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MACKA'S SAND PTY LTD

LANDSCAPE MANAGEMENT PLAN

Including Rehabilitation Management Plan and Long Term Management Strategy

FINAL

November 2021

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FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Mackas Sand Pty Limited

Project Director: Luke Bettridge
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Report No. R93
Date: November 2021

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
1	Brendan Rice (Umwelt (Australia) Pty Limited)	July 2016	Peter Jamieson (Umwelt (Australia) Pty Limited)	July 2016
2	Brendan Rice (Umwelt (Australia) Pty Limited)	August 2017	Bret Jenkins (Umwelt (Australia) Pty Limited)	August 2017
3	Rod Williams (Umwelt (Australia) Pty Limited)	November 2018	Bret Jenkins (Umwelt (Australia) Pty Limited)	November 2018
4	Rod Williams (Umwelt (Australia) Pty Limited)	February 2019	Bret Jenkins (Umwelt (Australia) Pty Limited)	February 2019
5	Dominic Brown (Umwelt (Australia) Pty Limited)	November 2021	Luke Bettridge (Umwelt (Australia) Pty Limited)	November 2021

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1.0 Introduction

Mackas Sand Pty Ltd (Mackas Sand) operations on Lots 218 and 220 are located approximately 25 kilometres (km) north-east of Newcastle near Salt Ash in the Port Stephens local government area (LGA) of New South Wales (NSW) (refer to **Figure 1.1**). Mackas Sand directors have operated sand extraction operations in the area since 1992. Lots 218 and 220 are owned by the Worimi Local Aboriginal Lands Council.

Mackas Sand was granted Project Approval No. 08_0142 (PA 08_0142) on 20 September 2009 by the Minister for Planning under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to operate sand extraction operations at Lots 220 and 218 (referred to hereafter as the Project). It is estimated that in excess of 21 million tonnes (Mt) of sand resource will be extracted from Lots 218 and 220, with Lot 218 having an indefinite extraction life due to the ongoing movement of sand from the adjoining mobile dunes.

The Project has been the subject of two (2) approved modifications, being:

- **Modification 1**: The modification includes a change to the approved extraction level from 1.0 to 0.7 metres (m) above the maximum predicted groundwater level (subject to satisfying additional requirements), as well as the construction and use of an alternative haul route to access Lot 218. The alternate route connects directly from Lot 218, northward to Nelson Bay Road, as depicted within **Figure 1.1**. Modification 1 (MOD 1) was approved on 30 September 2013 by the NSW Planning Assessment Commission (PAC) under delegation of the Minister for Planning and Infrastructure (now Secretary for the Department of Planning, Industry and Environment - DPIE). Construction of the MOD 1 alternate route commenced on 9 December 2013. With the subsequent extraction of sand commencing at Lot 218 in February 2015.
- **Modification 2**: Altering the truck movements (in and out) of Lot 218. Modification 2 (MOD 2) was approved by the PAC on 16 March 2016

1.1 Mackas Sand Operations

Key operational features relevant to this Landscape Management Plan (LMP) are:

- The approved hours of extraction being 24 hours a day 7 days a week except for operations within 250 m of the Hufnagl Residence (R27) near Lot 220 when operations at Lot 220 are limited to 7.00 am to 6.00 pm with no operations within 250 m of R27 outside these times, unless Mackas Sand has an agreement with R27 to generate higher noise levels and the Department has been advised in writing of the terms of this agreement.
- Transportation of sand from Lots 218 and 220 in accordance with the Project Approval (Condition 9 (b) of Schedule 3) between 5.00 am and 10.00 pm Monday to Saturday and 8.00 am to 12.00 pm Sundays and Public Holidays subject to Mackas Sand holding agreements with the identified owners. Copies of these agreements have been provided to the DPE.

Image Source: Nearmap (Jan 2021)

Legend

- Lot Boundaries
- Approval Areas
- Approved Site Access (not-utilised)
- Approved Site Access (utilised)
- Approved Alternate Site Access (utilised)

FIGURE 1.1

Locality Plan

1.2 Purpose and Scope

To satisfy Condition 25 and 26 of Schedule 3 of PA 08_142 (as modified), a LMP is required to be prepared and implemented for the project. The LMP is to be prepared in consultation with the Office of Environment and Heritage (OEH), DPI Water and Port Stephens Council (Council) and submitted to the DPE for approval.

The scope of the Mackas LMP covers sand extraction operations on Lots 218 and 220 approved under PA 08_0142 (as modified) and involve the following:

- a Rehabilitation Management Plan (RMP) that describes the short, medium, and long term measures to rehabilitate and landscape the site (**Section 3.0**)
- performance and completion criteria for rehabilitation and a program to monitor the progress of the rehabilitation measures against the performance and completion criteria (**Sections 3.2** , **3.3** and **3.8**)
- a Long Term Management Strategy that defines the objectives and criteria for quarry closure and post-extraction management and future uses of the site (**Section 4.0**)
- measures to minimise or manage the ongoing environmental effects of the Project (**Section 4.3**)
- a long term monitoring program to monitor the performance of the measures to minimise ongoing effects against performance criteria (**Section 4.4**).

Although there are limited rehabilitation opportunities within Lot 218, the long term final landform for this lot is included as part of this LMP as required by Condition 24 of PA 08_0142 (as modified).

1.3 Regulatory Requirements

1.3.1 Project Approval

A detailed list of the applicable PA 08_142 (as modified) conditions and where they are addressed in this document is included in **Table 1.1**

Mackas Sand referred a controlled action to the DPE for the construction of an alternate haul route from Nelson Bay Road to access the approved sand extraction area at Lot 218 (EPBC Act Referral 2011/6214). Mackas Sand has received Federal Approval for referral 2011/6214 from the DPE under the *Environmental Protection Biodiversity Conservation Act 1999* (EPBC Act) on 29 November 2013. A separate LMP has been prepared to meet the requirements of EPBC Approval 2011/6214. Additional requirements from the EPBC LMP have been included within this document where relevant. A copy of the EPBC LMP is available on the Mackas Sand website.

Table 1.1 Project Approval Conditions

Conditions		Addressed in Section
Schedule 3 – Environmental Performance Conditions **Rehabilitation**		
24.	The Proponent shall progressively rehabilitate the site in a manner that is generally consistent with the final landform in the EA, to the satisfaction of the Secretary.	**Whole document**

Conditions		Addressed in Section
	Note: The department acknowledges that the rehabilitation activities on Lot 218 may be limited given the planned ongoing extraction on this lot. However, the long-term landform for Lot 218 must be addressed as part of the Landscape Management Plan.	
Schedule 3 – Environmental Performance Conditions **Landscape Management Plan (LMP)**		
25.	The Proponent shall prepare and implement a LMP for the project to the satisfaction of the Secretary. This plan must: a. be prepared in consultation with OEH, DPI Water and Council, and be submitted to the Secretary within 6 months of the date of this approval, or prior to any vegetation clearing on Lot 220, whichever is sooner;	**Whole Document**
	b. include a: ○ Rehabilitation Management Plan (RMP); and ○ Long Term Management Strategy. The Proponent shall implement the approved management plan as approved from time to time by the Secretary.	**Section 3.0**
26.	The RMP must include: a. the objectives for the site rehabilitation and site landscaping;	**Section 3.1**
	b. a description of the short, medium, and long term measures that would be implemented to rehabilitate and landscape the site;	**Sections 3.4, 3.5** and **3.6**
	c. detailed performance and completion criteria for the site rehabilitation and site landscaping;	**Sections 3.2** and **3.3**
	d. a detailed description of the measures that would be implemented over the next 3 years, including the procedures to be implemented for: ○ progressively rehabilitating disturbed areas; ○ landscaping the site to minimise visual impacts; ○ protecting vegetation and soil outside the disturbance areas; ○ preventing and/or minimising the accretion of sand dunes outside the project disturbance areas; ○ undertaking pre-clearance surveys; ○ salvaging and reusing material from the site for habitat enhancement; ○ managing impacts on fauna; ○ maintaining koala habitat linkages; ○ conserving and reusing topsoil; ○ collecting and propagating seed for rehabilitation works;	**Section 3.7**

Conditions		Addressed in Section
	○ salvaging and reusing material from the site for habitat enhancement; ○ controlling weeds and feral pests; ○ controlling access; and ○ bushfire management.	
	e. program to monitor the effectiveness of these measures, and progress against the performance and completion criteria;	**Section 3.8**
	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 3.9**
	g. details of who would be responsible for monitoring, reviewing, and implementing the plan.	**Section 1.4**
27.	The Long Term Management Strategy must: • define the objectives and criteria for quarry closure and post-extraction management; • investigate and/or describe options for the future use of the site; • describe the measures that would be implemented to minimise or manage the ongoing environmental effects of the project; and • describe how the performance of these measures would be monitored over time.	**Section 4.0**
Schedule 3 – Environmental Performance Conditions Rehabilitation Bond		
28.	Within 3 months of the approval of the Landscape Management Plan, the Proponent shall lodge a rehabilitation bond for the project with the Secretary to ensure that the site rehabilitation is implemented in accordance with the performance and completion criteria of the Landscape Management Plan. The sum of the bond shall be determined by:	**Section 3.10**
	a. calculating the full cost of rehabilitating the site in each 3 year review period (see condition 7 of schedule 5); and	
	a. Employing a suitably qualified expert to verify the calculated costs, to the satisfaction of the Secretary. *Notes:* • If the rehabilitation is completed to the satisfaction of Secretary, the Secretary will release the bond. • *If the rehabilitation is not completed to the satisfaction of the Secretary, the Secretary will call in all or part of the bond, and arrange the satisfactory completion of the relevant works.*	

1.3.2 Stakeholder Consultation Regarding this Document

The approved LMP was developed in consultation with the DPIE, NSW Office of Water (NOW) and Council.

A copy of the revised LMP has been submitted to DPIE, NOW and Council for comment. Any comments received have been considered and addressed during the compilation of a final version, prior to the LMP submission to DPIE for the Secretary's satisfaction. Consultation records for this revision of the LMP will be provided in **Appendix 2** of this document.

1.4 Roles and Responsibilities

The Quarry Manager will be responsible for ensuring that the development is undertaken in accordance with the requirements of PA 08_0142 (as modified). Responsibilities in relation to landscape and rehabilitation management and monitoring are outlined in **Table 1.2**

Table 1.2 Roles and Responsibilities

Role	Responsibilities
Quarry Manager	• provide that sufficient resources are allocated for the implementation of this LMP • ensure that the requirements of this LMP are effectively implemented • schedule rehabilitation activities as per this plan • authorise internal and external reporting requirements as well as subsequent revisions of this program • ensure that the plan is relevant to current operations • ensure that all personnel are aware of noise management obligations • periodically reviewing progress against closure objectives and rehabilitation criteria • authorising internal and external reporting requirements as well as subsequent revisions of this program.
All employees and contractors	• undertake all activities in accordance with this LMP • undertake the compulsory site induction.

1.5 Proposed Final Land Use Option and Rehabilitation Strategy

The final landform at Lot 218 will be governed by the natural movement of sand into the extraction area, with mobile sand progressively filling the extraction area over time. Rehabilitation of this site will consist of the establishment of a bunded vegetated area at the western edge of the extraction area to provide a physical barrier between the mobile sand and native vegetation on the landward side of the mobile dunes.

Rehabilitation will be undertaken progressively at Lot 220 as extraction operations continue. Rehabilitation objectives for the site will be to:

- Ensure that at the end of the life of the operation, all infrastructure and equipment other than access roads that may be used in the future will be removed from the site. The site will be rehabilitated to re-establish the Coastal Sand Apple – Blackbutt Forest community that currently exists at the site.

- Achieve a final landform that is compatible with the surrounding topography and provides at minimum a cover of 1 m of sand above the predicted maximum groundwater level or 2 m above average groundwater level, in accordance with Schedule 2, Condition 7A of PA 08_0142.

To inform the management of the extraction depth and final landform requirements of Schedule 2, Condition 7 and 7A of PA 08_0142, Mackas will install physical depth markers for machinery operators to use as a point of reference when extracting sand, complete a weekly inspection of the extraction depth against the physical markers and validate the operational depth and extent against survey plans on a quarterly basis. Quarterly survey plans will be focus on active operational areas and will be provided in the Annual Review.

It is envisaged that the rehabilitated area may be incorporated into the Worimi Conservation Lands.

2.0 Environmental Baseline

The project area forms part of the Stockton Bight dune system and is located approximately 20 to 25 km to the north-east of Newcastle, near Salt Ash (refer to **Figure 1.1**). An overview of the existing environmental baselines for the area is outlined below.

2.1 Land Use and Tenure

Prior to sand mining, Lots 218 and 220 were vacant and were disturbed through activities such as vehicle and horse movements, walking and sand dune tours, weapons testing and squatting. Previous surveys undertaken in the area found evidence of vegetation clearing, suggesting other land uses may have occurred, such as grazing.

Both lots are zoned E3 Environmental Management under the Port Stephens LEP 2013. The access road into Lot 220, and the approved alternate access road to Lot 218 are located on land zoned RU2 Rural Landscape. Legal access is not granted to the public for entry to Lots 218 or 220, although both sites are used by off-road vehicle users and horse riders for recreational activities.

The land capability and agricultural suitability of the Lots 218 and 220 was mapped by OEH in 2009 and was found to be very low. Both lots were found to have a land capability of VII to VIII and an agricultural suitability classification of 5 and are therefore unsuitable for agriculture.

The lots were previously Crown lands and were granted to Worimi LALC in 2001 under the *Aboriginal Land Rights Act 1983*.

2.2 Services

A 50 m wide electricity transmission easement traverses Lot 220, generally from east to west across site (refer to **Figure 2.1**). This easement has never been used and Energy Australia (now Ausgrid) has indicated that this easement is no longer required.

A 20 m wide electricity transmission easement containing an overhead transmission line is located to the north of Lot 220. The easement and overhead transmission line continue along the edge of the inter-barrier depression and cross the approved alternate access road to the north of Lot 218.

2.2.1 Surrounding Land Uses

Lot 218 is bounded by land zoned RU2 Rural Landscape to the north and E1 National Parks and Nature Reserves to the east, south and west. Lot 220 is bounded by land zoned RU2 Rural landscape to the north and west and E1 National Parks and Nature Reserves to the east and south. Stockton Bight and the fore dunes (zoned E1 National Parks and Nature Reserves) remain accessible via Lavis land and other tracks along the dune area. Existing tracks are shown on **Figure 2.1**. Land uses in the vicinity of the Lot 218 and Lot 220 remain consistent with the activities presented in **Section 2.1**. Other land uses in the vicinity include:

- sand extraction, from operations run by Toll Bulk Sands to the west of Lot 218 (Pt Portion 77, Portions 71, 72, 93, 99, 100 and 157), Quality Sands and Ceramics, Sibelco adjacent to the west of Lot 220 on Lot 4 in DP 774726, Salt Ash Sand Quarry to the north of Lot 220 on Lot 4042 in DP 1090633 and Lots

632 & 633 in DP 609506 and existing Mackas Sand operations to the west of Lot 220 on Portion 3 in DP 753194 (refer to **Figure 2.2**)

- cattle grazing and other agricultural uses, which generally occur on low lying land such as the flats associated with Tilligerry Creek to the north
- water reserves – provision is made within the Water Sharing Plan for the Tomago Tomaree Stockton Groundwater Sources 2003 for Hunter Water Corporation (HWC) to obtain an allocation to utilise groundwater from the Stockton aquifer to supplement its existing reserves. A HWC easement in Water Reserve 57573 is located between the northern section of Lot 218 and the southern section of Lot 220. The easement contains no groundwater infrastructure at present but may, subject to licensing, be commissioned and used by HWC to access groundwater supplies if required in the future; and
- conservation, the Worimi Conservation Lands adjoin Lot 218 to the north, south and east and Lot 220 to the south. The conservation lands form a 4438 hectare (ha) conservation area that includes Worimi State Conservation Area, Worimi National Park and Worimi Regional Park.

A small number of residential and rural residential properties are located in the general area to the north of Lot 220; with one property located approximately 50 m to the north of the lot boundary (refer **Figure 2.2**). Two residences are located at the end of Lavis Lane, approximately 1 km to the west of Lot 218, and 6 residences are located near the approved Nelson Bay Road intersection for the alternate haul route to Lot 218.

2.3 Groundwater

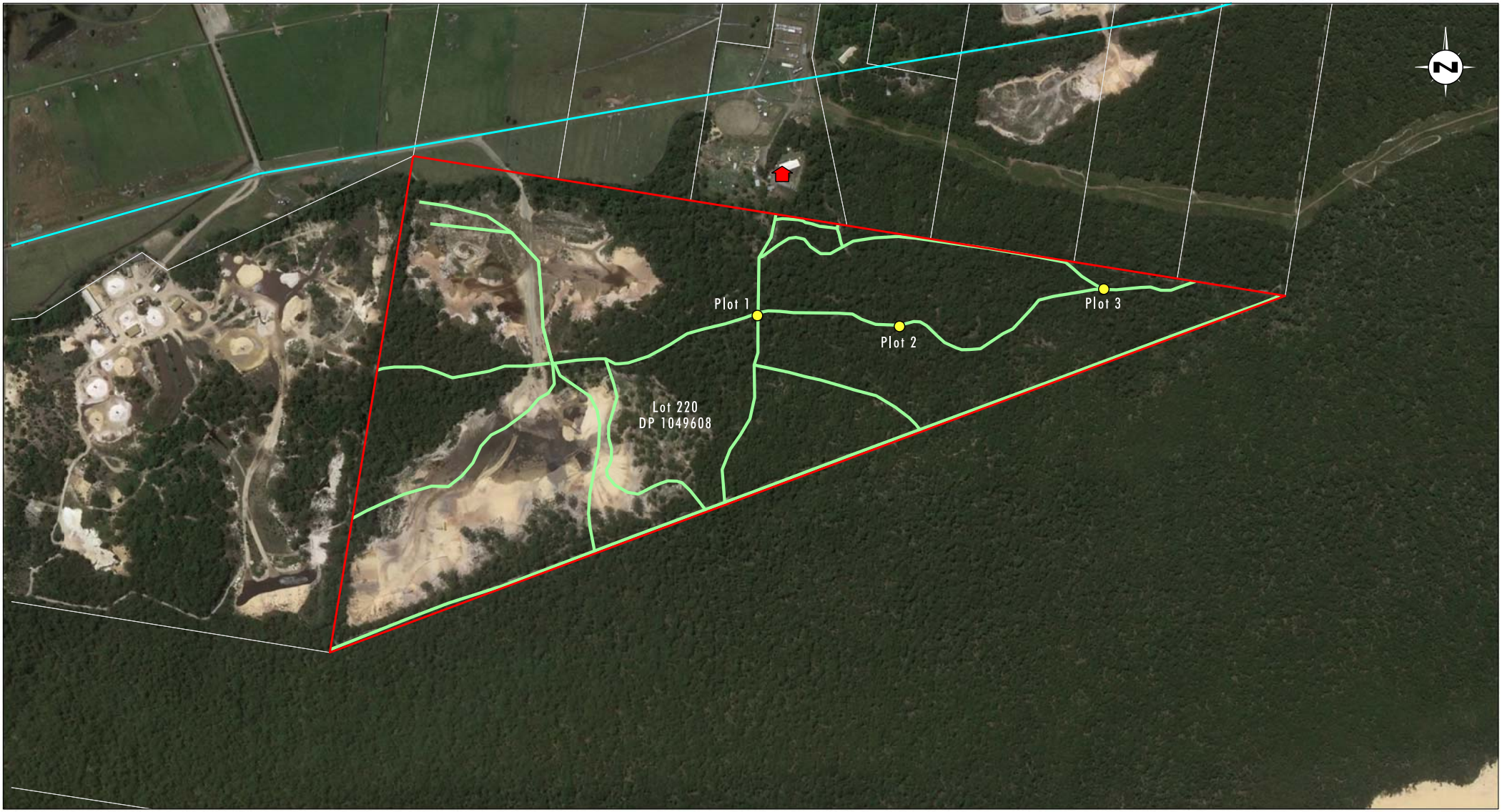
The sand extraction areas are located on the Stockton Sandbeds, a groundwater resource that has been identified by HWC as a potential reserve of potable water. Groundwater resources in the region are managed in accordance with the Water Sharing Plan for the Tomago-Tomaree-Stockton Groundwater Sources. HWC currently utilises groundwater from the Tomago and Tomaree Sandbeds which are located to the north and north-east of the Lots 218 and 220 extraction areas respectively. These groundwater aquifers provide approximately 20% of the potable water supplies to the Lower Hunter Region.

2.4 Acid Sulphate Soils

The Williamtown 1:25,000 Acid Sulfate Sulphate Soils Risk Map (NSW Department of Natural Resources 2006) classifies almost all of the extraction area as Wd4 and Wa4, which are described as landforms resulting from aeolian processes forming either dunes or sandplains at an elevation of above 4 m Australian Height Datum (AHD). The probability of acid sulphate soils being present in this landform is considered to be low. Any acid sulphate materials likely to be present will be sporadically distributed and at least 3 m below the ground surface and possibly much deeper if buried by windblown sand.

Very small sections of the north-eastern corners of the Lot 218 operational area and Lot 220 are classified Wa2 and Ap2 soils respectively. These soils are also considered to have a low probability of containing acid sulphate soils, although may contain acid sulphate material between 1 and 3 m below the ground surface. The section of Lot 220 that contains Ap2 soils will form part of the vegetation buffer that will surround the site and will not be disturbed.

It is considered that operations pose minimal risk of exposing acid sulphate soils, as sand extraction will not occur below the groundwater table. The probability of acid sulphate soils occurring within the extraction areas is very low as all of the material to be extracted would have been exposed to the air in the past. To date the extraction operations have not encountered any acid sulphate soils.



Source: Google Earth (2016)
Note: Reference Monitoring Sites (Section 3.8.1)

0 100 250 500m
1:10 000

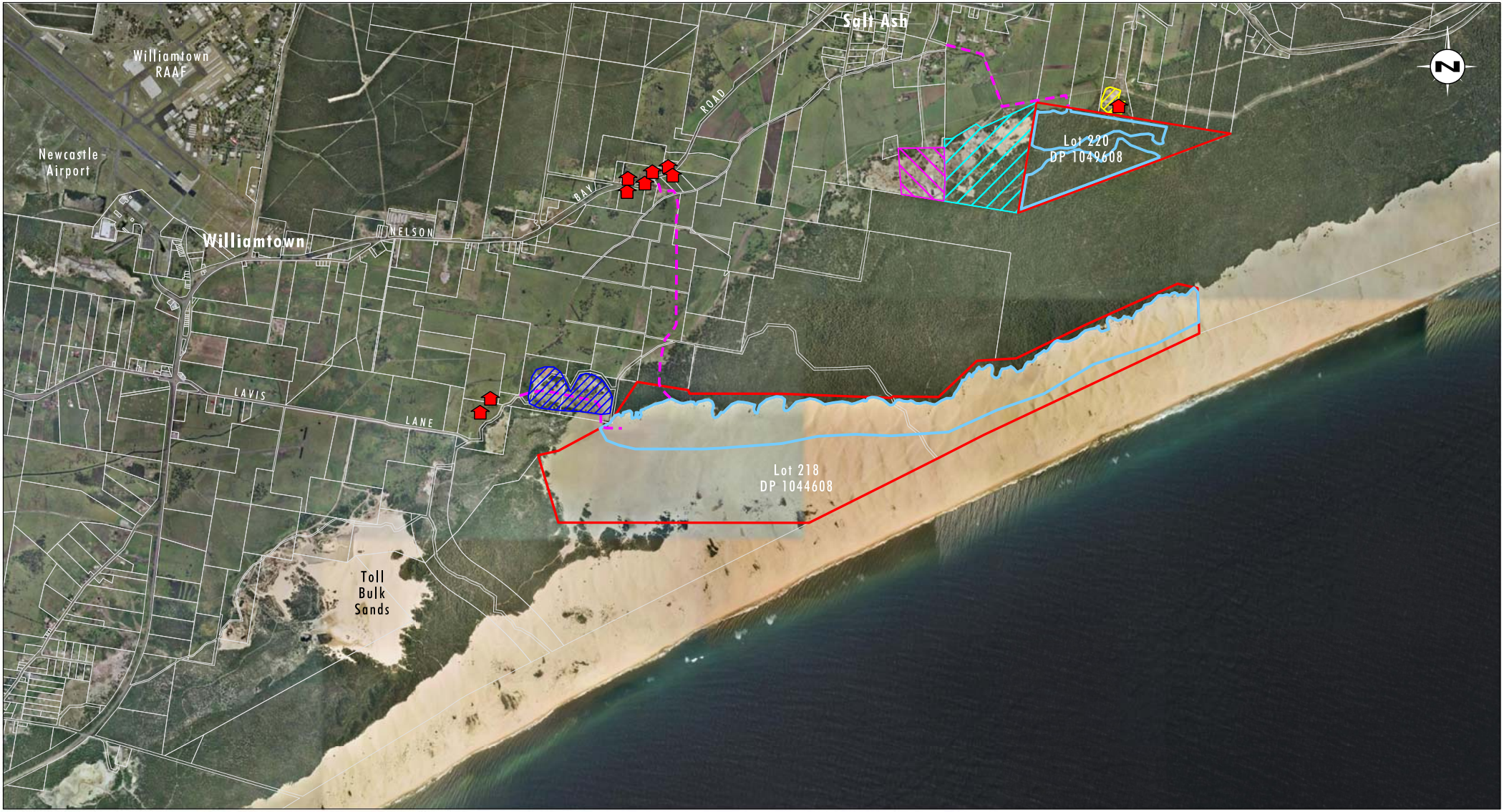
Legend

- Lot 220 Boundary
- Hufnagl Residence
- Existing Transmission Line in 20 metre Wide Easement
- Approximate Location of Existing Tracks
- Monitoring Plots

FIGURE 2.1

Lot 220 Features

File Name (A4): R61_V1/1646_441.dgn



Source: Google Earth (2012), Department of Lands (2003)

0 0.5 1.0 2km
1:45 000

Legend

- Lot Boundaries (218 & 220)
- Approved Extraction Areas
- Mackas Sand (existing operations)
- Sibelco
- Hunter Quarries
- Quality Sands and Ceramics
- Residence Receiver Locations
- Approved Site Access

FIGURE 2.2

Location of Lot 218, Lot 220 and Associated Extraction Areas

File Name (A4): R61_V1/1646_442.dgn

2.5 Unexploded Ordnance

As outlined in the Mackas Sand Unexploded Ordinance Management Plan (UOMP), Lots 218 and 220 extraction areas are unlikely to contain unexploded ordnance. However, part of Lot 218 may contain debris from exploded ordnance. Extraction within Lot 218 will occur within windblown sand that has been deposited in the area after World War II and the potential for this sand to contain unexploded ordnance is negligible. Any disturbance of the soil profile that existed prior to the 1950s will be excavated in accordance with the UOMP.

2.6 Flora

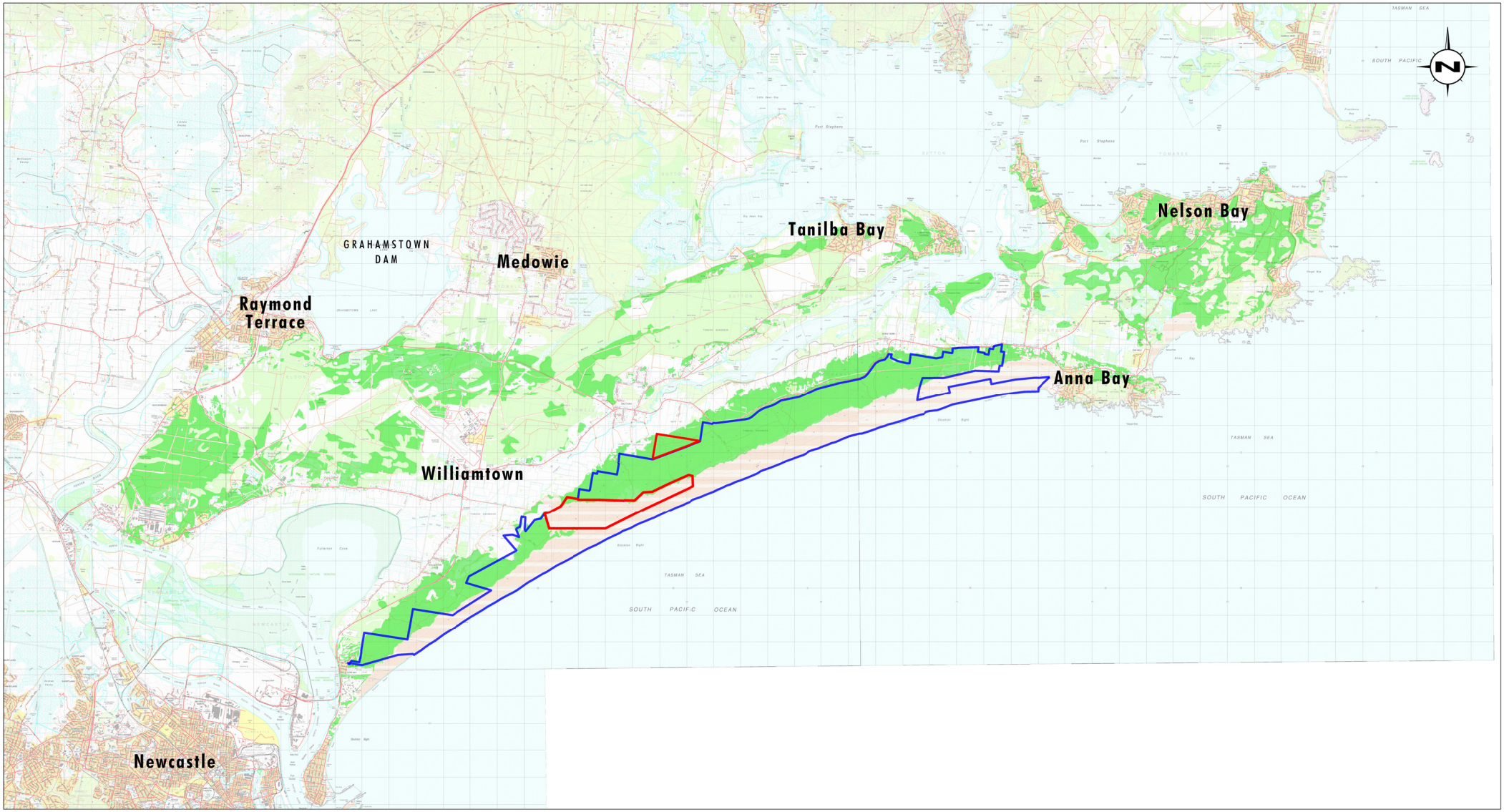
136 flora species, comprising of 49 families were recorded in the Lot 220 operational area during the preparation of *Environmental Assessment of Sand Extraction Operations from Lot 218 DP 1044608 and Lot 220 DP 1049608, Salt Ash* (Umwelt2009). Of the 136 flora species recorded, 22 (16%) were introduced species. Three vegetation communities were recorded within the project area, including Coastal Sand Apple – Blackbutt Forest, Swamp Mahogany – Paperbark Forest and Previously Disturbed Grassland. The distribution of these communities within Lot 220 is shown in **Figure 2.3** . No vegetation occurs in the Lot 218 operational area.

Additionally, the sand doubletail orchid (Diuris arenaria) which is listed under TSC Act and rough doubletail (Diuris praecox) which is listed under TSC and EPBC Acts were both identified during targeted field surveys. Populations of neither ground orchid were assesses to be significantly impacted by the access road or other aspects of the project.

2.7 Fauna Habitat

The coastal forest areas of Lot 220 provide foraging, roosting and nesting habitats for a variety of fauna species. Two broad habitat types were identified along the proposed alternate haul route, these being open forest and previously disturbed/grassland. While the previously disturbed/grassland areas provide mostly foraging habitat value, the open forest areas provide a range of habitat niches for fauna species.

The canopy species in the forest habitat provide an abundant range of tree hollows for hollow-dependent and opportunistic fauna, including small and medium sized arboreal mammals, birds and reptiles.



Source: Department of Lands (2006), Hunter Councils (2003)

0 2.5 5 10km
1:200 000

Legend

- Lot Boundaries (218 & 220)
- Worimi Conservation Lands
- Coastal Sand Apple Blackbutt Forest

FIGURE 2.3

Coastal Sand Apple Blackbutt Forest

Large tree hollows, suitable as nesting and roosting sites for large bird species, including owls and cockatoos, were sparsely recorded due to the lower abundance of large mature overstorey species. The canopy species provide foraging resources for nectarivorous bird and mammal species during the summer months. The swamp mahogany (Eucalyptus robusta) provides an important winter foraging resource for a wide range of species, in particular migratory birds such as the swift parrot (Lathamus discolor) and regent honeyeater (Anthochaera phrygia).

The open, mid-stratum of the open forest habitat supports tea-trees and paperbarks, providing a good nectar resource for birds and arboreal mammals. These shrubs, combined with the dense ground stratum of grasses and sedges, also provide important cover and refuge for reptiles, small mammals and birds.

The ground cover layer is dense, providing refuge for small mammals, birds and reptiles. Lot 220 displays evidence of a frequent fire regime from burnt wood on the ground and trunks of mature trees. Several fallen logs of various sizes were identified which may provide nesting and refuge for medium to small mammals and reptiles. No rocky outcrops, aquatic or semi-aquatic habitats were identified within Lots 218 or 220.

The Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy (House 2003) identified the Coastal Sand Apple – Blackbutt Forest occurring along the Stockton Bight dune system as regionally significant habitat and as a regionally significant habitat linkage. No significant habitat is located within the approved extraction area at Lot 218.

2.8 Fauna

Four threatened fauna species were identified in Lot 220 and an additional 4 species were recorded in proximate habitat to Lot 220 in previous surveys. No endangered fauna populations were identified in the project area and are none are known to occur in adjacent areas. As outlined in the EA (Umwelt 2012) for PA 08_0142 (MOD1), three threatened fauna species were identified and an additional 16 threatened or endangered fauna species are considered to have potential habitat within Lot 220.

No threatened fauna species were recorded within the alternate haul route alignment to Lot 218; however four threatened species were found in adjacent, contiguous habitats with the alternate haul route. It is considered that the local area around the alternate haul route provides potential habitat for similar species that were, or are expected to be, found within Lot 220.

Threatened species known to occur in the project area include:

- squirrel glider (Petaurus norfolcensis): recorded at 3 locations within Lot 220 during surveys in 2003 and 2008. The habitat throughout Lot 220 provides high quality nesting and food resources for this species
- grey-headed flying-fox (Pteropus poliocephalus): identified widely across Lot 220 during the 2003 survey. Mature flowering canopy species provide feeding resources for this species. No roost sites were identified. The species was also identified in proximity to the alternate haul route to Lot 218 during field surveys undertaken during 2012
- greater broad-nosed bat (Scoteanax rueppellii): recorded in 2003 on Lot 220 and proximate to the alternate haul route to Lot 218. These areas are expected to provide foraging and roosting habitat for this species

- eastern bentwing-bat (Miniopterus schreibersii oceanensis): recorded in 2003. Lot 220 is expected to provide foraging habitat for this species
- powerful owl (Ninox strenua): recorded to the south-west of Lot 220 (Umwelt 2004). Lot 220 is expected to form part of an extensive foraging habitat for this species
- koala (Phascolarctos cinereus): recorded to the south-west of Lot 220 (Umwelt 2004). Lot 220 has potential to be used as a corridor between preferred habitats however it is unlikely that Lot 220 would support a resident population of the species due to the lack of preferred koala feed trees
- eastern pygmy-possum (Cercartetus nanus): recorded to the south-west of Lot 220 (Umwelt 2004)
- masked owl (Tyto novaehollandiae): a pair of masked owls was recorded to the north in 2002. Surveys in 2003 and 2008 failed to identify the species and roost trees were not identified. The species may utilise Lost 220 as part of an extensive foraging range, however the species does prefer to hunt in open vegetated areas
- grey crowned babbler (eastern subsp.) (Pomatostomus temporalis temporalis): recorded to the north of Lot 218 in proximity to the Worimi Conservation Area during surveys for the Alternate Access Road in October 2012 (Umwelt 2012)
- little bentwing-bat (Miniopterus australis): recorded to the east of the Alternate Haul Route in earlier surveys (Umwelt 2012).
- 10 migratory species listed under the EPBC Act were recorded within Lots 218 and 220 during surveys. Additionally, the following species were considered within the EPBC referral, for which EPBC Approval 2011/6124 was received in November 2013:
    - New Holland mouse (Pseudomys novaehollandiae)
    - long-nosed potoroo (Potorous tridactylus tridactylus)
    - spotted-tailed quoll (Dasyurus maculatus maculatus)
    - grey-headed flying-fox (Pteropus poliocephalus) (as described above)
    - large-eared pied bat (Chalinolobus dwyeri)
    - regent honeyeater (Anthochaera phrygia)
    - swift parrot (Lathamus discolor).

3.0 Rehabilitation Management Plan

This Rehabilitation Management Plan relates to both the short and medium term rehabilitation of the site. The long term management strategy, which includes preliminary closure criteria for the site, is included in **Section 3.6**

3.1 Rehabilitation Objectives

The proposed final land uses for the project are outlined in **Section 1.5** . The key rehabilitation objectives to meet the intended land use will include the following:

- create a final landform with acceptable post mine land capability
- provide for the safety of employees and the public during and following the closure of the quarrying operations
- minimise the potential for long-term environmental impact and liability
- minimise the potential impacts from closure activities
- reduce the need for long term monitoring and maintenance
- complete the closure, decommissioning and rehabilitation works as quickly and cost effectively as possible
- through rehabilitation of disturbed areas, provide a sustainable plant cover using locally occurring plant species
- re-establish the native vegetation communities that are representative of those that existed prior to construction or sand extraction activities and covering a similar spatial extent
- implement appropriate control and remediation strategies in the event that contamination sources are identified, so as to prevent off-site impacts
- provide that design periods and factors of safety for all site works take into account extreme events and other natural processes such as erosion
- provide for the successful sign-off on the rehabilitation recovery of the security bond.

3.1.1 Protecting Vegetation outside of the Disturbance Footprint

All works associated with the construction of the alternate haul route to Lot 218 have been undertaken in accordance with the procedures and controls described in **Section 3.7.5**. As mentioned in **Section 1.3.1**, an EPBC LMP was developed specifically for the construction of the alternate haul route to address EPBC 2011/6214 conditions.

3.2 Preliminary Rehabilitation Completion Criteria

The preliminary rehabilitation completion criteria that have been determined for the site are outlined in **Table 3.1**. The preliminary rehabilitation criteria will be used to guide rehabilitation activities throughout the life of the operation with the aim of structuring rehabilitation activities towards final quarry closure requirements.

Table 3.1 Mackas Sand Pty Ltd Preliminary Rehabilitation Completion Criteria

Aspect	Preliminary Rehabilitation Criteria
Landform	• No significant erosion is present that would constitute a safety hazard or compromise the capability of supporting the end land use • Surface layer to be free of any hazardous materials • All infrastructure and equipment other than access roads that may be used in the future, will be removed from the site • Final landform is compatible with the surrounding topography and provides at minimum a cover of 1 m of sand above the predicted maximum groundwater level • Within Lot 218, a bunded vegetated area at the western edge of the extraction area has been established to provide a physical barrier between the mobile sand and native vegetation on the landward side of the mobile dunes
Soil	• Topsoil/organic material or a suitable alternative has been spread uniformly over the rehabilitation surface within Lot 220 • Monitoring demonstrates soil profile development in rehabilitated areas (e.g. development of organic layer, litter layer) within Lot 220
Vegetation	• Revegetation areas contain flora species assemblages characteristic of the desired native vegetation community (i.e. Coastal Sand Apple – Blackbutt Forest community) • Second generation tree seedlings are present or likely to be, based on monitoring in comparable older rehabilitation sites • More than 75% of trees are healthy and growing as indicated by Long Term Monitoring • There is no significant weed infestation such that that weeds do not compromise a significant proportion of species in any stratum
Fauna	• Rehabilitated areas provide a range of vegetation structural habitats (e.g. target tree species present, shrubs, ground cover, developing litter layer etc.)
Bushfire Hazard	• Appropriate bushfire hazard controls have been implemented on the advice from the NSW Rural Fire Service

3.3 Developing and Refining Rehabilitation Completion Objectives and Criteria

It is the intention that the rehabilitation completion criteria will be refined as required and finalised following the outcomes of rehabilitation monitoring and stakeholder feedback as shown in **Figure 3.1**. The process of developing and refining rehabilitation criteria will be progressive and allow for continual improvement. Mackas Sand will refine rehabilitation completion criteria in consideration of the following:

- the environmental values to be protected as identified in baseline monitoring and pre mining environmental assessments including literature reviews
- government stakeholder expectations, legislative requirements, development approval conditions and Environmental Assessment commitments
- regional synergies, including integrating rehabilitation objectives with surrounding vegetation community
- opportunities for alternative sustainable post-extraction land uses
- provide for visual enhancement of the site
- realistic community expectations
- what is achievable by using current best practice rehabilitation methodologies
- likely successional processes and seasonal variability
- potential impacts from feral plants and animals
- suitable monitoring programs can be developed to demonstrate that criteria have been met.

The criteria to be developed will be designed to be flexible to accommodate technological improvements and any updated outcomes from ongoing research.

3.4 Short Term Rehabilitation Strategy

3.4.1 Lot 218

As the rehabilitation strategy for Lot 218 will be governed by the natural movement of sand into the extraction area and will involve negligible revegetation, the short term rehabilitation strategy will be limited to the establishment of a vegetative bund on the western edge of the extraction area. The objective of the bund is to provide a physical barrier between the mobile sand and native vegetation on the landward side of the mobile dunes. This will initially commence following the extraction of a sufficient volume of sand to allow the bund to be established and will continue to be progressively established as sand extraction proceeds.

3.4.2 Lot 220

Sand extraction at Lot 220 has been undertaken since December 2009, and will continue to be generally undertaken in accordance with the EA for sand extraction operations (Umwelt 2009). The natural variation

of the sand resource across Lot 220 allows for multiple sand products to be sourced from Lot 220. This natural variability, in combination with supplier requirements determines the location from which sand is to be extracted, the frequency at which sand will be extracted, the life of the resource, the area required for operations and rehabilitation of the area disturbed by the quarry.

Rehabilitation of the quarry has commenced and will continue to be undertaken as sand extraction proceeds. It is anticipated that rehabilitation of the mined areas will be undertaken once the mined areas are no longer required for operational needs (e.g. material processing - stockpiling, screening operations, Front End Loader, etc equipment manoeuvring to access the sand resource and/or will not be subject to further ground disturbance, such as that associated with truck movements, etc) or as the sand resource in a section of the quarry has been exhausted. Ongoing short term rehabilitation strategies will be primarily focused on maximising the availability and viability of biological resources for use in rehabilitation activities, such as:

- salvage and reuse of material for habitat enhancement (refer to **Section 3.5.1**)
- topsoil/upper 100 mm substrate management (refer to **Section 3.5.2**).

3.5 Medium Term Rehabilitation Strategy – Progressive Rehabilitation

The medium term rehabilitation strategy for Lot 218 will involve the continued establishment of the vegetative bund on the western edge of the extraction area as the sand extraction operation continues. As the operation is within an active mobile dune system with no pre mining vegetation, the primary aim of rehabilitation will be to minimise the potential for sand encroachment into the adjacent native vegetation area. No revegetation activities will be undertaken within the extraction area.

The medium term rehabilitation strategy for Lot 220 relates to the progressive rehabilitation at this site. The key aspects of this rehabilitation program are discussed below.

3.5.1 Salvage and Reusing Material for Habitat Enhancement

Tree hollows and trees/logs salvaged during pre-clearing surveys will be stockpiled and used in site rehabilitation on Lot 220 and the vegetated bund at Lot 218. Once rehabilitation is structurally mature, salvaged tree hollows will be replaced in similar densities to those in unaffected vegetation on the site. Salvaged logs, stumps and stags will be emplaced in rehabilitation areas (in areas not intended for future development) following topsoil spreading to enhance ground fauna characteristics. All tree hollows identified during pre-clearance surveys will be re-instated into rehabilitation areas once the vegetation is structurally mature enough to support the structures.

Nest boxes will be used in lieu of salvaged tree hollows if appropriate, as determined as part of the rehabilitation management of the site. Since nest boxes will be used where there is insufficient salvaged tree hollows, it is difficult to quantify the amount or type of additional nest boxes that will be required. In the event that sufficient tree hollows cannot be salvaged as part of tree clearing procedures, a suitably qualified and experienced ecologist will determine the most appropriate nest box requirement based on the types and number of tree hollows being cleared. Nest box design will consider the full range of hollow-dependant species recorded in the project area and known to occur in the local area in similar/contiguous habitat, in particular hollow dependant threatened fauna species such as the squirrel glider (Petaurus

norfolcensis) and threatened tree roosting micro-bats. The density of salvaged tree hollows and nest boxes in rehabilitation areas will consider the carrying capacity of the rehabilitated vegetation in which the boxes are being established. Salvaged logs, stumps and stags sourced from the clearing of the alternate haul route will be emplaced adjacent to the alternate haul route to enhance ground fauna characteristics. It is envisaged that tree hollows and salvaged logs will be utilised in the rehabilitation of the alternate haul route if possible, should extractive operations at Lot 218 cease.

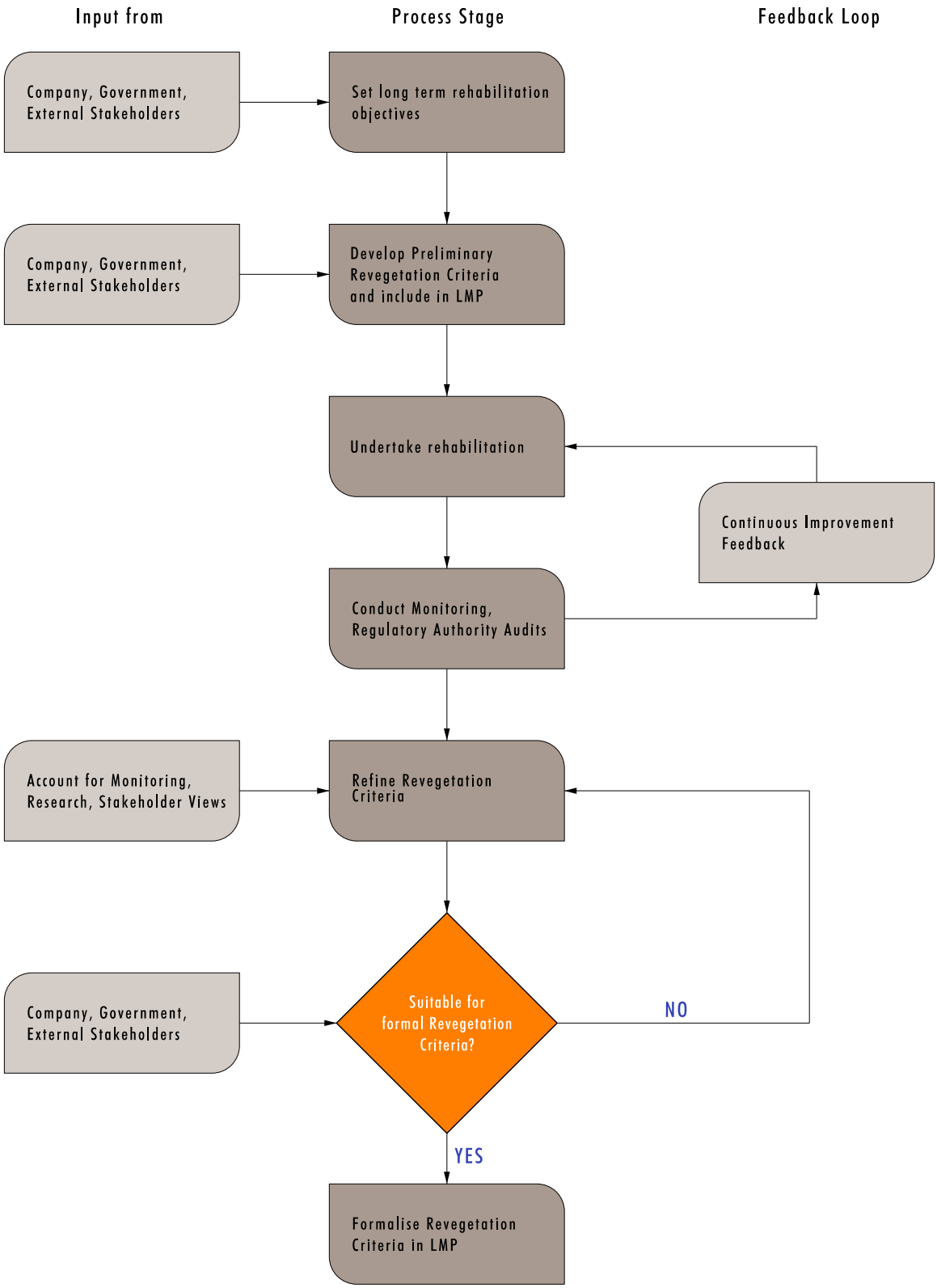


FIGURE 3.1

Process for Developing and Refining Rehabilitation Closure Criteria

Source: Adapted from Nichols 2006

3.5.2 Topsoil Management

Suitable soil material and vegetative debris, when available, will be stockpiled or directly reused so that it can be incorporated into the final landform to assist in providing a suitable growing medium for the establishment of trees and understorey species.

Where topsoil is available, the following measures will be adopted to protect its quality and enhance rehabilitation outcomes:

- where possible, topsoil will be stripped when moist to help maintain viability and to reduce dust generation
- where practical, topsoil will be direct-returned to reshaped quarry areas which are available for revegetation
- when direct return of topsoil is not practicable, stockpiles will be formed, located away from quarrying, traffic areas and watercourses
- level or gently sloping areas will be selected as stockpiles sites to minimise erosion and potential soil loss
- appropriate sediment controls will be installed at the base of stockpiles to prevent soil loss
- stockpiles to be kept longer than three months will be sown with a suitable cover crop to minimise soil erosion and invasion of weed species
- weed growth will be monitored and subsequently controlled if necessary
- prior to re-spreading, weed growth will be scalped from the top of the stockpiles to minimise the transport of weeds into rehabilitated areas
- stockpiles will be appropriately sign-posted or delineated to identify the area and minimise the potential for unauthorised use or disturbance.

It is generally considered that topsoil stockpiles should be no greater than 3 m in height in order to preserve soil structure, maximise surface exposure and biological activity. Given that topsoil stockpiles at Mackas Sand are primarily sand, there is minimal soil structure to preserve. Also, with a strong focus of direct return of topsoil, the topsoil stockpiled is primarily from the first 12 months of operations. Accordingly it is considered that the site conditions within Lot 220 warrant the construction of higher stockpiles. The construction of a 4 to 5 m high stockpile will minimise the surface area that is exposed to weed infestation and will make more area available for direct return of topsoil by reducing the footprint size of the stockpile.

3.5.3 Landform Design

In regards to Lot 218, the final landform will be governed by the natural movement of sand into the extraction area, with mobile sand progressively filling the extraction.

The rehabilitation strategy for Lot 220 aims to achieve a final landform that is compatible with the surrounding topography (refer to **Figure 3.2**) and provides at minimum a cover of 1 m of sand above the

predicted maximum groundwater level. Landform elements will be shaped, where possible, in undulating informal profiles in keeping with natural landforms of the surrounding environment.

3.5.4 Surface Preparation

Surface preparation activities for rehabilitated areas will be commenced as soon as possible following the completion of sand extraction activities. A general overview of surface preparation activities undertaken at the Mackas Sand site includes:

- topsoil will be applied for incorporation into the final shaped surface
- structures such as tree hollows and logs will be incorporated into the final landform to augment the habitat value of the rehabilitated areas
- suitable erosion control measures (e.g. silt fences, mulches etc.) will be implemented where required to minimise soil loss from areas undergoing rehabilitation.

3.5.5 Revegetation

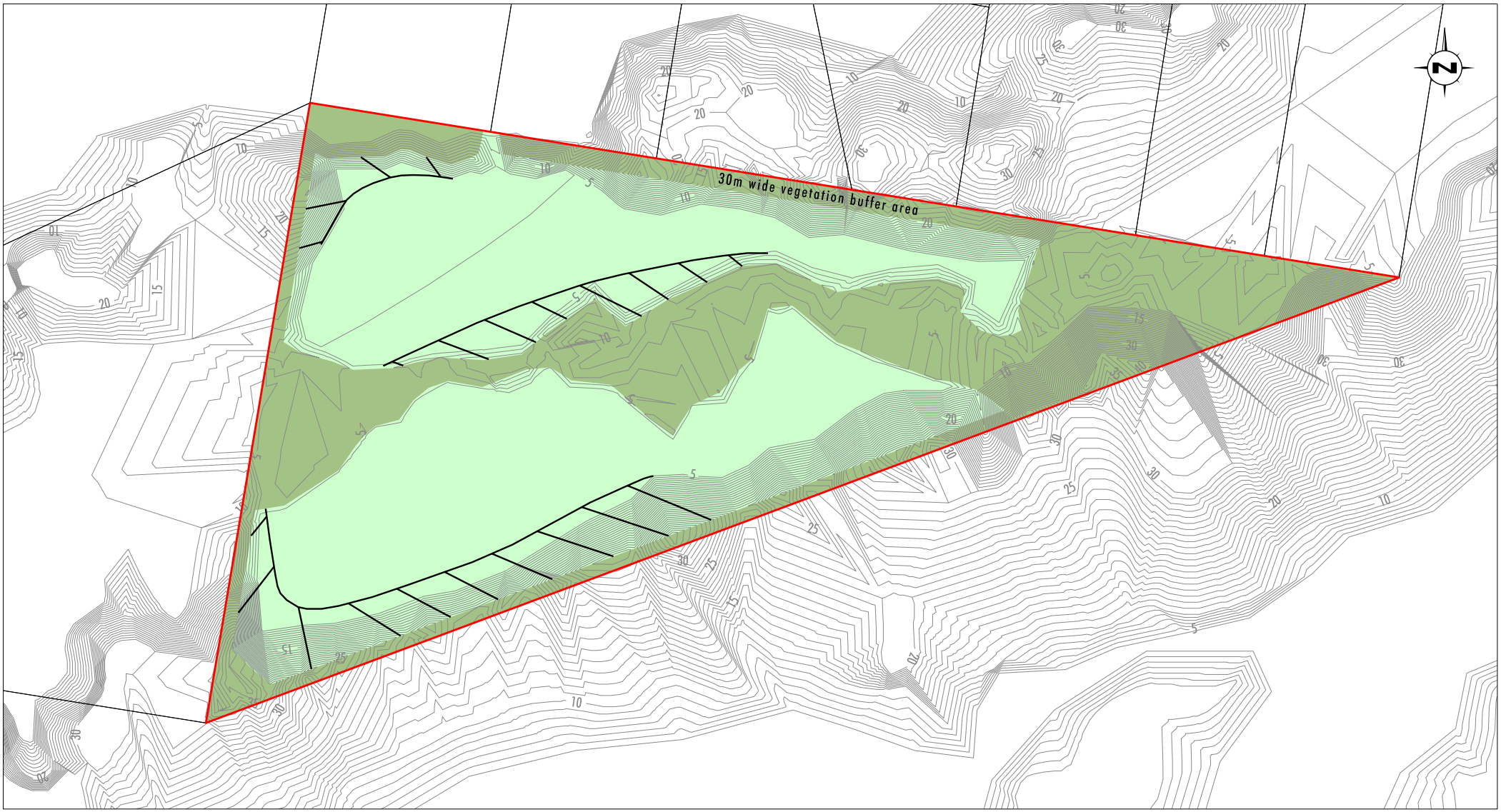
In general, revegetation activities across Mackas Sand operations at Lot 220 will be undertaken in spring and autumn, however, opportunistic revegetation may be practised if areas become available for sowing in summer and winter.

The rehabilitation strategy for Lot 220 aims to re-establish Coastal Sand Apple – Blackbutt Forest on disturbed areas of the site. Native trees will initially be planted at a density of approximately 1000 stems/ha with subsequent infill planting of up to approximately 300 trees/ha (as required) in the following year to replace any trees that may not survive.

Ongoing planting and weed control measures will be undertaken while a stable native vegetative cover is being established. Primarily, revegetation will involve direct seeding and planting of tube stock. Revegetation techniques will be continually developed and refined over the life of the quarry through a continual process of research, trialling, monitoring and improvement.

3.5.6 Rehabilitation Schedule

Rehabilitation will be undertaken as the previously mined areas which are surplus to ongoing operational needs become available. It is envisaged that once the approximately 4 ha processing plant area is established, that the remainder of the proposed extraction area at Lot 220 will be cleared at a rate of approximately 3 ha/year on average. Progressive rehabilitation at Lot 220 will involve reshaping to final landform following the completion of sand extraction activities, and native planting.



Source: Department of Lands (2003)
Note: Contour Interval 10m

0 100 200 400m
1:8000

Legend

- Lot 220 Boundary Planted
- Final Landform (Native Vegetation) - Coastal Sand Apple - Blackbutt Forest
- Existing Native Vegetation - Coastal Sand Apple - Blackbutt Forest
- Batter Reshaped

FIGURE 3.2

Rehabilitation Plan for Lot 220

3.6 Long Term Rehabilitation Strategy – Care and Maintenance

In the context of the Mackas Sand Project, the long term rehabilitation strategy relates to the care and maintenance activities required to progress rehabilitated areas towards meeting the appropriate objectives and criteria in a timely and cost effective manner. The scope of the rehabilitation care and maintenance phase may include the following:

- weed and feral animal control of rehabilitation and offset areas
- erosion and sediment control works
- re-seeding/planting of rehabilitation areas that may have failed due to adverse conditions or bushfire
- maintenance fertilising if required
- repair of fence lines, access tracks and other general related land management activities.

The scope of these works will be determined based upon the outcomes of the annual rehabilitation inspection and long term rehabilitation monitoring programs (refer to **Section 3.8**).

Australian native species such as those occurring in Coastal Sand Apple – Blackbutt Forest communities are well adapted to bushfire with germination of seeds commonly being triggered by bushfire events. If the rehabilitation areas are affected by bushfire, an assessment will be undertaken prior to the following planting season (autumn to spring) to see if natural regeneration following the fire is evident. If not, additional planting will be undertaken to replace those plants lost due to fire.

Dependent upon the success of rehabilitation works, a care and maintenance period of two to ten years post-extraction may be required before rehabilitation completion criteria are achieved.

3.7 Measures to be Implemented over Next Three Years

An outline of the measures to be adopted over the next three years, which will continue to be implemented as required during the life of the operation, are discussed below.

3.7.1 Progressively Rehabilitating Disturbed Areas on Lot 220

As outlined in **Section 3.5.6**, it is the intention that rehabilitation will be undertaken throughout the life of the project on Lot 220, as the previously mined areas which are in excess to ongoing operational needs become available. Initial rehabilitation works have commenced on boundary bunds and within an approximately 3 ha area which has been mined and is no longer required for operational purposes. Works have included revegetation and weed control. Additionally a small Gathering Place has been designated within the rehabilitation area in consultation with the Aboriginal Heritage Management Group as a place to meet and discuss Aboriginal cultural heritage as rehabilitation progresses and post-quarry closure.

3.7.2 Landscaping to Minimise Visual Impacts

The main method of mitigating visual impacts associated with the operation at Lot 220 is maintenance of a 30 m wide vegetated buffer area along the northern boundary of the site with supplementary infill planting

as required. This buffer provides sufficient screening to restrict views of the proposed operation from Nelson Bay Road (refer to **Figure 3.2**).

Buffer areas of 20 m will also continue to be left undisturbed at the other boundaries of the site.

Extensive supplementary planting of suitable screening species will be undertaken within the section of the buffer area between Lot 220 and the Hufnagl residence and 50 m either side, in consultation with the residents at the Hufnagl residence (see **Figure 2.1**). This resident has verbally expressed that any planting was unnecessary and undesirable and they did not want it to occur at this stage. Nonetheless the commitment to establish a visual vegetation screen stands should circumstances change in the future.

3.7.3 Protecting Vegetation and Soil in Non-Disturbed Areas

In regards to Lot 220, the extraction plan will leave buffer areas of 30 m from the northern boundary and 20 m from the other boundaries undisturbed. The central low lying section of the site will also be left undisturbed, except where the two proposed access tracks will cross it; leaving a total area of approximately 28.6 ha of the site undisturbed (refer to **Figure 3.2**).

Retained vegetation and soils on the site occur in a near-natural, undisturbed condition and will be protected to maintain values with the following measures:

- demarcation of areas (e.g. flagging tape, temporary fencing etc.) where required to prevent vehicle access and unauthorised clearing
- on-going ecological monitoring targeting factors detrimental to the ecological values and functions of retained vegetation with the annual rehabilitation inspection (see **Section 3.8.2.1**)
- on-going maintenance of weeds and feral animals, if required.

3.7.4 Prevention/Minimisation of Sand Dune Accretion

As discussed in **Section 3.4.1**, a vegetative bund will be established on the western edge of the extraction area of Lot 218. The objective of the bund will be to provide a physical barrier between the mobile sand and native vegetation on the landward side of the mobile dunes.

In regards to Lot 220, an objective of the progressive rehabilitation program will be to stabilise the dunes in order to minimise the potential for dune movement.

3.7.5 Pre-Clearance Surveys

A detailed pre-clearance survey will be undertaken prior to any vegetation clearing occurring as part of the operation. The following procedure will be implemented for all vegetation clearing required as part of the operation:

- prior to clearing, hollow-bearing trees and other habitat structures such as stags, logs and stumps will be clearly marked by an appropriately qualified and experienced person to prevent accidental clearing
- where possible, micro-habitats such as tree hollows, logs will be salvaged and retained for use in rehabilitation once re-established vegetation is suitably mature

- vegetation surrounding any marked habitat structures will be cleared and the marked structures left undisturbed for a period of 24 hours
- marked hollow-bearing trees will be shaken prior to felling using a bulldozer and then left for a short period to allow any fauna using the hollows to be observed
- hollow-bearing trees will be slowly pushed over using a bulldozer, with care taken to avoid damage to hollows
- immediately following tree felling any identified hollows will be examined for fauna by a suitably qualified and experienced person
- where practical, felled trees will be left for a 24-hour period prior to removal in order to allow species to move in to adjoining vegetation of their own volition
- any captured nocturnal species which do not immediately move into adjoining vegetation will be captured and kept in a warm, dark and quiet place prior to release on the evening of capture, within the same vegetation community from which it was captured at night
- suitable hollows and other habitat structures (including logs, stumps and stags) appropriate for relocation to areas not intended for future development or for use in rehabilitation, will be selected by an appropriately qualified and experienced person
- hollows intended for re-erection will be selected by a suitably qualified and experienced person, then removed and then capped with marine plywood or other suitable material
- logs, stumps, stags and hollows intended for ground habitat will be cut into sections, as required and stockpiled for use in rehabilitation
- in the event that injured fauna are identified, species will be immediately taken to the nearest veterinarian or certified wildlife carer for treatment.

Clearing operations will be timed so that potential impacts on breeding species, particularly the squirrel glider and threatened micro-bats are avoided. Where possible, clearing will be avoided in winter months when micro-bats and the eastern pygmy possum are in a state of torpor and squirrel gliders begin to breed.

3.7.6 Salvaging and Reusing Material from the Site for Habitat Enhancement

During clearing of native vegetation, measures as outlined in **Section 3.5.1** will be implemented to salvage appropriate material for habitat enhancement of rehabilitation areas.

3.7.7 Managing Potential Fauna Impacts

The timing of clearing operations will be designed to reduce the potential impact on breeding species, particularly the squirrel glider and threatened micro-bats. Clearing will (where possible) avoid the winter months when micro-bats and the eastern pygmy possum are in a state of torpor and squirrel gliders begin to breed.

To minimise fauna impacts, a vegetation clearance procedure has been developed (refer to **Section 3.7.5**) and will be implemented prior to clearing activities.

3.7.8 Maintaining Koala Habitat Linkages

The koala (Phascolarctos cinereus) has been recorded to the south-west of the operation (Umwelt 2004). Lot 220 has potential to be used as a corridor between preferred habitats however it is unlikely that Lot 220 would support a resident population of the species due to the lack of preferred koala feed trees.

Koala habitat linkages will be maintained across the site through the following mechanisms:

- setting up 'no go' areas around remnant vegetation that bisects the site and provides a potential koala movement corridor, to prevent unauthorised access
- the re-establishment of native vegetation communities to ensure the post-extraction landscape provides similar levels of corridor function to those currently occurring at and adjoining the site.

3.7.9 Topsoil Conservation and Reuse

Details regarding measures to conserve and reuse topsoil for rehabilitation purposes, which will commence at the time of clearing, are outlined in **Section 3.5.2**.

3.7.10 Collecting and Propagating Seed Rehabilitation Works

One of the objectives of the rehabilitation of the site is to revegetate disturbed areas with local, indigenous species with the goal of re-establishing the Coastal Sand Apple Blackbutt Forest vegetation community across the site. Local provenance seed (where available) will be used in rehabilitation where possible to help meet this objective. This will include exploring whether seed for rehabilitation of the site can be harvested from the adjoining Worimi Conservation Lands. However, where seed cannot be sourced from local sources it will be supplemented from external seed suppliers.

Seed collection practitioners will be employed to collect and propagate seed from within Lot 220 and on the adjoining Worimi Conservation Lands, if permitted, to maintain a site seed bank for use in rehabilitation. Seed will be collected from retained remnant vegetation and also from areas of vegetation that have not been subject to clearing as operations and rehabilitation progress.

3.7.11 Controlling Weeds

It is important that weeds are not allowed to establish on the site nor spread to other natural areas as a result of operations or rehabilitation. Mackas Sand will target its weed management responsibilities in accordance in with the *Biosecurity Act 2015*. Weed monitoring and hand weeding will be undertaken on a regular basis on rehabilitated areas with a detailed survey and controls being undertaken annually as part of the Annual Rehabilitation Inspection.

In particular, bitou bush (Crysanthemoides monolifera subsp. chrysanthemoides) is a highly invasive species occurring in coastal habitats along the NSW coast with potential to invade the newly disturbed and rehabilitated site. This weed has a vigorous growth habitat which results in the smothering of native groundcovers and inhibiting regeneration. This species will be targeted for eradication in any areas where it is recorded and measures such as herbicide sprays will be implemented to prevent it from establishing in new rehabilitation areas. Bitou bush control will be undertaken in accordance with procedures set out in: *Current management and control options for bitou bush (Chrysanthemoides monilifera ssp. rotundata) in Australia, (2008)*.

If the occurrence of a previously unrecorded weed species is discovered, advice will be sought from a suitably qualified and experienced person on the management and control options for that species and appropriate measures for mitigating any impacts caused by its management on native species will be developed.

Generally, weed control measures will include:

- monthly observation of rehabilitated areas to check for weeds and hand weeding of any weeds identified
- annual site inspections to identify areas of weed infestation and type of weed species
- development and implementation of an eradication plan applicable to the circumstances, which may include manual or mechanical removal, spot spraying, boom spraying of pesticides or other biological controls
- regular contact with neighbouring property owners to attempt to eradicate weed species from the surrounding area
- minimisation of vegetation disturbance by reducing the number of tracks and using the same access routes
- minimisation of clearing and other disturbance of vegetation associated with civil works
- regular maintenance of topsoil stockpiles to eradicate weed infestation.

3.7.12 Controlling Feral Pests

There are no known pest feral animals on the site, however if the occurrence of a previously unrecorded feral fauna species is discovered, advice will be sought from a suitably qualified and experienced person on the management and control options for that species and appropriate measures for mitigating any impacts caused by its management on native species will be developed. Feral animal control would be undertaken in consultation with neighbouring landholders. Programs to control feral animals will include the determination of appropriate control practices, consultation with appropriate authorities, obtaining appropriate approvals, implementing control practices and undertaking follow-up monitoring and control as required.

3.7.13 Controlling Access

As outlined in **Section 2.1** , there has been evidence whereby parts of the project area, including both Lots 218 and 220, have been used for unauthorised activities such as vehicle and horse movements. Whilst it is acknowledged that it will be impractical to prevent access to the entire project area, measures to be implemented at both sites to minimise unauthorised access will include the following:

- delineating high risk areas such as the extraction area, wash plant and site facilities (at Lot 220)
- installation of gates on the access points to the site, which will be closed to prevent access during non-operational periods
- demarcation of the site via means of signage to indicate that access is by authorised means only.

3.7.14 Bushfire Management

Bushfire control works will be undertaken in consultation with the NSW Rural Fire Service (RFS). In general, measures to be adopted on an ongoing basis will include the following:

- conducting a regular surface slashing program (as required) around critical infrastructure such as the wash plant and site facilities
- maintaining roadways and tracks that are either existing or constructed as a requirement of the project in order to provide an effective fire break
- provision and maintenance of on-site firefighting equipment (as advised by RFS).

3.8 Rehabilitation Monitoring

Rehabilitation success will be assessed according to the criteria listed within **Section 3.1** and monitored with the establishment of analogue/reference sites on site against which to compare the results of rehabilitation monitoring.

In designing the rehabilitation monitoring program, indicators and methods have been selected that:

- provide a good indication of the status of the environmental value that the project aims to protect
- are relatively simple to measure and are reproducible
- are cost effective.

Where relevant, the scope of the monitoring program is to cover each phase of the sand extraction operation including:

- pre-extraction baseline surveys
- rehabilitation
- post-rehabilitation.

Ongoing monitoring of rehabilitated areas will continue until they have satisfied the rehabilitation closure criteria within **Section 3.1**.

3.8.1 Pre-extraction Baseline Surveys

Baseline ecological monitoring surveys have been conducted as part of the preliminary Environmental Assessment for the project (Umwelt 2009). Further to this, a total of three permanent analogue sites were established in February 2011. Monitoring of these sites will be continued every three years throughout the life of the operation. This information will be used to refine rehabilitation criteria and to assess the performance of rehabilitation on site. Analogue sites were established in retained remnant vegetation and are clearly marked on site and with a GPS to allow for repeatable surveys over time (see **Figure 2.1**).

A number of monitoring criteria have been considered in designing the pre-extraction baseline monitoring survey. These criteria should be considered throughout all phases of the project. As the objective of the

rehabilitation is to return the site to a native ecosystem, reference/analogue sites are required based on the following criteria:

- analogue sites should occur in natural ecosystems, representative of the goal/target for rehabilitation
- where possible, analogue sites should occur in areas that have experienced minimal disturbance.

3.8.2 Evaluation of Rehabilitation Area Performance

As part of the Quarry Manager (or their delegate) routine inspections of the quarry will be undertaken. Should observations identify any issues of concern (e.g. increasing presence of weeds, dieback, pest or disease) appropriate action can be initiated at that time.

In addition to the Quarry Manager's routine inspections, a formal annual inspection of the rehabilitation area(s) and analogue site(s) as relevant, is undertaken. This annual inspection assesses the performance of each rehabilitation area against the performance/completion criteria as noted in **Sections 3.2** and **3.3**. This annual inspection utilises qualitative observations generally in the early years when the plants are establishing and quantitative data methodologies, typically once the vegetation has reached a level of maturity where such assessment is of benefit. The qualitative observation allows for the identification of general trends and comparison of rehabilitation areas between years while the use of quantitative data allows for comparisons with data collected from analogue site and other rehabilitation areas over time. Further details of the annual and longer term assessment of rehabilitation areas performance are include in **Sections 3.8.2.1** and **3.8.2.2**.

3.8.2.1 Annual Rehabilitation Inspection

Mackas Sand will implement an annual rehabilitation inspection to evaluate how successful the rehabilitation onsite has been. The scope of the inspection is to include all existing and recently completed rehabilitation areas on site.

Outcomes of the annual rehabilitation inspection will inform an evaluation of performance relative to completion criteria, and will identify any mitigation actions that are identified as part of the inspection. These will be recorded in the annual rehabilitation inspection report and reported as part of the Annual Review process. Where necessary, rehabilitation procedures should be amended accordingly with the aim to continually improve rehabilitation standards.

In the event that rehabilitation failure has occurred, further investigations to establish a cause and appropriate remediation strategy(s) should be undertaken. Issues to consider include the following:

- nutrient availability
- pH, salinity and metal toxicity
- shallow root depth
- other soil limitations
- insect attack
- lack of N-fixing legumes

- lack of organisms involved in litter breakdown (e.g. fungal fruiting bodies) and nutrient cycling (e.g. puff balls)
- predation
- evidence of drought effects or storm damage
- poor soil preparation
- weed competition.

3.8.2.2 Long-Term Rehabilitation Monitoring

The objective of long-term rehabilitation monitoring is to evaluate progress of rehabilitation towards fulfilling long term land use objectives. The monitoring program will be continued within rehabilitation areas as well as include analogue sites (refer to **Section 3.8.1**) until the rehabilitation completion criteria (see **Section 3.1**) have been met.

As a minimum, the long term rehabilitation monitoring program report will:

- compare results against rehabilitation objectives and targets
- identify possible trends and continuous improvement
- link to records of rehabilitation to determine causes and explain results
- assess effectiveness of environmental controls implemented
- where required, identify modifications required for the monitoring program, rehabilitation practices or areas requiring research
- compare flora species present against original seed mix and/or analogue sites
- assess vegetation health
- assess vegetation structure (e.g. upper, mid and lower storey)
- the presence and abundance of any weed species
- assessment of natural regeneration/recruitment of new species
- where applicable, assess native fauna species diversity and the effectiveness of habitat creation for target fauna species.

Once the rehabilitation is considered to have met the preliminary rehabilitation criteria an ecological assessment will be undertaken in accordance with the relevant survey and assessment guidelines to ascertain the effectiveness of rehabilitation in providing vegetation community and fauna species and habitat re-establishment. Monitoring will include plot-based survey of vegetation communities and vegetation mapping and survey and assessment of all fauna groups. Ground fauna and bird diversity and abundance will be monitored to provide data on the re-establishment of native vegetation communities and habitats in the project area.

Permanent rehabilitation monitoring sites will be determined as operations extend over time. As additional areas become available for rehabilitation, additional permanent rehabilitation monitoring sites will be incorporated into the monitoring schedule. This will allow a range of sites, of varying stages of rehabilitation to be monitored and compared to the preliminary rehabilitation criteria and rehabilitation objectives.

3.9 Potential Risks to Successful Rehabilitation

A list of the potential risks to successful rehabilitation, applicable mitigation strategies and where they are addressed within this management plan is included in **Table 3.2.**

Table 3.2 Potential Risks to Successful Rehabilitation

Issue/Risk	Risk Rating	Management of Risk
Failure to meet government and community expectations	H	Closure criteria to be developed in consultation with relevant stakeholders (**Sections 3.2** and **3.3**)
Inadequate provision to meet the cost of rehabilitation	H	Rehabilitation Bond estimate to be developed 3 months of LMP approval (**Section 3.10**)
Delayed relinquishment of lease due to poor rehabilitation	H	Rehabilitation care and maintenance program to be implemented as per **Section 3.6** and rehabilitation monitoring program as per **Section 3.8**
Lack of clarity on completion criteria	H	Completion criteria has been developed in **Section 3.2**
Failure of rehabilitation	H	A range of strategies have been developed to minimise risk of rehabilitation failure (**Sections 3.5** to **3.8**)
Failure to obtain sign-off on quality of rehabilitation	H	Lease and licence relinquishment strategy developed (**Section 5.0**)
Post-mining landform instability	M	Strategy for Landform Design (**Section 3.5.3**)
Damage to rehabilitation from adverse weather event (e.g. rainfall)	M	Rehabilitation care and maintenance program to be implemented as per **Section 3.6** and rehabilitation monitoring program as per **Section 3.8**
Sand dune accretion	M	Strategy for minimisation of potential for dune accretion (**Section 3.7.4**)
Inappropriate species used in rehabilitation	M	Strategy for collecting and propagating seed rehabilitation works (**Section 3.7.10**)
Revegetation in sub-optimal seasonal conditions	M	Timing of rehabilitation targeted for spring and autumn (**Section 3.5.5**)
Weed infestation	L	Weed Control Strategy (**Section 3.7.11**)
Bushfire	L	Response measures following bushfire are discussed in **Section 3.6**

3.10 Rehabilitation Bond

In accordance with Condition 28 of Schedule 3 of PA 08_142 (as modified), a rehabilitation bond has been implemented in accordance with the performance and completion criteria discussed in **Section 3.2**. An initial bank guarantee was received by Mackas Sand on 7 February 2011 securing rehabilitation commitments made by Mackas Sand. Bank guarantees were revised following Independent Environmental Audits in 2012, 2015, 2018 and 2021.

Costs of the bond were determined by a qualified expert and include the full cost of completing rehabilitation across the site over a 3 year period in accordance with Condition 7 of Schedule 5 of the PA 08_142 (as modified). These criteria will be revised within three months of the submission of a copy of an Independent Environmental Audit Report to the Secretary, generally every 3 years.

3.11 Rehabilitation Reporting

A summary of rehabilitation activities and progress against the Mackas Sand rehabilitation schedule and recommendations from the previous year's rehabilitation monitoring report will be reported annually in the Mackas Sand Annual Review in accordance with Condition 4 of Schedule 5 of PA 08_0142 (as modified).

4.0 Conceptual Long Term Management Strategy

Given the initial phase of the project and as acknowledged in the Notes of Schedule 3 Condition 25 of PA 08_0142 (as modified), the long term management strategy for Lots 218 and 220 is currently conceptual. It is the intention that this strategy will be updated in subsequent reviews of this document. The key aspects of the long term management strategy as required by Schedule 3, Condition 25 (b) and how they have been preliminary addressed within this LMP are outlined below.

4.1 Objectives and Criteria for Quarry Closure and Post-Extraction Management

Preliminary objectives and criteria have been defined in **Sections 3.1** and **3.2**. As outlined in **Section 3.3**, it is the intention that Mackas Sand will refine the rehabilitation completion criteria as required following the outcomes of rehabilitation monitoring, stakeholder feedback and in consideration of other factors including opportunities for alternative sustainable post-extraction land uses.

4.2 Options for Future Use of the Site

The proposed final land use for the site is outlined in **Section 1.5**. Opportunities for alternative sustainable land use options will be evaluated throughout the life of the operation. However, at least 5 years prior to closure of the operations, it is the intention to conduct a final land use investigation based on the environment and community constraints and opportunities that may exist at this time. It is envisaged that a detailed closure plan will be developed based upon the most sustainable/feasible land use option in consultation with the relevant government agencies.

4.3 Ongoing Management of Environmental Effects of the Project

A range of measures to minimise or manage the ongoing environmental effects of the project, particularly in relation to flora and fauna impacts, are discussed through **Section 3.0**. Further details regarding other environmental controls will be detailed in separate documents required by consent including the following:

- Noise Management Plan
- Soil and Water Management Plan
- Aboriginal Cultural Heritage Management Plan
- Non-Indigenous Heritage Management Plan.

It is also a requirement of consent that measures be installed in relation to waste as well as emergency and hazardous management.

4.4 Performance Measurement

The above environmental management measures have been integrated into Mackas Sand Environmental Management Strategy (EMS) as per Condition 1 of Schedule 5 of the consent. The EMS is utilised as the key mechanism by which the performance of these measures is monitored over time. This will form part of the Annual Review.

5.0 Approvals Relinquishment Process

On the basis of rehabilitation monitoring when Mackas Sand is of the opinion that rehabilitation (or parts thereof) is ready for signoff, the following steps are to be undertaken:

- arrange for a suitably qualified and experienced person to complete a final rehabilitation inspection to determine that all rehabilitation objectives and criteria have been met
- collate all relevant records, monitoring and research data, including previous long term rehabilitation monitoring reports, which are to be used as supporting information for assessing compliance with rehabilitation criteria
- submit a rehabilitation completion criteria report for DPIE, NOW and Port Stephens Council for review and comment
- arrange for a close-out inspection with government agencies, to obtain consensus that the necessary requirements have been fulfilled and that no further work is required. As part of the meeting, justification (e.g. rehabilitation monitoring results) as to how closure criteria have been met should be presented to the government agencies. If consensus is not achieved, an action plan is to be developed to address any potential outstanding issues in order to achieve sign-off.

It is the intention that where rehabilitation has been assessed as meeting the appropriate criteria that opportunities for progressive sign-off of areas will be sought through the life of the operation. This includes opportunities to reduce the rehabilitation security bond held for the site.

6.0 Review,Reporting and Training

6.1 Revision of the LMP and Independent Environmental Audit

Revisions of the LMP will be undertaken in accordance with Schedule 5, Condition 4A of Project Approval 08_0142. While independent reviews of the LMP will be undertaken in accordance with Schedule 5, Condition 7 of Project Approval 08_0142.

6.2 Annual Review

A summary of rehabilitation and associated monitoring activities and results will be reported annually to the Secretary of the DPIE and relevant government agencies as part of the Annual Review that is required by Schedule 5, Condition 4 of the Project Approval 08_0142.

6.3 Training

The roles and responsibilities identified in Section 1.4 will be made aware of the relevant requirements of this LMP.

7.0 References

Bell, S. and Driscoll, C. 2010. Vegetation of the Worimi Conservation Lands Port Stephens, NSW. Report prepared for Dept. of Environment, Climate Change & Water, November 2010.

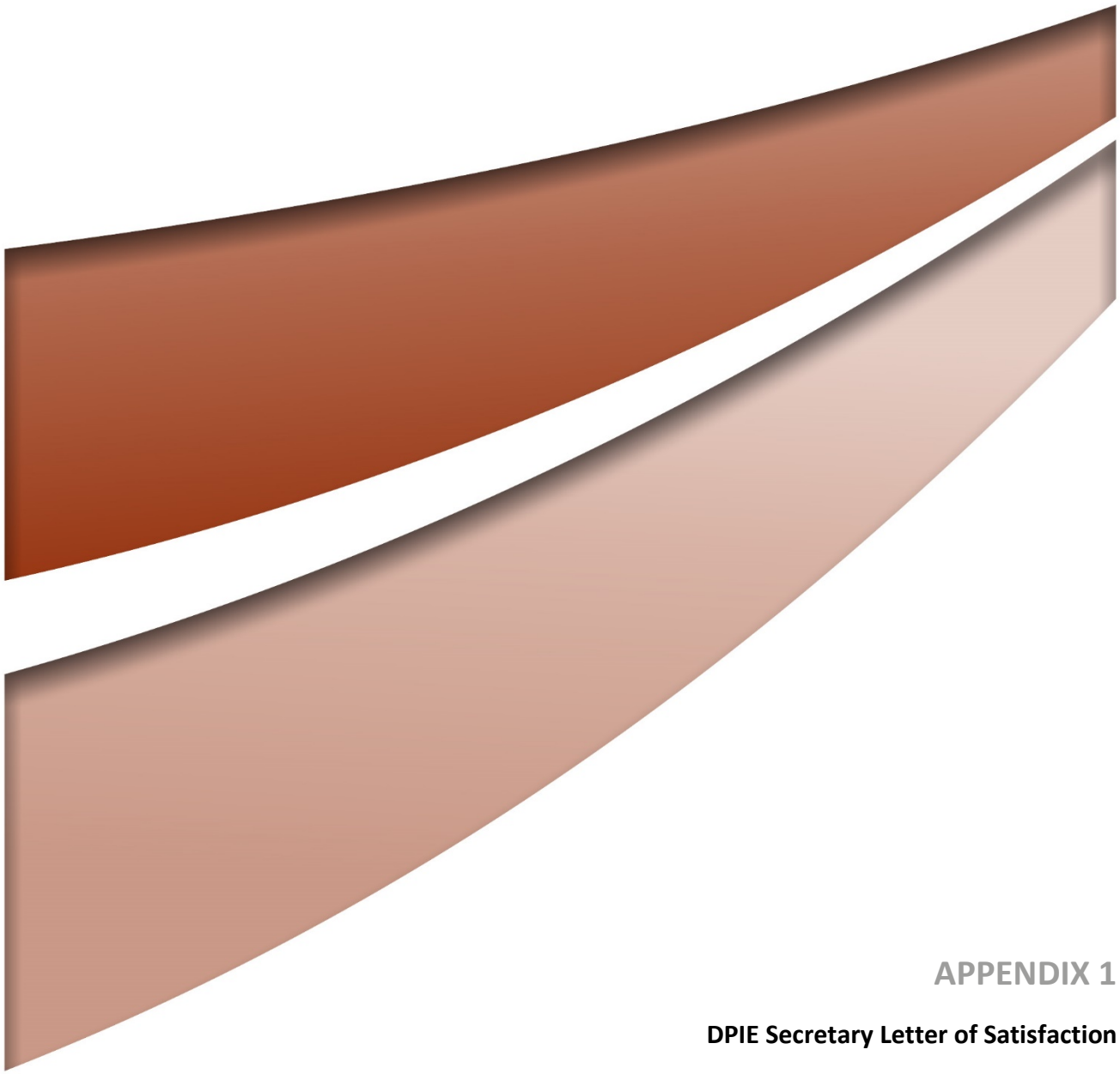
House, S, (2003). Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy, Technical Report, Digital Aerial Photo Interpretation and Updated Extant Vegetation Community Map, May 2003. Lower Hunter and Central Coast Regional Environmental Management Strategy, Callaghan, NSW.

Department of Natural Resources (2006). Williamtown 1:25,000 Acid Sulfate Sulphate Soils Risk Map.

Umwelt (Australia) Pty Limited (Umwelt) (2004). Flora and Fauna Assessment for Proposed Rezoning of Lot 218, Stockton Bight.

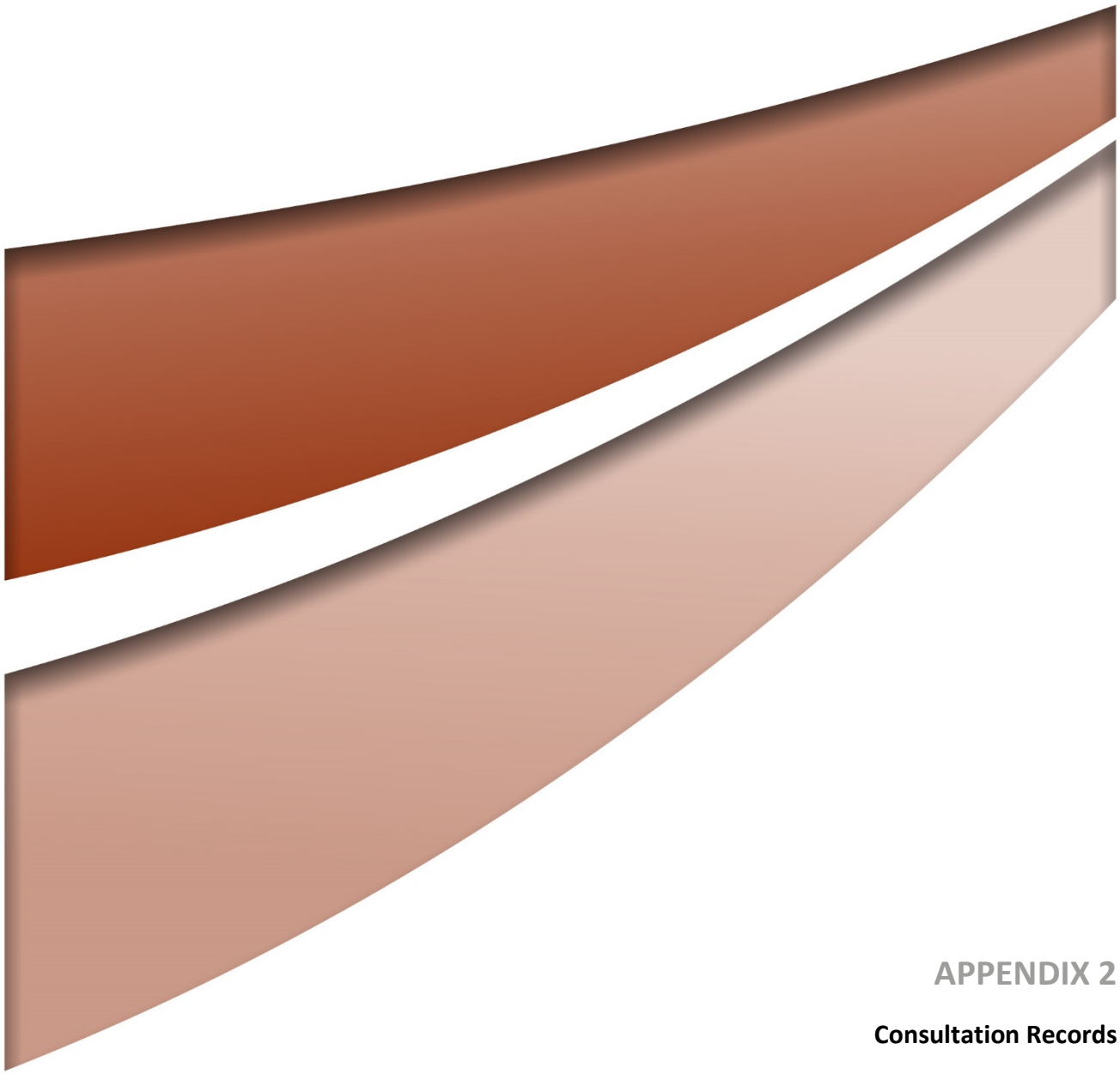
Umwelt (Australia) Pty Limited (2009). Environmental Assessment of Sand Extraction Operations from Lot 218 DP 1044608 and Lot 220 DP 1049608, Salt Ash.

Umwelt (Australia) Pty Limited (2012). Environmental Assessment Modification to Sand Extraction Operations on Lot 218 and Lot 220, Salt Ash, NSW.



APPENDIX 1

DPIE Secretary Letter of Satisfaction



APPENDIX 2

Consultation Records

umwelt
Environmental & Social Consultants

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