species:</p> <ul style="list-style-type: none"> • During pre-clearing surveys active searches for Koalas will be conducted and any trees containing Koalas will be marked. If prior to clearing commencing the Koala/s have not relocated from the site the following methodology will be followed: <ul style="list-style-type: none"> ○ Surrounding vegetation will be cleared, no vegetation will be felled onto the occupied tree; ○ The occupied tree will be left standing two nights to encourage self-relocation; ○ If by this time the Koala/s have not self-relocated they will be retrieved from the tree prior to felling and relocated to a safe location outside the disturbance area, if possible with a preferred Koala feed tree (see Table 8, Section 4.4.2). • Peak breeding season of the novel <i>Uperoleia</i> sp. is most likely to be during summer (based on breeding cycle of other <i>Uperoleia</i> sp.); this is when the species is most active and tadpoles will be present. Clearing during summer will be avoided to limit the potential impacts of clearing on the species; • Additionally, the habitat tree clearing protocol (outlined in item C below) will serve to mitigate impacts on other threatened species (Microchiropteran bats, birds, and arboreal mammals) that have previously been recorded in the extension area. 	During vegetation clearing	AEMR

Item	Action	Trigger/ Timing	Reporting
C.	<p>Clearing Protocol</p> <ul style="list-style-type: none"> • A fully qualified, experienced and licenced ecologist will supervise clearing and encourage movement of any displaced animals into adjoining vegetation (see Item D below for details of fauna displacement); • Clearing will be undertaken predominantly by bulldozer and may be conducted in conjunction with topsoil removal; • Vegetation should be cleared in a way that maintains habitat linkages and allows fauna species living in or near the clearing site to move safely from the site to adjacent areas: <ul style="list-style-type: none"> ○ Clearing should occur towards connecting vegetation; ○ The direction of clearing should also ensure that fauna species are directed away from threats such as roads and developed or disturbed areas (e.g. residential areas or cleared spaces > 100 m); and ○ Sequential clearing should not create an 'island' of habitat that is isolated from adjoining habitat by roads or cleared and disturbed areas. • Ideally, no clearing should occur during the early evening or at night (when fauna species are most likely to be on the move and are more vulnerable to injury); • Any available plant material that can be collected for brush matting will be cut ahead of the mining face and spread over areas that have been re-distributed with topsoil; • Large organic debris, and where possible, other vegetation cleared from the operational area will be stockpiled and either spread on rehabilitated areas immediately after re-distribution of topsoil or utilised within the offset areas requiring revegetation; • During clearing additional Aboriginal archaeological surveys will be conducted at approximately 6 to 10 quadrats within the extraction area. Quadrats will be approximately 10 m x 10 m and located in landform areas most likely to contain Aboriginal archaeological sites. Inspections will be conducted by registered Aboriginal stakeholders and if any sites are found the protocol outlined in the Aboriginal Cultural Heritage Management Plan; and • If during vegetation clearing and/ or topsoil stripping any items of Aboriginal cultural heritage are identified procedures outlined in the Cultural Heritage Management Plan will be followed. 	During vegetation clearing	AEMR

Item	Action	Trigger/ Timing	Reporting
D.	<p><u>Habitat Tree Removal Protocol</u></p> <p>Hollow bearing trees will be left standing for two nights after the surrounding vegetation has been cleared to encourage any native fauna species utilising the habitat hollows to self-relocate. The actual felling of any habitat trees will be attended by a suitably experienced fauna ecologist in order to ensure the safety of any fauna found to be in the hollows.</p> <p>On all occasions, trees having potential habitat hollows will be 'soft felled' by an experienced machine operator. The recommended soft felling procedure is as follows:</p> <ul style="list-style-type: none"> • The hollow-bearing tree is given several moderate nudges with an excavator to give a warning to any occupying native fauna; • The hollow-bearing tree is then carefully watched and native fauna given an opportunity to self-relocate before the tree is actually felled; • The hollow-bearing tree is soft felled with the rate of the trees fall controlled by the machinery operator to minimise impact; • All hollows will be inspected for native fauna species and if any are found, the animal should be relocated at an appropriate time of day (i.e. dusk for nocturnal species). If the animal is injured, it should be taken to a local veterinarian (see Item E below); • Hollows should be cut from the tree at least one metre beyond the deepest point of the hollow and then stored in a dry safe place in size related categories, or transported to the offset areas for erection; and • Erection of the hollows will occur within the offset areas in accordance with the Nest Box Installation and Monitoring Protocol outlined in the BMP. 	During felling of habitat trees	AEMR
E.	<p><u>Fauna Displacement Protocol</u></p> <p>Displacement of fauna may occur as part of the clearing process. All clearing will be supervised by a suitable qualified, experienced and licenced ecologist, the following protocol should be followed in case of an injured animal:</p> <ul style="list-style-type: none"> • If possible any fauna fleeing the clearing area should be captured and relocated or directed to a safe area outside the extraction zone during the tree removal process; • All fauna are to be handled in such a way as to prevent injury to the animal or the handler; • Once the animal is safely handled it should be relocated or caged in a hessian bag or box and released at an appropriate time of day; • Any microbats or other nocturnal species captured during the tree removal process should be held in cotton or hessian bags and released at dusk on the same day as capture if possible; • If any animal is injured during the construction process, a veterinarian should be contacted immediately for professional advice on the best course of action; and • If any native animal is injured during other operational/ construction processes while an ecologist, environmental representative or animal handler is not present, they must be contacted immediately. 	When fauna are encountered during clearing or operations	AEMR

Item	Action	Trigger/ Timing	Reporting
F.	<p>Transplanting</p> <p>During clearing, where possible mature <i>Xanthorrhoea</i> species (Grass Trees) will be transplanted to rehabilitation areas using the following methodology:</p> <ul style="list-style-type: none"> The plants will be excavated with a front-end loader (or similar) retaining as much soil around the roots as possible; and The Grass Tree will then be moved to a prepared hole, water in where possible, and burnt. Burning the skirt of dead leaves and some of the lower green leaves is important to stimulate new growth and flowering. 	During vegetation clearing and rehabilitation	AEMR
4.3.4 Topsoil Management			
A.	Topsoil stripping and respreading will be carried out in autumn, winter or spring, and avoided in summer when higher temperatures and hot winds may result in a greater loss of topsoil.	During topsoil stripping and respreading	AEMR
B.	<p>Topsoil Stripping and Stockpiling</p> <ul style="list-style-type: none"> Stripping will normally be conducted by a bulldozer to an average depth of 30 cm (actual depth will be determined by the Safety and Environment Coordinator in consultation with operating personnel); Once an area has been stripped a survey of stockpiles will determine the volume of topsoil reclaimed and available for rehabilitation; The initial removal of topsoil (30 cm from two hectares, generating 7, 000 tonnes) will be stockpiled parallel to the mining path; Subsequent areas (alongside the initial cleared area) can be stripped and redistributed directly over exhausted areas, short term stockpiling in areas approved by the Safety and Environment Coordinator may be required; Topsoil stockpile locations will be determined by the Safety and Environment Coordinator to minimise dust generation, stockpile erosion and sediment run-off; Long-term stockpiles (longer than 6 months) will not exceed a height of three metres, short-term stockpiles (up to six-months) may be of greater dimension, depending on the optimal requirements of the particular situation; and Vegetation usually regenerates naturally on the stockpiles (germination of the seedbank), where native vegetation does not establish on the stockpiles it will be established (seeding/ planting) to maintain soil biological activity. 	During topsoil stripping and stockpiling	AEMR & Topsoil inventory
C.	Throughout the life of the quarrying within the extension area a topsoil inventory will be maintained to determine the volume of topsoil reclaimed and available for subsequent landform rehabilitation.	During operations	Topsoil inventory

Item	Action	Trigger/ Timing	Reporting
4.3.5 Progressive Rehabilitation of Disturbed areas			
A.	<p>Redistribution of Topsoil</p> <ul style="list-style-type: none"> • Topsoil is to be transferred and respread directly over the previous mined area as soon as it is mined out and no longer required for access (exhausted area); • Once an area is exhausted and becomes available for rehabilitation the floor of the mined area will be ripped, if it is hard and impenetrable, prior to redistribution of topsoil; • Direct topsoil transfer from an area ahead of the mining face, to the recently exhausted area, will be utilised to facilitate the natural regeneration of plant species and limit the degradation of soil microbes; • Consideration will be given to segregation of topsoils stripped from different landscape units and subsequent replacement in the appropriate situation in the final landscape; and • Topsoil will be re-distributed at an average depth of 30 cm. 	Once an area is exhausted	AEMR & Topsoil inventory
B.	<p>Seeding and Planting</p> <p>The methodology for revegetation is outlined in Section 4.4, and will include the following:</p> <ul style="list-style-type: none"> • Organic Screening: Organic material sourced from the processing plant will be redistributed over the rehabilitation to provide organic matter, legume seeds and erosion control; • Direct Seeding: Locally sourced seed will be used, and will be sown in the soil rather than broadcast; • Brush Matting: Plant material will be spread in a thick layer over re-topsoiled areas; and • Propagation and Replanting: Seeds collected will be supplied to a local nursery for propagation and planting programs will occur in autumn. 	Post topsoil spreading	AEMR

Item	Action	Trigger/ Timing	Reporting
4.3.6 Rehabilitation Monitoring			
A.	<p>Bi-annual Monitoring</p> <p>Six months after each rehabilitation area (block) has been re-distributed within topsoil bi-annual monitoring will commence. Bi-annual monitoring will occur in summer and winter for a period of three years (six survey events):</p> <ul style="list-style-type: none"> • During the bi-annual monitoring data will be collected from a series of 2 m x 2 m plots that are evenly distributed over the rehabilitation area. Data collected will include the following: <ul style="list-style-type: none"> ○ Species composition; ○ Plant/ species density; ○ Stratum proportions (structural development); ○ Overall growth; ○ Cover; and ○ Presence of fire resistant species. • During each monitoring event inspections of the rehabilitation will also be conducted to identify any weeds, signs of feral pests, erosion issues, die-off and site access issues. <p>See Section 4.6.1 for the bi-annual monitoring protocol.</p>	Bi-annually in Summer and Winter for three years (initial monitoring 6-months post topsoil spreading)	AEMR
B.	<p>Post 3-year Monitoring</p> <p>Post three years rehabilitation blocks will have three monitoring events; at years four, five and eight.</p> <ul style="list-style-type: none"> • Post three year monitoring will consist of one permanent 20 m x 20 m quadrat per hectare of rehabilitation with six 2 m x 2 m plots randomly distributed within the quadrat. Data collected within the 2 m x 2 m plots will be as the bi-annual monitoring (Item A above), and data collected from the 20 m x 20m quadrat will be as follows: <ul style="list-style-type: none"> ○ Total species richness; ○ Average height; ○ Species cover abundance; ○ Reproductive status and any evidence of second generation plants (succession) will be recorded for each species; and ○ General comments; including notes on litter deposition and structural formation. • A photographic record of each quadrat will occur during the post 3-year monitoring; and • Inspections of the rehabilitation will be conducted at each survey to identify any weeds, signs of feral pests, erosion issues, die-off and site access issues. 	Annually at years 4, 5 and 8 post rehabilitation	AEMR

Item	Action	Trigger/ Timing	Reporting
4.3.7 Site Stabilisation, Erosion and Stormwater Control			
A.	The extent of clearing will be clearly delineated to minimise disturbance areas.	Pre-clearing surveys	Nil
B.	The use of best practice erosion and sediment control measures will occur as required to minimise the impacts of soil disturbance on surrounding vegetation/ habitat. Procedures outlined in the Soil and Water Management Plan will be followed.	As required	AEMR
C.	Progressive rehabilitation of the site will be conducted to ensure the disturbance area is revegetated in a timely manner, reducing long-term erosion potential.	During operations	AEMR
D.	Regular inspections of the disturbance area and any control measures that have been implemented will occur to identify potential erosion problems.	As new areas are disturbed	AEMR
4.3.8 Additional Measures for Threatened Species Protection			
These mitigation measures are in addition to those outlined in the pre-clearing and clearing protocols			
A.	Koala Protection <ul style="list-style-type: none"> Staff and contractors will be made aware of the possibility of encountering Koalas during work activities. All staff and contractors will be made aware of the identified Koala habitat surrounding the extraction area and that the extraction area is a potential movement corridor for the species. This will be achieved by placing a map of the identified Koala habitat at Sibelco's site office in view of staff and contractors and through inductions and Toolbox Talks; Speed limits of 20 km/ hr are signposted and enforced across the site; and 	At all times	Nil
	<ul style="list-style-type: none"> Where appropriate habitat for Koala feed trees (Table 8 in Section 4.4.2) occurs in the final landscape, these species will be re-introduced into the rehabilitation area to encourage Koalas into the post extraction landscape. 	During revegetation	AEMR
B.	Wallum Froglet <ul style="list-style-type: none"> The design of the sand extraction activities allows for the retention of a vegetation buffer around the habitat for the Wallum Froglet. With the retention of the visual amenity buffer, there will be a minimum vegetation buffer of approximately 50 m between the disturbance area and the areas of identified habitat for the species (shown in Figure 4); and, As outlined in Section 4.3.7, site stabilisation and erosion control will occur across the disturbance area to mitigate against potential offsite impacts to habitat from soil disturbance. 	During Operations	Nil

Item	Action	Trigger/ Timing	Reporting
C.	<p>Indirect impact to Fauna</p> <p>The use of herbicides, pesticides, insecticides and biocides within all areas (extraction area and offsets) will be limited so to reduce the impacts on threatened species, their habitat and food resources. When chemicals are to be used, techniques that limit the quantity being used will be utilised and less harmful chemicals will be preferred.</p> <p>Weed and pest control to be conducted by a suitably qualified person/contractor.</p>	At all times	AEMR
4.3.9 Weed and Pest Control			
A.	<p>Weed and pest management will be implemented within the extension area to reduce competition, encourage growth of native species and protect locally occurring fauna species. control measures will include:</p> <ul style="list-style-type: none"> • During monitoring of the rehabilitation, inspections will be conducted to identify any weeds, including non-local native species, and pests within the site; • Weed and pest management will be conducted by a suitably qualified contractor with a focus on the recommendations made in the AEMR (as a result of monitoring); and • Control of weeds will predominantly be through manual removal to limit the use of chemicals. Chemical controls will only be utilised where there are significant outbreaks. 	Inspections during monitoring and management as required	AEMR
B.	<p>Vehicles</p> <ul style="list-style-type: none"> • Before any machinery/ vehicle (other than haul trucks) enters the extension area, it must be cleaned to remove all soil and plant material so to limit the introduction and spread of weeds and soil pathogens; • Any haul truck that has been operating on a site other than the Tanilba Northern Dune will be cleaned to remove soil and plant material prior to joining the hauling operation; and • Vehicle access to the rehabilitation will be restricted to authorised personnel. 	<p>Prior to entering site</p> <p>At all times</p>	Nil
C.	Once access tracks are no longer required they will be re-vegetated as they can provide a vector for weeds.	As required	AEMR
4.3.10 Bushfire Management			
A.	A separation distance of 10 m will be maintained between stockpiles of combustible material and remnant vegetation.	During operational planning	Nil
B.	Operations and the site will be managed to minimise the likelihood of ignition sources through good 'housekeeping' (for example, all waste in bins).	At all times	Nil



Item	Action	Trigger/ Timing	Reporting
C.	A emergency action plan will be prepared prior to operations to outline procedures in the event of a bushfire.	Prior to operations	AEMR
D.	All earth moving machinery will be fitted with spark arresting mufflers and haul trucks will have serviceable exhaust systems to prevent accidental ignition of vegetation.	At all times	Nil
E.	The operational area will be equipped with fire fighting measures to assist in the management of any fires on site. Fire extinguishers in all machinery, trucks and vehicles, water cart (as contracted), and the site front-end loader and bulldozer will be available for any requisite fire fighting purposes.	At all times	Nil
4.3.11 Visual Impacts			
A.	Visual impacts of the project will be minimal and short lived, however the following measures will be implemented throughout the project to mitigate any potential impacts: <ul style="list-style-type: none"> Retention of a visual amenity buffer along the northern edge of the extraction area where the site occurs adjacent to Ruttle Road (see Section 4.3.2); and 	Defined during pre-clearing surveys and maintenance as required	AEMR
B.	<ul style="list-style-type: none"> Rehabilitation of the extraction area will occur progressively, as outlined in Section 4.3.5. 	Post-extraction in each area	AEMR

4.4 REVEGETATION METHODOLOGY

As the final landform across the extraction area will be lower than the pre-mining landscape, Coastal Sand Wallum Woodland – Heath will be the target vegetation community across the site. There will be some scope for other vegetation communities (primarily Coast Sand Apple – Blackbutt Forest) in higher areas of the final landform. Therefore, specific species mixes will be required for different landforms within the extraction area.

To aid in the re-establishment of native vegetation over the extraction area a combination of methods will be utilised. Initially topsoil will be distributed over the exhausted areas; a significant number of species will naturally regenerate from the topsoil seedbank. Where certain species are lacking (i.e. major structural species), or are known to not readily regenerate from the topsoil a number of methods will be utilised to re-introduce these species. The revegetation strategy will consist of a schedule that defines species and target plant densities for respective vegetation types in accordance with baseline survey data and recommendations from monitoring events.

Given that vegetation rehabilitation is vulnerable to climatic and other ecological factors (including human intervention), and regeneration of native species follows a pattern of succession over time, rehabilitation areas will be monitored (refer to **Section 4.6**) and supplemented where necessary for up to 8-years after initial planting.

4.4.1 Species Selection and Revegetation Method

The recommended choice of rehabilitation methods for particular plant species is summarized in **Table 7**. This Table will be used as a guide to vegetation rehabilitation. Actual methods of rehabilitation may be modified or varied in response to the results of monitoring surveys as detailed in **Section 4.6**.

Habitat types are abbreviated as follows:

HS: Heathy Scrub: Coastal Sand Wallum Woodland – Heath

F: Forest: Coastal Sand Apple – Blackbutt Forest

Methods of re-establishment, in order of preference, are listed below and are abbreviated as follows:

R Regenerates from topsoil

- B** Brush matting
D Direct Seeding
M Mature Specimens retained in mine path
P Propagation
O Organic Screenings
T Transplanted specimens

Table 7: Species to be re-vegetation on the Tanilba Northern Dune Extension

Scientific Name	Common Name	Habitat	Mode of Re-establishment
<i>Acacia baueri</i>	Tiny Wattle	HS	R, P
<i>Acacia suaveolens</i>	Sweet Wattle	HS/ F	R
<i>Acacia terminalis</i>	Sunshine Wattle	F	R
<i>Acacia ulicifolia</i>	Juniper Wattle	HS / F	R, O
<i>Actinotus helianthi</i>	Flannel Flower	HS / F	R
<i>Amperea xiphocloida</i>	Broom Spurge	HS	R
<i>Angophora costata</i>	Smooth barked apple	F	M, P, D
<i>Banksia aemula</i>	Wallum Banksia	HS / F	P, D
<i>Boronia pinnata</i>	Pinnate Boronia	HS / F	R
<i>Bossiaea ensata</i>	Sword Bossiaea	HS / F	R
<i>Bossiaea heterophylla</i>	Variable Bossiaea	HS / F	R
<i>Calytrix tetragona</i>	Fringe Myrtle	HS	R, P
<i>Caustis pentandra</i>	Thick Twist rush	HS	R
<i>Caustis recurvata</i>	Curly sedge	HS	R
<i>Corymbia gummifera</i>	Red Bloodwood	HS / F	P, B, M
<i>Dianella caerulea</i>	Paroo Lily	F	R, T
<i>Dillwynia retorta</i>	Small leaf Parrot pea	HS / F	R, O
<i>Eriostemon australasius</i>	Wax Flower	HS / F	R, T
<i>Eucalyptus capitellata</i>	Brown Stringybark	F	P, B
<i>Eucalyptus piliularis</i>	Blackbutt	F	P, B, M
<i>Eucalyptus piperita</i>	Sydney Peppermint	HS / F	P, B, M
<i>Eucalyptus robusta</i>	Swamp Mahogany	SF	P, B
<i>Eucalyptus signata</i>	Scribbly Gum	F	P, B
<i>Euryomyrtus ramosissima</i>	Rosy Baeckea	HS / F	R
<i>Gompholobium virgatum</i>	Glory pea	HS / F	R, O
<i>Hakea teretifolia</i>	Dagger Hakea	HS / F	P
<i>Hardenbergia violacea</i>	Purple Coral pea	F	R, O, P
<i>Hibbertia fasciculata</i>	-	HS / F	R

Scientific Name	Common Name	Habitat	Mode of Re-establishment
<i>Hibbertia linearis</i>	Guinea Flower	HS / F	R
<i>Hypolaena fastigiata</i>	Tassel Rope rush	HS / F	R
<i>Isopogon anemonifolius</i>	Drumstick cone bush	HS	R, P
<i>Leptocarpos tenax</i>	Slender Twine rush	HS	R, T
<i>Leptomeria acida</i>	Sour Currant bush	HS	R
<i>Leptospermum trinervium</i>	Paperbark Tea tree	HS / F	P, B
<i>Leptospermum polygalifolia</i>	Yellow Tea Tree	HS / F	P, B
<i>Lepyrodia scariosa</i>	Scale rush	HS	R
<i>Leucopogon ericoides</i>	Pink Beard Heath	HS / F	R
<i>Leucopogon juniperinus</i>	Long flower Beard Heath	HS	R
<i>Leucopogon virgatus</i>	Common Beard Heath	HS / F	R
<i>Lomandra glauca</i>	Pale Mat rush	HS / F	T, R
<i>Melaleuca nodosa</i>	Ball Honey Myrtle	HS	P, B, R
<i>Melaleuca sieberi</i>	Sieber's Paperbark	HS	P, B
<i>Monotoca scoparia</i>	Prickly Broom heath	HS / F	R
<i>Persoonia lanceolata</i>	Geebung	HS / F	R
<i>Pimelea linifolia</i>	Slender Rice Flower	HS / F	R
<i>Pteridium esculentum</i>	Austral Bracken	F	R
<i>Ricinocarpos pinifolius</i>	Wedding Bush	HS / F	R
<i>Tetradlea thymifolia</i>	Black eyed Susan	HS / F	R
<i>Woolisia pungens</i>	Woolisia	HS / F	R
<i>Xanthorrhoea glauca ssp. glauca</i>	Austral Grass Tree	HS / F	T, P, D
<i>Xanthorrhoea latifolia ssp. latifolia</i>	Forest Grass Tree	HS / F	T, P, D

4.4.1.1 Direct Seeding

Locally sourced seed will be used, and will be sown in the soil rather than broadcast. Harvesting of mature seed and direct sowing into re-topsoiled areas at the most appropriate time of year (usually autumn or spring) will be undertaken for species that typically do not readily regenerate from the soil seedbank, such as *Eucalyptus*, *Angophora*, *Banksia* and *Xanthorrhoea*.

Common pioneer (i.e. *Acacia* species and *Actinotus helianthi*) will usually regenerate in abundance and direct seeding is not required. If for any reason they don't germinate within areas of the rehabilitation; they can be introduced in this way.

4.4.1.2 Brush Matting

Rehabilitation will be facilitated by spreading brush matting composed of plant material cut ahead of the mining face and spread in a thick layer over the rehabilitation areas. Large branches and whole plants are preferred for matting because they will not move in the wind. Brush matting facilitates direct seeding, provides a protected microclimate for developing seedlings, and adds nutrients to the soil.

Where possible individual plant species (especially *Leptospermum*, *Melaleuca* and *Eucalyptus* species) will be harvested when they are bearing mature seed rather than immediately prior to clearing. Bradysporous (seed retaining) species are best harvested and spread in autumn whereas geosporous (seed shedding) species are best harvested immediately prior to annual seed release in late spring.

4.4.1.3 Propagation and Replanting

The focus of propagation is twofold:

- Dominant structural species that have difficulty establishing naturally or recalcitrant species, and
- Species that are desired for establishment in strategic locations or densities to achieve the revegetation objective.

Seed will be collected locally and supplied to a wholesale nursery for propagation, or alternatively, will be propagated at the Sibelco nursery. Planting programs will occur in autumn for optimum seedling establishment success.

4.4.1.4 Transplanting

Transplanting of will be a valuable method of revegetation for certain species (outlined in **Section 4.4.1, Table 7**). The transplanting efforts will focus on mature *Xanthorrhoea* species as they are an important part of the heath vegetation and do not readily germinate from the topsoil seedbank. The methodology for transplanting the *Xanthorrhoea* species is outlined in **Section 4.3.3**.

4.4.2 Food Trees for Koalas

All canopy species identified within the extension area are potentially important to Koalas in the Port Stephens LGA; these have been identified from multiple sources (**Table 8**). A focus

on the revegetation of species that are preferred Koala feed trees will occur where appropriate habitat for these species occurs in the final landform. This will aim to encourage Koalas into the post extraction landscape.

Table 8: Tree species important for Koalas within the Tanilba Northern Dune Extension Area (extraction area and offsets)

Scientific Name	Common Name	Source
<i>Angophora costata</i>	Smooth-barked Apple	Potentially important in LGA (CKPoM)
<i>Corymbia gummifera</i>	Red Bloodwood	Potentially important in LGA (CKPoM)
<i>Eucalyptus capitellata</i>	Brown Stringybark	Potentially important in LGA (CKPoM)
<i>Eucalyptus pilularis</i>	Blackbutt	Potentially important in LGA (CKPoM)
<i>Eucalyptus piperita</i>	Sydney Peppermint	Potentially important in LGA (CKPoM)
<i>Eucalyptus robusta</i>	Swamp Mahogany	Preferred feed tree in LGA (CKPoM) Primary feed tree on North Coast (Recovery Plan) Feed tree (SEPP 44)
<i>Eucalyptus signata</i>	Scribbly Gum	Feed tree (SEPP 44)

4.5 PERFORMANCE INDICATORS AND COMPLETION CRITERIA

As stated in Section 4.1 the objective of the RMP is:

“to progressively re-establish original vegetation community types to achieve a standard of tree and shrub growth, and recovery in species richness and abundance, as close as possible to that of the original vegetation, within the limits of current best practice techniques, and a reasonable period of post-extraction monitoring.”

“As close as possible”, recognises the fact that the final landform will be lower in elevation than the original topography resulting in re-vegetated communities being at different proportions when compared with original vegetation community types.

4.5.1 Baseline Data

The desired outcome for the vegetation rehabilitation of the sand extraction areas is to achieve a vegetative structure and content similar to that of the extraction area that will have a similarly shallow elevation above the water table (Coastal Sand Wallum Woodland – Heath).

The target figures for the ideal outcome for the parameters assessed during monitoring have been determined from two 20 m x 20 m (400 m²) sample plots located in the undisturbed vegetation either side of the approved extraction area (Tanilba Northern Dune, near Block A). The baseline target figures are outlined in **Table 9**, and the species composition of the baseline quadrats is shown in **Table 10**. These data will define the ideal species composition and richness, ecosystem structural components, and dominant species for the rehabilitation of the Tanilba Northern Dune Extension Area.

Table 9: Rehabilitation targets from baseline survey quadrats

Parameter	Target figure
Cover (%)	80
Fire resistant species (plants per 4 m ²)	1
Average height (cm)	230
Number of plants (plants per 4 m ²)	40
Number of species (plants per 4 m ²)	12
Structural Proportions	
Ground stratum proportion (%)	27
Shrub stratum proportion (%)	61
Midstorey stratum proportion (%)	7
Overstorey stratum proportion (%)	5
Key Species	
<i>Banksia aemula</i> (plants per ha) – Midstorey	2 600
<i>Corymbia gummifera</i> (plants per ha) - Overstorey	80
<i>Eucalyptus piperita</i> (plants per ha) - Overstorey	30
<i>Leptospermum trinervium</i> (plants per ha) – Midstorey	1 360
<i>Melaleuca nodosa</i> (plants per ha) - Overstorey	2 800

Table 10: Species composition of baseline survey quadrats

Species	Stratum	Target Cover Abundance (c.a)
<i>Acianthus fornicatus</i>	G	1
<i>Schizaea dichotoma</i>	G	1
<i>Banksia oblongifolia</i>	M	1
<i>Dampiera stricta</i>	G	1
<i>Darwinia leptantha</i>	S	1
<i>Dillwynia retorta</i>	S	1
<i>Hibbertia linearis</i>	S	1
<i>Leucopogon esquamatus</i>	S	1
<i>Lomandra glauca</i>	G	1
<i>Petrophile pulchella</i>	S	1
<i>Platysace linearifolia</i>	S	1
<i>Pseudanthus orientalis</i>	S	1
<i>Schoenus ericetorum</i>	G	1

Species	Stratum	Target Cover Abundance (c.a)
<i>Acacia suaveolens</i>	S	2
<i>Acacia ulicifolia</i>	S	2
<i>Amperea xiphioclada</i>	G	2
<i>Baëckea imbricata</i>	S	2
<i>Boronia pinnata</i>	S	2
<i>Bossiaea ensata</i>	S	2
<i>Bossiaea heterophylla</i>	S	2
<i>Cassyltha glabella</i>	G	2
<i>Conospermum taxifolium</i>	S	2
<i>Dianella</i> sp.	G	2
<i>Entolasia stricta</i>	G	2
<i>Eriostemon australasius</i>	S	2
<i>Hibbertia fasciculata</i>	S	2
<i>Hypolaena fastigiata</i>	G	2
<i>Isopogon anemonifolius</i>	S	2
<i>Juncus continuus</i>	G	2
<i>Lepidosperma</i> sp.	G	2
<i>Leptocarpos tenax</i>	G	2
<i>Leptomeria acida</i>	S	2
<i>Leptospermum polygalifolium</i>	M	2
<i>Leucopogon ericoides</i>	S	2
<i>Leucopogon virgatus</i>	S	2
<i>Persoonia lanceolata</i>	S	2
<i>Pimelea linifolia</i>	S	2
<i>Ricinocarpos pinifolius</i>	S	2
<i>Tetratheca thymifolia</i>	S	2
<i>Themeda australis</i>	G	2
<i>Calytrix tetragona</i>	S	3
<i>Cautis recurvata</i>	G	3
<i>Corymbia gummifera</i>	O	3
<i>Euryomyrtus ramosissima</i>	S	3
<i>Harmogia densifolia</i>	S	3
<i>Leptospermum trinervium</i>	M	3
<i>Monotoca scoparia</i>	S	3
<i>Woolisia pungens</i>	S	3
<i>Eucalyptus piperita</i>	O	4
<i>Leptospermum juniperinus</i>	S	4
<i>Melaleuca nodosa</i>	O	4
<i>Xanthorrhoea glauca</i>	S	4
<i>Banksia aemula</i>	M	5

G=Ground; S=Shrub; M=Midstorey; O=Overstorey.

4.5.2 Performance Indicators

At each stage of monitoring the rehabilitation will be compared to the performance indicators outlined in. If the rehabilitation areas are not meeting these performance indicators specific management measures will be outlined in the AEMR.

Table 11: Performance indicators for Tanilba Northern Dune Extension rehabilitation

Year	Aims for Each Strategic Ecosystem Development Stage	Performance Indicators
1		<ul style="list-style-type: none"> • Early pioneer stage appearing: Small seedlings (< 5 cm) regenerating from topsoil, < 5% surface cover; • At least 25 mature Grass Trees per hectare; • Brush-matting evident; and • Adequate store of fresh local seed.
2	<p>Monitoring will be on a bi-annual basis until achieving the early pioneer stage, with the following features:</p> <ul style="list-style-type: none"> • Topsoil stabilized by primary colonizers (eg. acacias & pea species); • Key species present and densities increasing towards target numbers (outlined in Table 9); 	<ul style="list-style-type: none"> • Natural regeneration of pioneer species covering 20% of ground surface, average 20 cm tall; • Seedlings developing under brush-matting; • Planted trees and shrubs in predetermined numbers according to revegetation strategy, 20 - 30 cm tall; • No significant erosion problems; • Noxious or significant environmental weeds control programme in place; and • Rehabilitation area is clean of rubbish.
3	<ul style="list-style-type: none"> • No significant erosion problems; and • Weed control program in place 	<ul style="list-style-type: none"> • All structural species present in predetermined density, 30 - 90 cm tall; • Shrub layer and ground cover strata evident; • Natural regeneration covering 40 - 60% of surface, average 50 - 80 cm tall; • No significant erosion problems; • Weed control programme in place and weeds successfully controlled; and • Rehabilitation area is clean of rubbish.
4	<p>Single annual monitoring event to determine development of mature pioneer stage characterised by:</p> <ul style="list-style-type: none"> • Gradual dieback of some primary colonizers; • Appearance of mature vegetation species; • Key species present at target densities, or showing increase towards target numbers (outlined in Table 9); 	<ul style="list-style-type: none"> • Structural species in predetermined density, average 1 m tall; • Mature pioneer stage evident; cover 60 - 80%, average 80 cm; • No significant erosion problems; • Weed control programme in place and weeds successfully controlled; and • Rehabilitation area is clean of rubbish.
5	<ul style="list-style-type: none"> • Beginning of differentiation of structural layers (canopy, sub-canopy, shrub layer); • No significant erosion problems; and • Weed control program in place. 	<ul style="list-style-type: none"> • Decline in pioneer community, coinciding with emergence in canopy species; • Canopy layer emerging above shrub layer; • No significant erosion problems; • Weed control programme in place and weeds successfully controlled; and • Rehabilitation area is clean of rubbish.

Year	Aims for Each Strategic Ecosystem Development Stage	Performance Indicators
8	<p>Single monitoring event to determine development of early stages of mature vegetation assemblage characterised by:</p> <ul style="list-style-type: none"> • Increase in dominant shrub and tree species; • Development of structural layers; and • Species composition similar to pre-mining. 	<ul style="list-style-type: none"> • Overstorey and midstorey species increasing in height and percentage cover; • Overstorey and midstorey species density stable; • Key overstorey and midstorey species present at densities comparable to pre-mining at similar elevations; • Increase in differentiation of structural layers, including litter; and • Overstorey layer evident above shrub layer.

4.5.3 Completion Criteria

At the end of the monitoring program (8-years) the rehabilitation will be assessed against the completion criteria set out in **Table 12**. Each rehabilitation block will be assessed against these completion criteria to determine eligibility of operational areas for release from further rehabilitation or monitoring, and if the rehabilitation bond can be released (Condition 20).

The Completion Criteria will be independently audited to assess whether those Release Criteria are in fact reasonable performance indicators for the Extraction Operations in respect of the objectives of the RMP.

Table 12: Completion criteria for Tanilba Northern Dune Extension rehabilitation

Completion Indicator	Completion Criteria
Vegetation islands retained within the extraction area.	Minimum of two vegetation islands per hectare within the extraction area (equivalent to minimum 2% vegetation retained within the extraction area).
Topsoil coverage across the rehabilitation area.	100% topsoil cover.
Similar species composition to pre-extraction at similar topographic levels.	Species composition of the rehabilitation similar to that outlined in Table 10 .
Species richness of overstorey species 100% compared to baseline data.	<i>Corymbia gummifera</i> , <i>Eucalyptus piperita</i> and <i>Melaleuca nodosa</i> present across the rehabilitation.
Species richness of common midstorey 100% compared to baseline data.	<i>Banksia aemula</i> , and <i>Leptospermum trinervium</i> are present across the rehabilitation.
Canopy average height.	Canopy >1.5 m tall.
Midstorey average height .	Midstorey >1 m tall.
Shrub layer average height.	Shrubs 90 cm tall.
Structural components present at densities comparable to baseline data.	Structural proportions of the rehabilitation comparable to Table 9 .
Dominant species (> 2m) present at densities comparable to baseline data.	Canopy species (<i>Corymbia gummifera</i> , <i>Eucalyptus piperita</i> and <i>Melaleuca nodosa</i>) and midstorey species (<i>Banksia aemula</i> , and <i>Leptospermum trinervium</i>) present at densities comparable to Table 9 .
Litter development.	Early litter development evident.

4.6 MONITORING PROTOCOL

Monitoring of the rehabilitation over time will occur to assess progression against performance indicators, completion criteria and rehabilitation objectives. Monitoring will also be used to identify any weed and pest problems, erosion and die-off of species within the rehabilitation.

4.6.1 Bi-annual Monitoring

4.6.1.1 Plot monitoring

Each block will have points overlaid in a grid fashion at approximately 15 m intervals using a GIS program; these points represent a single sample plot, each 2 x 2 m (4 m²). The plot points will be confirmed in the field during the first monitoring event, to ensure each point occurs within the extraction area. These confirmed points will be retained and used for following monitoring events until completion after 3 years.

The pre-confirmed 2 x 2 m quadrat locations will be uploaded on to hand held GPS unit and a qualified ecologist will visit each of these quadrat locations using the GPS. Once the point is located, four 2 m poles will be laid on the ground around the point to define the sample area and the data outlined in Table 13 will be collected at each point.

Table 13: Details of data collected at each survey

Parameter	Details	Description
Species	The total number of different species of plant present.	A measure of biodiversity/ species composition
Plants	The total number of each species present.	A measure of plant/ species density.
Stratum proportions – ground, shrub, midstorey and overstorey species	The proportion of species which will become ground, shrub, midstorey and overstorey layers.	A measure of the stage of vegetation development and community structure
Height	The average height of all plants in the plot.	An indicator of overall growth.
Cover	An estimate of the total plot area having plant cover-percentage of area.	A measure of the total green cover for the rehabilitation area.
Fire resistant species	The proportion of fire resistant species to total species present.	An indicator of the potential resilience of the new vegetation to a fire event.

4.6.1.2 Inspection

During all monitoring events an inspection of each block for weeds, signs of feral pests, erosion, die-off and site access issues will occur. Any significant problems will be mapped.

4.6.1.3 Reporting

Data will be collected bi-annually and reported on annually. These data will be compared to the baseline information and any previous surveys events to assess the progression of the rehabilitation. Additionally, the rehabilitation will be assessed against the performance indicators outlined in **Table 11**. If the rehabilitation blocks are not meeting these performance indicators, specific management measures (i.e. revegetation measures, weed and pest control and/ or measures for erosion control) will be outlined in the AEMR.

4.6.2 Post 3-year Monitoring

4.6.2.1 Quadrat Monitoring

One permanent 20 m x 20 m quadrat will be established per hectare of rehabilitation. This quadrat will be used to give a broad scale indication of the rehabilitation structure and diversity. The quadrat location will be in an area that is representative of rehabilitation within the block. The data collected from each quadrat will include:

- Total species richness;
- Average height;
- Species cover abundance based on the modified Braun-Blanquet cover abundance scale:
 - 1 < 5% cover, few individuals or sparse occurrence;
 - 2 < 5% cover, many individuals;
 - 3 5 – 25% cover;
 - 4 25 – 50% cover;
 - 5 50 – 75% cover; and
 - 6 75 – 100% cover.
- Reproductive status and any evidence of second generation plants (succession) will be recorded for each species; and
- General comments; including notes on litter deposition and structural formation.

4.6.2.2 Plot Monitoring

Within the 20 m x 20 m quadrats, six 2 m x 2 m plots will be surveyed (methods as **Section 4.6.1**). The location of each of these plots within the 20 m x 20 m will be selected at random each year.

4.6.2.3 Photographic Record

A permanent photographic monitoring point will be established in one corner of each quadrat. A panoramic photograph will be taken at each survey to allow a visual assessment of the rehabilitation progression in future monitoring events.

4.6.2.4 Inspection

During all monitoring events an inspection of each block for weeds, signs of feral pests, erosion, die-off and site access issues will occur. Any significant problems will be mapped.

4.6.2.5 Reporting

The survey data from the post 3-year monitoring will be compared against the baseline data, previous survey events and the performance indicators to assess the progression of the rehabilitation. Any recommendations for revegetation, weed and pest control and any mitigation measures for erosion issues will be outlined in the AEMR. In addition, the eight year survey data will be assessed against the completion criteria (outlined in **Table 12**) to determine whether the rehabilitation block can be released from further rehabilitation and monitoring.

4.7 RISK ASSESSMENT

Table 14 outlines the potential risks to successful rehabilitation that have been identified and the measures that have been implemented to ensure successful rehabilitation.

Table 14: Potential risks to rehabilitation success and management measures to mitigate these risks

Risks	Contingency Measures	Section
Topsoil resource degraded and not fully utilised (loss of seedbank)	Stockpiling of topsoil will be avoided where possible. Topsoil is to be respread directly onto rehabilitation areas rather than stockpiled to prevent the degradation of the associated seedbank. Where stockpiling does occur it will be at a maximum height of three metres.	4.3.4
	Topsoil will be stripped and spread at an average thickness of 30 cm.	
	Stripping will be avoided during summer.	
Erosion	Best practice erosion and sediment control measures will be used (as outlined in the Soil and Water Management Plan).	4.3.7
	Progressive rehabilitation will occur to limit exposed areas.	4.3.5
	Monitoring will identify any areas of erosion and recommended appropriate mitigation measures.	4.6
Plant species mix not in accordance with final land use	Only species outlined in Section 4.4.1 will be seeded and planted into the rehabilitation area.	4.3.5 and 4.4.1
	Only seed collected from the disturbance area and surroundings (through seed collection or brush matting) will be used on the rehabilitation.	
Failure of seeded/ planted species	The most appropriate revegetation method for each species will be used.	4.4.1
	Seeds will be sown rather than broadcast to limit loss, and direct seeding will be avoided in summer.	4.4.1.1
	Material for brush matting will be collected at the most appropriate time depending upon the species.	4.4.1.2
	Tubestock will be planted during autumn to maximise survival rates.	4.4.1.3
	Biannual monitoring will identify areas containing any failed plantings which can then be replanted if necessary.	4.6.1
Structural layers of mature vegetation not developing	Bi-annual and post three year monitoring will identify any areas deficient in key structural components and outlined additional plantings/ seeding required.	4.6
Invasive species and pests impacting on rehabilitation development	Vehicle hygiene to be maintained before accessing the site.	4.3.9
	Monitoring will identify and weed or pest problems and recommend actions as required.	4.3.9 and 4.6
Bushfire impacts	Bushfire measures will be implemented to manage potential bushfire impacts.	4.3.10
Unauthorised access impacting on development of rehabilitation	Access to the site will be controlled at all times.	4.3.1
Extreme natural weather events (drought or flood)	If any extreme weather events occur the regular monitoring events will detect impacts (erosion and plant die-off) and recommend appropriate mitigations measures.	4.6

5. LONG TERM MANAGEMENT STRATEGY

5.1 OBJECTIVES AND CRITERIA FOR CLOSURE

The rehabilitation aim for the extraction area is to re-establish the original vegetation community types; although at different proportions due to variations in landform. Hence, the long term objective of the extraction area is that the native vegetation established across the site is a self-sustaining ecosystem that provides habitat to flora and fauna, and also serves as fauna habitat corridor.

Post extraction management is expected to occur up to Year 8, where revegetation and monitoring is undertaken. At Year 8, based on previous rehabilitation it is expected that the completion criteria (**Table 12**) will be achieved. Once completion criteria is achieved, and the Director-General is satisfied the Rehabilitation Bond (Condition 20) can be released. On release of the bond the site would be subject to the long term management and land use defined in **Section 5.2**. Release of the rehabilitation may occur progressively during the life of the operation, and quarry closure would be considered to be achieved on release of the bond from the full extraction area.

5.2 LONG TERM MANAGEMENT AND FUTURE SITE USE

As the rehabilitation plan for the extraction area is to return the disturbed areas to native vegetation consistent with the pre-cleared vegetation communities and the surrounding landscape, the most appropriate use for the site would be conservation.

Part of the extraction area is on land that is not owned by Sibelco; Lots 1 and 2 DP 408240 are owned by the HWC and Lot 408 DP 1041934 is Crown Land. Once the rehabilitation area is released these lands would be returned to their respective owners and the long-term management would be dependent upon HWC and Crown Lands.

The objective for the part of the extraction area that is owned by Sibelco, Lots 11, 12 and 13 DP 601306, is conservation. This area is connected to the Northern Biodiversity Offset to the north and the Gir-um-bit State Conservation Area to the north east. Potential options to providing long-term security for the Biodiversity Offset Areas are either enter into a

Biobanking Agreement in accordance with Part 7A of the *Threatened Species Conservation Act 1995*, or to transfer the Biodiversity Offset Areas into the national parks estate. Once the rehabilitation area has met the completion criteria, BioBanking or transfer to national parks estate are also potential options for the long-term security of the land owned by Sibelco. This would provide a positive outcome as it would expand conserved lands in the locality and provide protection for a greater area of the east-west wildlife corridor along the Tilligerry Peninsula.

6. REPORTING FRAMEWORK

Reporting, as required for the Tanilba Northern Dune Extension Project, will occur through the AEMR. The following summarises the reporting requirements of this LMP:

- Details on the pre-clearing surveys conducted in the past year, including:
 - Description of the targeted *Uperoleia sp. nov.* surveys conducted and details of any individuals encountered;
 - Description methods conducted during fauna habitat surveys and details of the features identified;
 - Description and location of the vegetation islands retained; and
 - Information on seed harvesting methods carried out.
- Details of clearing conducted in the past year, including:
 - Details of any fauna species encountered and description of relocation method;
 - Details of resources stockpiled for re-use within rehabilitation areas or transferred to the Biodiversity Offsets; and
 - Details of any transplanting.
- A description of the topsoil resources and the methods used (either stockpiling or direct transfer);
- Details of rehabilitation actions carried out in the past year, including:
 - Topsoil distribution; and
 - Seeding and planting methods carried out.
- Details of erosion and sedimentation controls in place and their effectiveness;
- Describe the management works (weed and pest control) that were carried out in the previous year, and the works that are proposed to be carried out over coming year; and
- A comprehensive review of the rehabilitation area monitoring results over the past year, which includes:
 - A comparison of the results against the previous year;
 - Assessment against performance indicators; and
 - Identify trends in the monitoring data over the life of the project.

The AEMR will be distributed to PSC, OEH, HWC and DP&I, the report will also be made publically available on Sibelco's website.

Other reporting requirements relevant to this LMP include a Topsoil Inventory, which will be maintained to maximise the utilisation of the resource. The document will characterise the topsoil resources in terms of:

- Quantity;
- Source;
- Type;
- Characteristics;
- Native seedbank potential; and
- Weed seedbank potential.

The Topsoil Inventory will be distributed internally and used as required during topsoil stripping and rehabilitation.

7. REVIEW AND PERFORMANCE

This LMP will be reviewed and/ or updated annually, or within three months of a:

- Submission of an Annual Environmental Management Report;
- Submission of an Independent Environmental Audit; and
- Modification to the conditions of the Project Approval that has the potential to alter impacts.

In order to assess the performance of this LMP the following aspects will be considered:

- Are the performance indicators and completion criteria being met at the various stages of rehabilitation? And are the completion criteria still appropriate?
- Do the management actions still fulfil the objectives?
- Were the management actions and reporting completed as specified within the plan?
- Are aspects of the plan now obsolete, inefficient or ineffective?

The response to these aspects will inform the update of the LMP.

7.1 ROLES AND RESPONSIBILITIES

The Sibelco Operations Manager has the overall responsibility for works undertaken at the Tanilba Northern Dune Extension. The appointed Safety and Environment Coordinator, reports to the Operations Manager, and is responsible for implementation of the management measures detailed in Table 6, engaging appropriately qualified personnel to undertake required actions, engaging stakeholders appropriately to assist with actions as relevant, and review of this LMP.

Other Mine Personnel and Contractors involved in construction and operation activities will be required to follow the directions of Sibelco and abide by the requirements of this plan.

8. REFERENCES

Clulow (2008). *Resolution of the taxonomic status of a species of the frog genus Uperoleia (Gray, 1841) found at Oyster Cove, New South Wales*. Report prepared by ecobiological for Sibelco Australia Limited (formerly Unimin Australia Limited).

Department of Planning and Infrastructure (DP&I) (2013) *Project Approval 09_0091 Tanilba Northern Dune Extension Project*. Approved 8 March 2013.

ERM (2012) *Tanilba Northern Dune Sand Extraction Extension: Environmental Assessment Report, Volume 1 & 2*. Prepared under the Environmental Planning and Assessment Act 1979 – Section 75.

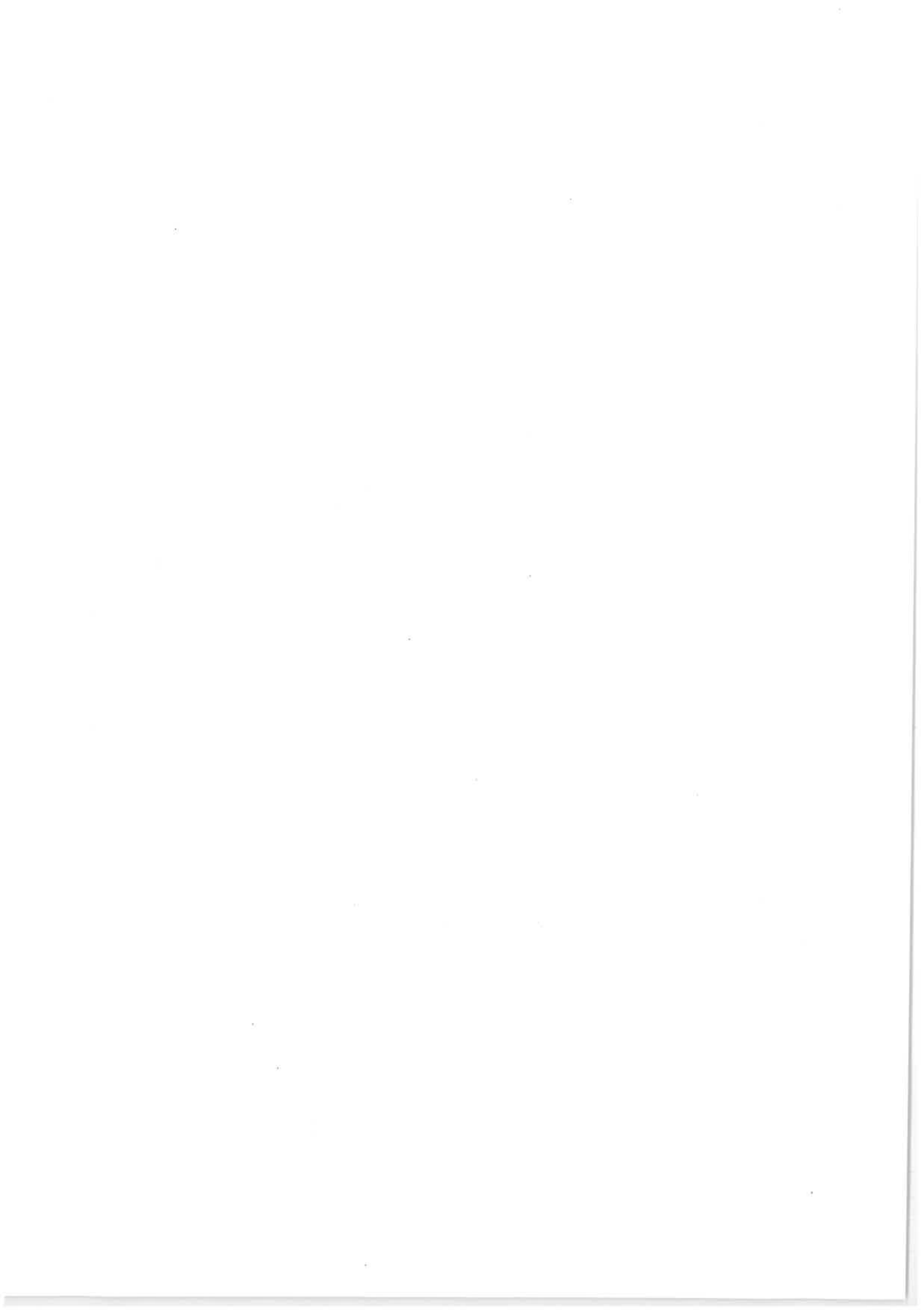
Port Stephens Council (2007) *Koala Habitat Planning Map – Medowie/ Tilligerry Aug06*. Mapping prepared by Land use Planning: Sustainable Planning Group for Port Stephens Council, February, 2007.

APPENDIX 1. RELEVANT PROJECT APPROVALS

Condition	Condition Requirement	Section where Addressed
17	The Proponent shall prepare and implement a Landscape Management Plan for the project to the satisfaction of the Director-General. This plan must: a) Be prepared: <ul style="list-style-type: none"> ○ By suitably qualified person(s), approved by the Director-General; and ○ In consultation with Council and HWC; 	This document is the Landscape Management Plan and has been prepared by Kleinfelder for approval by the DG.
	b) Be plan must be submitted to the Director-General for approval prior to commencing quarrying operations; and	
	c) Include: <ul style="list-style-type: none"> ○ A Rehabilitation Management Plan; and 	Section 4
	<ul style="list-style-type: none"> ○ A Long Term Management Strategy. 	Section 5
18	The Rehabilitation Management Plan must include: a) Rehabilitation objectives for the site;	Section 4.1
	b) A description of the measures that would be implemented to: <ul style="list-style-type: none"> ○ Rehabilitate and stabilise the site; ○ Minimise the removal of mature trees; and ○ Manage the remnant vegetation and habitat on the site. 	Section 4.2
	c) Detailed performance and completion criteria for the rehabilitation and stabilisation of the site;	Section 4.5
	d) A detailed description of how the performance of rehabilitation would be monitored over time to measure achievement of the performance and completion criteria and the rehabilitation objectives	Section 4.3.6
	e) A detailed description of what measures would be implemented to rehabilitate and manage the landscape of the site, including the procedures to be implemented for: <ul style="list-style-type: none"> ○ Progressively rehabilitating and stabilising areas disturbed by quarrying; 	Section 4.3.5
	<ul style="list-style-type: none"> ○ Implementing revegetation and regeneration within the disturbance areas; 	
	<ul style="list-style-type: none"> ○ Protecting areas outside the disturbance areas; 	Section 4.3.2
	<ul style="list-style-type: none"> ○ Vegetation clearing protocols, including a protocol for clearing any trees containing hollows and the relocation of hollows from felled trees; 	Section 4.3.3
	<ul style="list-style-type: none"> ○ Managing impacts on fauna; 	Section 4.3.2, Section 4.3.3 and Section 4.3.8

Condition	Condition Requirement	Section where Addressed
	<ul style="list-style-type: none"> o Controlling weeds and pests; 	Section 4.3.9
	<ul style="list-style-type: none"> o Controlling access; 	Section 4.3.1
	<ul style="list-style-type: none"> o Bushfire management; and 	Section 4.3.10
	<ul style="list-style-type: none"> o Reducing the visual impacts of the project. 	Section 4.3.2 and Section 4.3.5
	<ul style="list-style-type: none"> 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 	Section 4.7
	<ul style="list-style-type: none"> g) Details of who is responsible for monitoring, reviewing, and implementing the plan. 	Section 7.1
19	<p>The Long Term Management Strategy must:</p> <ul style="list-style-type: none"> a) Define the objectives and criteria for quarry closure and post-extraction management; 	Section 5.1
	<ul style="list-style-type: none"> b) Investigate and/or describe options for the future use of the site; c) Describe the measures that would be implemented to minimise or manage the ongoing environmental effects of the project; and d) Describe how the performance of these measures would be monitored over time. 	Section 5.2
20	<p>Prior to commencing quarrying operations, the Proponent shall lodge a rehabilitation bond for the project with the Director-General. The Proponent may lodge the rehabilitation bond in two portions. The first portion for 4.5 hectares must be lodged with the Department prior to commencing quarrying operations, with no land disturbance to exceed 4.5 hectares until the second portion of the bond is accepted by the Department.</p> <p>The sum of the bond shall be calculated at \$2.50/ m² for the area to be disturbed by quarrying operations, to the satisfaction of the Director-General.</p> <p>If rehabilitation and revegetation works have been completed in accordance with the Rehabilitation Management Plan and to the satisfaction of the Director-General, the Director-General will release the rehabilitation bond.</p> <p>If rehabilitation and revegetation works area not completed to the satisfaction of the Director-General, the Director-General will call in all parts of the rehabilitation bond, and arrange for the satisfactory completion of the relevant works.</p>	Section 4.5

APPENDIX 2. STAKEHOLDER CONSULTATION



APPENDIX 3. RELEVANT STATEMENTS OF COMMITMENTS

Issue	Mitigation measure/ Commitment	Section where Addressed
Ecology	Hollow bearing trees 16, 17, 18 and 20 (refer to Figure 2.2, Northern Dune Submission Report) to be retained.	Section 4.3.2 of this LMP
	<ul style="list-style-type: none"> Avoidance of the use of biocides and implementing erosion and sediment controls; 	Section 4.3.6 and Section 4.3.7 of this LMP and Section 5.1.7 of the BMP
	<ul style="list-style-type: none"> Incorporating implementation of pre-clearing surveys, a fauna displacement mitigation protocol, Koala mitigation measures, nest box installation and monitoring, and a monitoring plan for the Wallum Froglet (as detailed in Annex M of the EA); 	Section 4.3.2, Section 4.3.3, Section 4.3.7 of this LMP and Section 5.1.7, Section 5.1.2 and Section 5.2.4 of the BMP
	<ul style="list-style-type: none"> Staged rehabilitation of the extraction area (to be supported by a Vegetation Rehabilitation Management Plan), to be conducted in the same fashion as successful rehabilitation of Sibelco's existing approved extraction areas directly to the south; and 	Section 4.3.5 of this LMP
	<ul style="list-style-type: none"> Implementation of an offset strategy as detailed in Section 11.6.4 of the EA 	Section 1.4 and Section 5.1.2 of the BMP
Vegetation Clearing	At least one week prior to any vegetation clearing, a survey of habitat trees will be conducted in the planned clearing area in accordance with the survey methodology outlined in Section 11.6.1 of the EA	Section 4.3.2 of this LMP
	Pre-clearing surveys will be conducted to check for the presence of any Koalas within the proposed extraction area	
	Hollow-bearing trees will be left standing for two nights after the surrounding vegetation has been cleared to encourage any native fauna species utilising the habitat hollows to self-relocate. The actual felling of any habitat trees will be attended by a suitably experienced fauna ecologist in order to ensure the safety of any fauna found to be in the hollows. On all occasions, trees having potential habitat hollows should be 'soft felled' by an experienced machine operator in accordance with the procedure outlined in Section 11.6.1 of the EA	Section 4.3.3 of this LMP.
Fauna Displacement Protocol	A fully qualified, experienced and licenced ecologist will supervise clearing and encourage movement of any displaced animals into adjoining vegetation	Section 4.3.3 of this LMP.
	Captured fauna and/ or displaced fauna will be relocated to adjacent habitat by an ecologist. During tree removal or any other construction activity, Fauna Displacement Protocols outlined in Section 11.6.2 of the EA will be followed in the case of any injured animal	

Issue	Mitigation measure/ Commitment	Section where Addressed
Wallum Froglet Management Plan	<p>A management plan for the Wallum Froglet (<i>Crinia tinnula</i>) will be developed in accordance with the management guidelines outlined under Section 6 of the National Recovery Plan for the Wallum Sedgefrog and Other Wallum-dependent Frog Species. In particular this will include:</p> <ul style="list-style-type: none"> • Minimising affects from soil disturbance; • Ensuring sufficient retention of vegetation particularly around breeding sites; and • Monitoring the habitat condition and frog numbers to ensure the threats to the speices are properly managed. This should be undertaken with sufficient regularity and should preferably be carried out a year or more before development starts and continue for the duration of extraction operations, including rehabilitation works 	Section 5.1.7 and Section 5.2.4 of the BMP.
Nest box installation and monitoring program	<p>A next box installation and monitoring program will be implemented on a ratio of 2: 1 to replace 38 hollows present in 17 Hollow-bearing Trees mapped within the proposed extraction area. Nest boxes should be erected prior to clearing commencing in order to provide alternative dens and / or nest sites for any displaced fauna.</p> <p>Nest boxes are to be erected within the Proposed Offset Areas on Lots 11, 12 and 13. Nest box design should be selected to replace the natural hollow sizes removed (i.e. 20 small, 16 medium and 2 large) and will target insectivorous bats, gliders and possums. Annual monitoring for a minimum 6-year period post installation is recommended to record uptake of the nest boxes and to attend to any maintenance issues. A brief letter confirming annual inspection of the nest boxes and documentation of results should be provided to OEH.</p>	Section 5.1.2 of the BMP.
Vegetation Management and Monitoring Plan	<p>Wee Management and Vegetation Management and Monitoring Plans will be prepared for the rehabilitation area and proposed Offset Ares on Lots 11, 12, 13 and 24, which will include a through and intensive program to protect the adjoining forested wetland communities against weed invasion, and surface and underground run-off that may occur both during and after sand extraction activities. The management and monitoring plans will consider:</p> <ul style="list-style-type: none"> • The nature and control of sediment run-off during the extraction phase particularly as a result of an exceptional storm event; • The volume path and content of stormwater discharging from the site during and after extraction; • The handling of hydrocarbon spills on the site; • Existing flow regime of surface and groundwater flow from the proposed extraction area into the forested wetlands; and • Weed invasion. 	Section 4.3.1, Section 4.3.7 and Section 4.3.9 of this LMP, and Section 5.1.4, Section 5.1.5 and Section 5.2 of the BMP.
Biodiversity Offset Strategy	<p>A Biodiversity Offset strategy will be adopted as outlined in detail in Appendix P of the EA. Biodiversity offsets are proposed on lands currently owned by Sibelco, comprising portions of Lots 11 to 13, DP601306 (approximately 18.35 ha) and all of lots 24, DP579700 (approximately 9.44 ha) (the offset lands). A secure offset mechanism (through Voluntary Conservation Agreement or other similar tool for management in perpetuity) will be placed over these offset lands which will result in permanent protection and management of the land and result in numerous ecological benefits.</p>	Section 1.4 and Section 5.1.2 of the BMP.

APPENDIX 4. STAFF CONTRIBUTIONS

The following Kleinfelder staff were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
Dan Pedersen	BSEngTech GFireE, BPAD-A	Senior Ecologist (Botany)/ Bushfire Consultant	Report technical review
Gayle Joyce	BSc (Forestry) (Hons)	GIS Specialist	Preparation of maps
Jonathan Berry	BAppSc (Hons)	Senior Environmental Planner	Report peer review
Gilbert Whyte	PhD	Senior Ecologist (Botanist)/ Entomologist	Report preparation
Samara Schulz	BEnvSc & Mgt (Hons)	Ecologist	Report preparation