REHABILITATION PLAN

for a
Proposed Sand Extraction Facility
at

Lot 591 DP 1191380
Nelson Bay Road
ANNA BAY
NSW

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Job No: 12462 ***January 2020***

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Project Name	Rehabilitation Plan for a Proposed sand extraction facility within Lot 591 DP 1191380 Nelson Bay Road, Anna Bay NSW	
Project Number	12462	
Prepared By	Dr Kylie Bridges BEnvSc Hons PhD Ecologist	
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Status	January 2020	

Disclaimer

This report has been prepared in accordance with the proposal provided by the Client and outlined within this report. All findings, conclusions or recommendations contained within this report are based upon the data and results collected under the times and conditions specified in the report and are only applicable for the proposal considered within this report. This report has been prepared for use exclusively by the Client. No responsibility for its use by any other party is accepted by WILDTHING Environmental Consultants.

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1.0 INTRODUCTION

Wildthing Environmental Consultants has prepared this Rehabilitation Plan for the proposed sand extraction facility at Lot 591 DP 1191380 Nelson Bay Road, Anna Bay NSW (Figure 1.1). The Rehabilitation Plan is required to demonstrate compliance with Section 7.2 of the *Biodiversity Conservation Act 2016* and Clause 13 of the *State Environmental Planning Policy (Coastal Management)* 2018. The Rehabilitation Plan provides a description of native vegetation on site; a breakdown of the sand extraction facility location into management zones; a schedule of works detailing the sequence and duration or works necessary for revegetation and maintenance works for each management zone.

1.1 OBJECTIVE OF THE REHABILITATION PLAN

The objectives of the Rehabilitation Plan include:

- To rehabilitate vegetation south of the Ausgrid easement during Stage 2 of the proposed development
- To rehabilitate vegetation south of the Ausgrid easement upon completion of the sand extraction facility licence.
- To ensure the ongoing ecological viability of the retained areas of vegetation by protecting the ecological biodiversity and habitat values of the land;
- To create stabilisation of the sand dunes to allow plantings to establish.

The Rehabilitation Plan will include:

- The condition of the existing vegetation;
- Description of proposed environment;
- Protection of native vegetation;
- Weed management techniques;
- Planting methods;
- Monitoring and reporting;
- Costs.

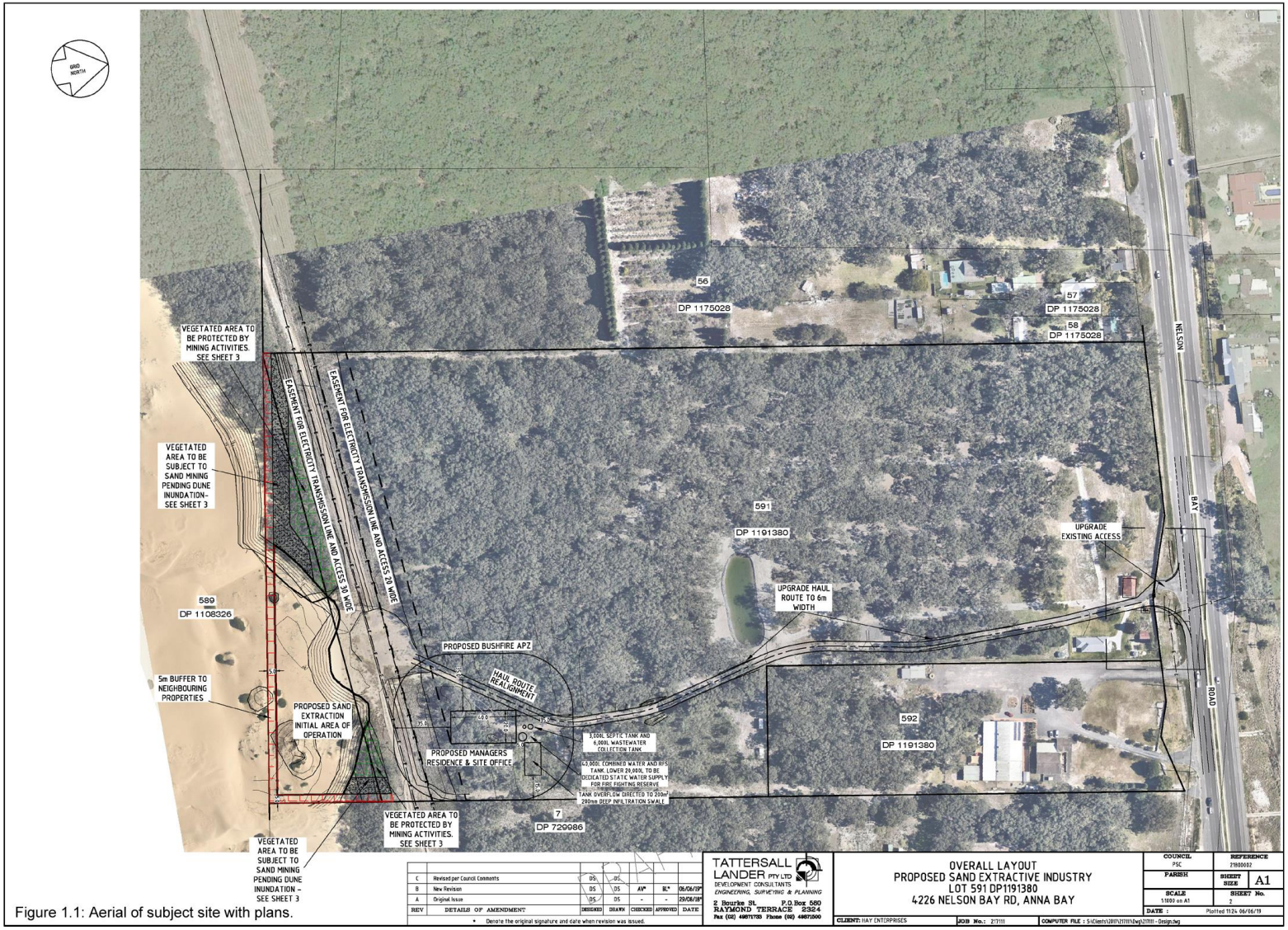


Figure 1.1: Aerial of subject site with plans.

1.2 DOCUMENTATION USED IN REHABILITATION PLAN

The Rehabilitation Plan has considered the information contained within the following documentation:

- Wildthing Environmental Consultants. *Biodiversity Development Assessment Report for a proposed sand extraction quarry at Lot 591 DP 1191380 Nelson Bay Road, Anna Bay NSW.* Updated January 2020.
- Port Stephens Council (2014). *Port Stephens Council Development Control Plan,* November 2014;
- Port Stephens Council (2014). *Port Stephens Council Vegetation Technical Specification*. May 2014.
- NSW Department of Land and Water Conservation (2001). Coastal Dune Management: A Manual of Coastal Dune Management and Rehabilitation Techniques, Coastal Unit, DLWC, Newcastle

2.0 SITE DESCRIPTION

2.1 SITE LOCATION

The 13.66 ha study area (Lot 591 DP 1191380) is located at Anna Bay, NSW, approximately 32km north-east of Newcastle and 9km south-west of Nelson Bay. The study area is situated on the southern side of Nelson Bay Road, bounded by the Stockton sand dunes to the south and predominantly bushland to the east and west.

2.2 DESCRIPTION OF DEVELOPMENT

The proposed sand extraction facility will require the installation of several minor project components during its construction stage, which are:

- A minor realignment of a pre-existing access track running north through the study area to allow for the movement of reticulated vehicles accessing the sand dunes of Stockton Bight from Nelson Bay Road
- The construction of a site office/manager's residence with a development footprint of approx. 800m2
- The establishment of a bushfire asset protection zone with a radius of approximately 35m from the edge of the site office/manager's residence

Operational effects of the sand extraction process will be restricted to the bulk handling of sand material, utilising front end loaders and reticulated vehicles for the transport of the material to the required markets. Initially the extraction of sand will be restricted to the area of Stockton Sand Dunes that has encroached into the study area (approximately 1 ha). It is anticipated, based upon previous observations made by the proponent, that the sand dune incursion within the study area will advance over time allowing for more sand material extent to be extracted. The sand extraction will continue to be largely dependent on wind deposition. Once the existing sand resource is retrieved, the facility will only operate occasionally. The operation will provide up to 50,000 cubic metres of extracted material per annum. When in operation, the development is proposed to operate between the hours of 7:00 am and 6:00 pm Monday to Friday and between 8:00 am to 1:00 pm on Saturdays. No work is proposed on Sundays or on Public Holidays.

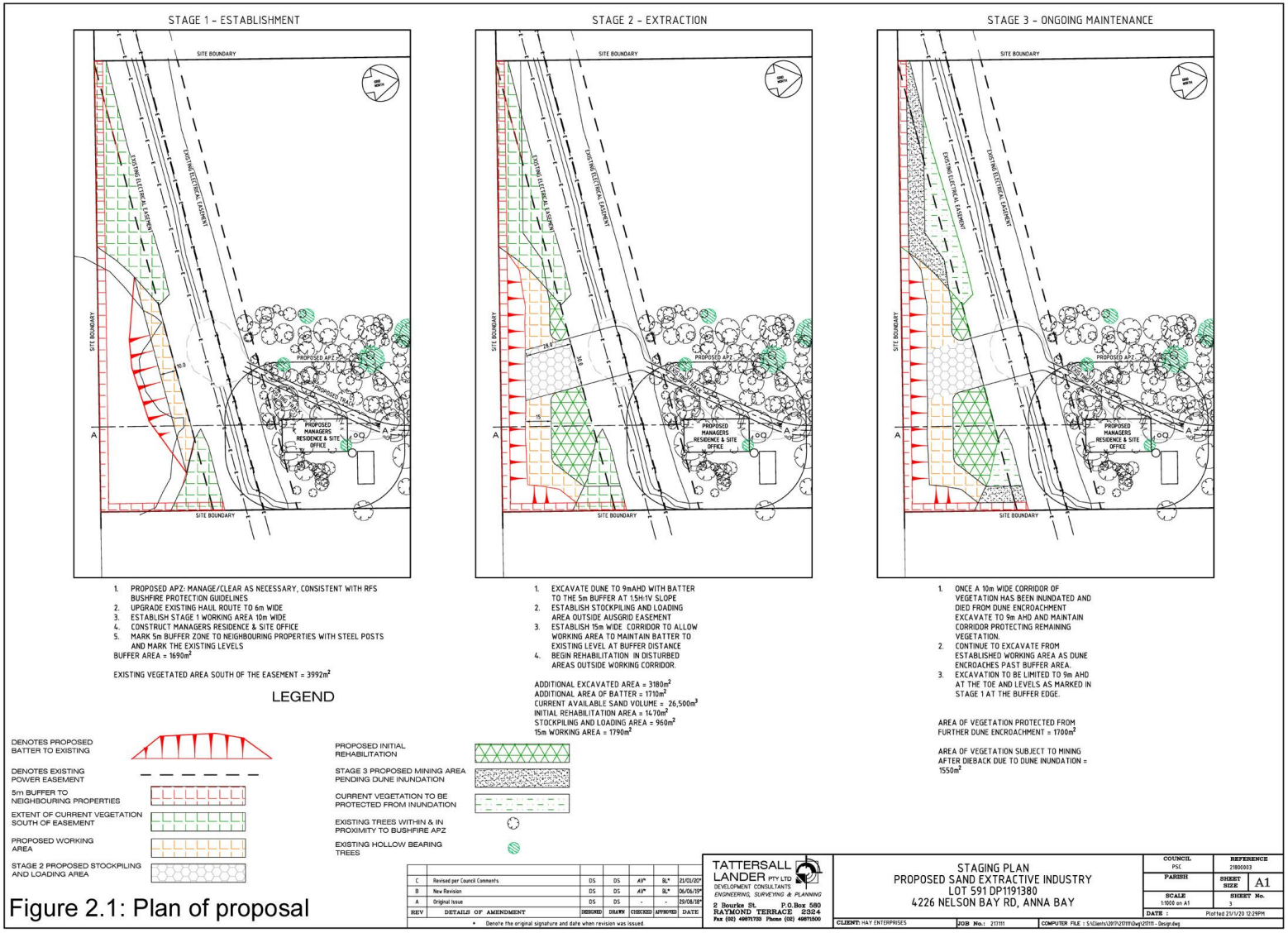


Figure 2.1: Plan of proposal

The above project components and operational effects of the proposed sand extraction facility are hereafter collectively referred to as the proposed development.

2.3 TOPOGRAPHY & HYDROLOGY

The study area is located on the Port Stephens soil landscape, composed of Holocene sand sheets and beach ridges (Murphy, 1995). The soil consists of loamy sand throughout the majority of the study area. The topography is flat to undulating throughout the study area, with a sharp incline into sand dunes in the south of the study area. The southern portion of the study area borders Stockton Bight sand dunes and is characterised by transgressive sand dunes of marine and Aeolian Holocene sands. There are no karst, caves, cliffs or other areas of geological significance within the study area or within the surrounding assessment area.

The study area is located within the Hunter Central Rivers Catchment. According to the NSW Government SEED mapping, no rivers, streams and estuaries are present within the study area (NSW Gov 2018). A Coastal Wetland (Coastal Management SEPP) was present approximately 0.65km to the north west of the study area, this wetland was not a listed as a wetland of International Importance developed under the Ramsar Convention (NSW Gov 2018) nor a DIWA listed wetland (DoEE 2108).

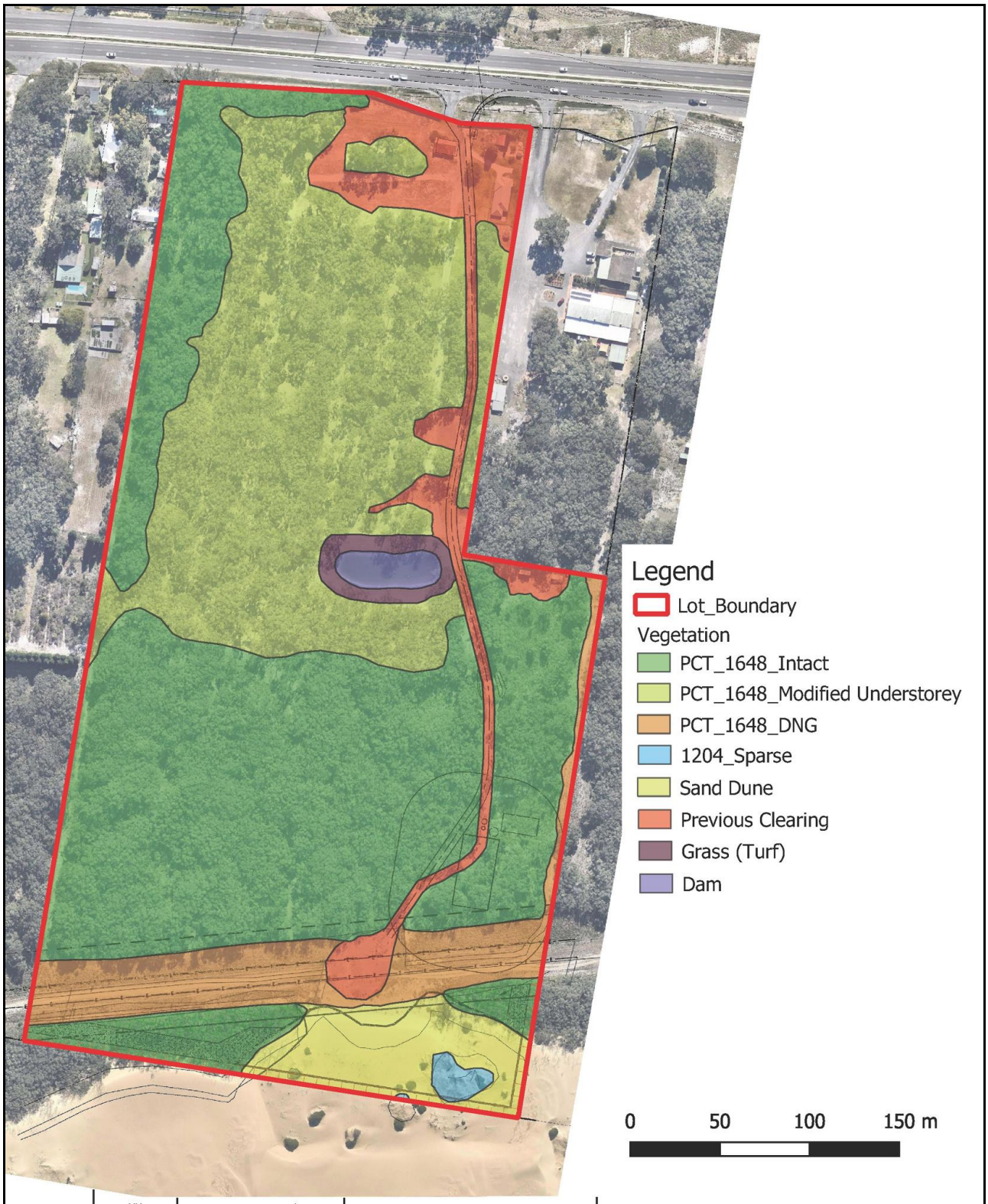
2.4 VEGETATION

Two Plant Community Types (PCT) were determined to be present within the study area, being:

- PCT 1648 - Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula (11.17 ha);
- PCT 1204 - Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion (0.06 ha).

A description of the two vegetation communities is shown below in Table 2.1. A vegetation map of the subject site is shown in Figure 2.2.

*Note on Vegetation Community Distribution Map. A map of vegetation of any area seeks to describe the distribution of the plant species in that area by defining a number of vegetation units (assemblages or communities), which are relatively internally homogenous. Whilst such mapping is a convenient tool, it greatly oversimplifies the real situation. Plants rarely occur in defined communities with distinct boundaries. Accordingly vegetation units used for the accompanying map should be viewed as indicative of their extent rather than being precise edges of communities.



Author	XX
A4 Scale	1:10000

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarentee is given that the information protrayed is free from error or omission. In addition the spatial accuracy of the map is wholly dependant on source data. Please verify the accuracy of all information prior to use. Development footprint areas should be used for indicative areas only.

Figure 2.2

Vegetation Zones

Nelson Bay Road
Anna Bay, NSW

January 2020

WILDTHING Environmental Consultants
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Table 2.1: Descriptions of vegetation communities located within the site.

Smooth-barked Apple Blackbutt heathy open Forest of the Tomaree Peninsula	
Vegetation Formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Vegetation Class	Coastal Dune Dry Sclerophyll Forests
Vegetation Community Type (PCT) No.	PCT -1648
PCT Name	Smooth-barked Apple Blackbutt heathy open Forest of the Tomaree Peninsula
Extent	11.404ha
Species present	***Angophora costata**, Corymbia gummifera, **Eucalyptus pilularis** / **Banksia serrata**, Acacia terminalis, **Bossiaea rhombifolia**, **Dillwynia retorta**, Eriostemon australasius, **Acacia suaveolens** , **Ricinocarpus pinifolius**, **Acacia ulicifolia** , **Persoonia levis / Themeda australis** , Leucopogon ericoides, Tetratheca ericifolia , Hypolaena fastigiata , **Pteridium esculentum**, Epacris pulchella* *The associated species above which occurred within the study area and informed assignment of this PCT have been made bold
TEC Status	This PCT can form part of the TEC River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, which is listed as Endangered under Schedule 2 of the BC Act. No occurrence of this PCT within the study area was situated within a floodplain, thus this PCT was not found to be consistent with this TEC.
Examples of PCT 1649 on site.	
Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1204)	
Vegetation Formation	Grasslands
Vegetation Class	Maritime Grasslands
Vegetation Community Type (PCT) No.	1204
PCT Name	Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion
Extent	0.11 ha
Species present	***Spinifex sericeus**; Austrofestuca littoralis; Carpobrotus glaucescens; Calystegia soldanella; Actites megalocarpa; Isolepis nodosa* *The associated species above which occurred within the study area and informed assignment of this PCT have been made bold.

TEC Status	This PCT is not likely to form part of a TEC
Example of PCT 1646 within the site.	

2.4.1 THREATENED ECOLOGICAL COMMUNITIES AND THREATENED FLORA

No Threatened Ecological Communities were located within the site. A number of specimens of *Diuris praecox* (Rough Doubletail) were located within the Ausgrid easement within the site.

2.5 PRIORITY WEEDS AND WEEDS OF STATE AND NATIONAL SIGNIFICANCE

The impact of weeds on site is considered to be a threat to rehabilitation works and the long-term survival of the area of native vegetation within the vegetation to the south of the Ausgrid easement. Three priority weed species listed under the Biosecurity Act 2015 were identified on site and are listed below in Table 2.2. The site lies within the Hunter Regional Weed Committee (HRWC).

Table 2.2: Priority Weed species found within the subject site.

Weed Species	Biosecurity Duty	Additional Significance
Senecio madagascariensis (Fireweed)	• General Biosecurity Duty • Prohibition on dealings	N
Nephrolepis cordifolia (Fishbone Fern)	• General Biosecurity Duty • Prohibition on dealings	
Arundo donax (Giant Reed)	• General Biosecurity Duty • Prohibition on dealings • **Regional Recommended Measure** Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment.	

Weed Species	Biosecurity Duty	Additional Significance
Eragrostis curvula (African lovegrass)	• General Biosecurity Duty • Prohibition on dealings	
Schinus sp (Peppercorn)	• General Biosecurity Duty • Prohibition on dealings	
Conyza species (Fleabane)	• General Biosecurity Duty • Prohibition on dealings	
Chrysanthemoides monilifera subsp. Rotundata (Bitou bush)	• General Biosecurity Duty • Prohibition on dealings • **Biosecurity Zone** Within the Biosecurity Zone (all of NSW) this weed must be eradicated where practicable, or as much of the weed destroyed as practicable, and any remaining weed suppressed. The local control authority must be notified of any new infestations of this weed within the Biosecurity Zone	T N
Ricinus communis (Castor oil plant)	• General Biosecurity Duty • Prohibition on dealings	
Lantana camara (Lantana)	• General Biosecurity Duty • Prohibition on dealings	T N
Lilium formosanum (Taiwan lily)	• General Biosecurity Duty • Prohibition on dealings	

T – Listed as a Threatening Process under the NSW BC Act 2016.
N –Weed of National Significance.

***Priorities under the Biosecurity Act 2015**

General Biosecurity Duty - any person dealing with plant matter must take measures to prevent, minimise or eliminate the biosecurity risk (as far as is reasonably practicable).

Prohibition on dealings - Must not be imported into the State or sold

Regional Recommended Measure - Land managers mitigate the risk of the plant being introduced to their land. Land managers reduce impacts from the plant on priority assets. Land managers prevent spread from their land where feasible. The plant or parts of the plant are not traded, carried, grown or released into the environment

Biosecurity Zone – The Bitou Bush Biosecurity Zone is established for all land within the State except land within 10 kilometres of the mean high water mark of the Pacific Ocean between Cape Byron in the north and Point Perpendicular in the south. *Within the Biosecurity Zone this weed must be eradicated where practicable, or as much of the weed destroyed as practicable, and any remaining weed suppressed. The local control authority must be notified of any new infestations of this weed within the Biosecurity Zone*

Information on the control of these species as contained within the NSW DPI *Noxious and environmental weed control handbook* (2014) is included in Appendix A. Other weed species recorded in the vegetation to the south of the Ausgrid easement include:

Cyperus eragrostis	*Umbrella Sedge*
Andropogon virginicus	*Whisky Grass*
Anthoxanthum odoratum	*Sweet Vernal Grass*
Axonopus fissifolius	*Narrow-leaved Carpet Grass*
Briza maxima	*Quaking Grass*

Chloris gayana	*Rhodes Grass*
Melinis repens	*Red Natal Grass*
Paspalum dilatatum	*Paspalum*
Setaria gracilis	*Slender Pigeon Grass*
Setaria parviflora	
Foeniculum vulgare	*Fennel*
Hydrocotyle bonariensis	*Kurnell Curse*
Bidens pilosa	*Cobblers Pegs*
Cirsium vulgare	*Spear Thistle*
Conyza bonariensis	*Flax-leaved Fleabane*
Conyza parva	*Whorled Fleabane*
Coreopsis lanceolata	*Coreopsis*
Acanthospermum australe	*Star Burr*
Sonchus oleraceus	*Common Sow Thistle*
Cakile edentula	*American Sea Rocket*
Ricinus communis	*Castor Oil Plant*
Medicago polymorpha	*Burr Medic*
Trifolium repens	*White Clover*
Solanum mauritianum	*Wild Tobacco*
Solanum nigrum	*Blackberry Nightshade*
Verbena bonariensis	*Purple Top*
Richardia humistrata	
Anagallis arvensis var. arvensis	*Scarlet Pimpernel*
Plantago lanceolata	*Plantain*
Verbena bonariensis	*Purple Topped Verbena*

These species should be controlled during primary weed control to assist the establishment of planted species in vegetation to the south of the Ausgrid easement.

3.0 DESCRIPTION OF PROPOSED ENVIRONMENT

Initial rehabilitation will occur during Stage 2 of the proposed development and will be undertaken by revegetation in disturbed areas outside of the working corridor (Figure 2.1). This will consist of an area of 1470 m^2 that will be revegetated with Smooth-barked Apple - Blackbutt heathy open forest. During Stage 2 the current vegetation present to the south of the easement will be retained and weed control will be carried out. The southern extent of the vegetation is currently subject to dune encroachment. Once dieback to a 10m corridor has occurred from inundation, Stage 3 of the proposed development will commence and this corridor will be removed and sand extracted (Figure 2.1). This will enable 1700m^2 of Smooth-barked Apple - Blackbutt heathy open forest to be retained and protected from further dune encroachment to the immediate south of the Ausgrid easement within the site. Due to the nature of this area of vegetation, natural regeneration of the understorey would be feasible after weed control is undertaken. Post-operation rehabilitation will be undertaken in Management Zones 2, 4 and 5 by planting 3350m^2 of Spinifex beach strand grassland on the 5m buffer and batter of sand dune and 3950m^2 of Smooth-barked Apple - Blackbutt heathy open forest within the proposed working area and stockpiling/loading area.

3.1 VEGETATION REHABILITATION AND ENHANCEMENT

Two main approaches to vegetation rehabilitation to be used are:

- Assisted natural regeneration;
- Revegetation.

3.2 ASSISTED NATURAL REGENERATION

Assisted Natural Regeneration will involve the following stages to control weeds and facilitate native regeneration:

- **Weed control –** targeting the removal of invasive species. Species to target include *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush). This will involve the use of mechanical and/or chemical approaches as discussed in Section 4.3.

3.3 REVEGETATION

Revegetation of Smooth-barked Apple - Blackbutt heathy open forest will be undertaken in Management Zone 1 & 2. Revegetation of Spinifex beach strand grassland will be undertaken in Management Zone 3. Suitable species and techniques have been suggested in Section 4.5.

4.0 REHABILITATION PLAN IMPLEMENTATION

The implementation of the Rehabilitation Plan will include:

- Management Zones
- Site Protection
- Weed Control
- Dune Stabilising Fences
- Revegetation Plantings
- Maintenance
- Monitoring and Reporting

4.1 MANAGEMENT ZONES

To ensure the success of the Rehabilitation Plan, the site has been broken down into five management zones (Figure 4.1). These zones include:

- Management Zone 1: Vegetation to be retained south of Easement (1700m^2)
- Management Zone 2: Mining Area pending Dune Inundation (1550m^2)
- Management Zone 3: Initial Rehabilitation Area: Smooth-barked Apple - Blackbutt heathy open forest (approximately 1470m^2);
- Management Zone 4: Post Operations Area: Smooth-barked Apple - Blackbutt heathy open forest (2400m^2);
- Management Zone 5: Post Operations Area: Spinifex beach strand grassland (approximately 3350m^2);

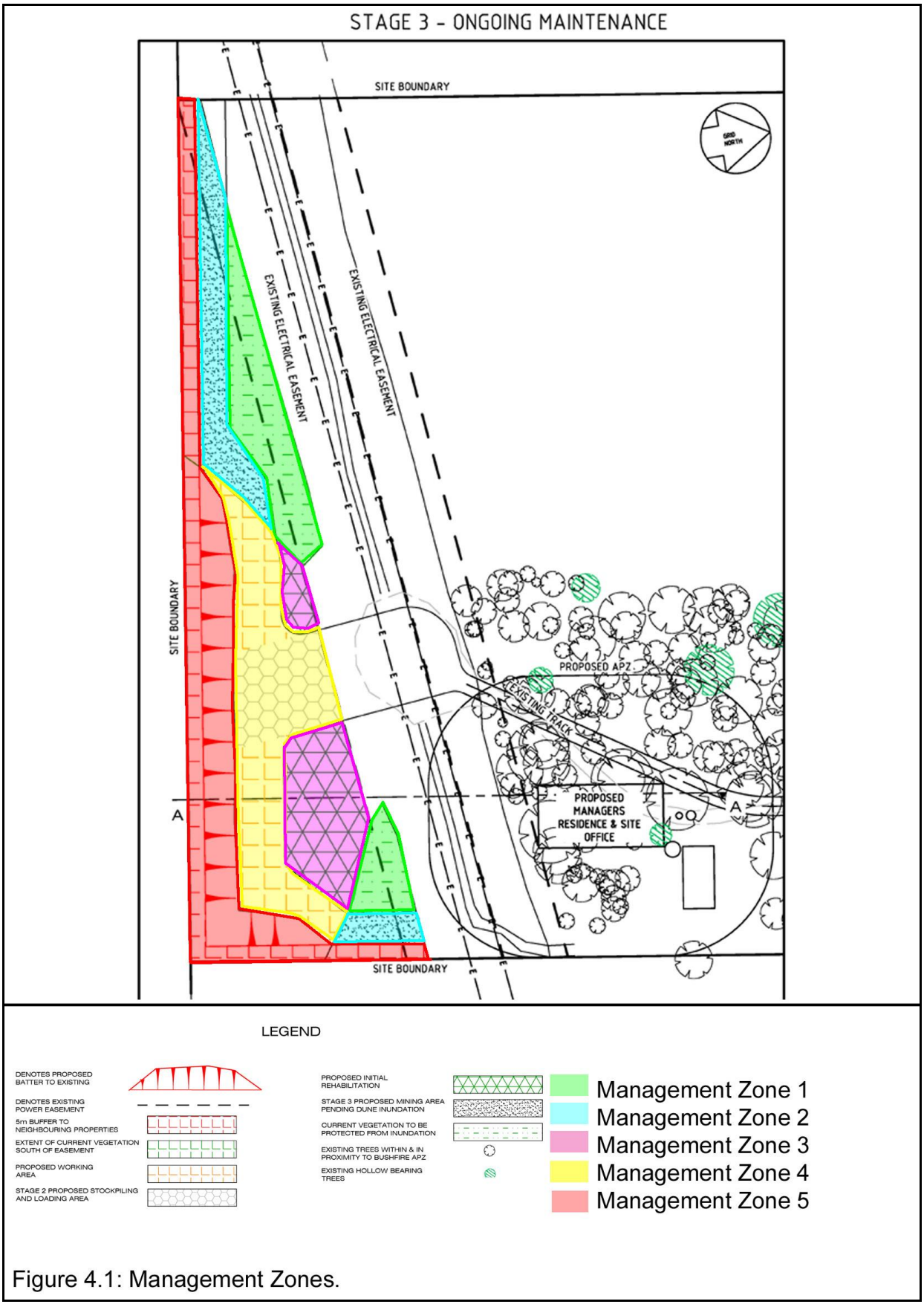

Figure 4.1: Management Zones.

The following sections provide a description of the management activities to be undertaken in each of these zones:

4.1.1 ZONE 1 – VEGETATION TO BE RETAINED SOUTH OF EASEMENT

The 1700m^2 area is located to the immediate south of the Ausgrid easement. Management actions within this area will largely be in the form of weed control and assisted regeneration.

Required actions:

- Assisted revegetation;
- Control of weeds;
- Exclusion of livestock;
- Relocation of dead wood from Management Zone 2.

4.1.2 ZONE 2 – MINING AREA PENDING DUNE INUNDATION

A 10m wide corridor of vegetation, which is located to the immediate north of the sand dunes, will die back from dune encroachment and subsequently be removed once dead to initiate Stage 3 of the proposal. The removal will allow the protection of Management Zone 1 from dune encroachment for the remaining lifespan of the sand extraction facility.

Required actions:

- Control of weeds (to prevent incursion into Management Zones 1 and 3)
- Mark out 10m corridor to monitor dune encroachment and allow natural dieback
- Once dieback has occurred, initiate Stage 3 of the development proposal;
- Install clearing boundary using flagging tape;
- Immediately prior to clearing an ecologist is required to inspect dead vegetation to identify any hollow-bearing trees;
- If hollow-bearing trees are located within this zone, an ecologist is required to supervise removal;
- Dead trees are to be felled away from Management Zone 1;
- Relocate dead wood into Management Zone 1;
- Post-operations, implement revegetation of Smooth-barked Apple - Blackbutt heathy open forest.
- Monitor and maintain revegetation works

4.1.3 ZONE 3 – INITIAL REHABILITATION AREA: SMOOTH-BARKED APPLE - BLACKBUTT HEATHY OPEN FOREST

The 1470m^2 area is located to the immediate south of the Ausgrid easement.

Required actions:

- Revegetation of Smooth-barked Apple - Blackbutt heathy open forest during Stage 2 of the development proposal;
- Control of weeds;

- Exclusion of livestock;
- Monitor and maintain revegetation works.

4.1.4 ZONE 4 – POST OPERATIONS AREA: SMOOTH-BARKED APPLE - BLACKBUTT HEATHY OPEN FOREST

The 2400m^2 area is composed of the Stage 2 working area, proposed stockpiling and loading area.
Required actions:

- Revegetation of Smooth-barked Apple - Blackbutt heathy open forest;
- Control of weeds;
- Exclusion of livestock;
- Monitor and maintain revegetation works.

4.1.5 ZONE 5 – POST OPERATIONS AREA: SPINIFEX BEACH STRAND GRASSLAND

The 3350m^2 area is composed of the batter and 5m buffer to neighbouring properties.
Required actions:

- Revegetation of Spinifex beach strand grassland;
- Implement dune stabilisation techniques including dune stabilising fencing to act as a sand trap and protect plantings;
- Control of weeds;
- Exclusion of livestock;
- Monitor and maintain revegetation works.

4.2 SITE PROTECTION

Prior to the commencement of clearing in Management Zone 2, a defined clearance zone is to be clearly marked along the clearance boundary between Management Zone 2 and 3 using flagging tape, ensuring no machinery can enter the retained vegetation corridor. Also, prior to any earthworks occurring, silt fencing is to be erected along the boundary of the clearance zone and retained vegetation corridor (between Management Zone 2 and 3) so that no excess sediment will enter this habitat.

4.3 WEED CONTROL

Noxious weeds and a number of additional weed species are to be treated within the vegetation corridor in a targeted weed control program prior to revegetation work. Control of weeds within the vegetation corridor will aid in the natural regeneration of the corridor and give established native vegetation and plantings the best chance of survival.

Weed control is proposed for the entire vegetated corridor to the immediate north of the sand dunes and will involve the following stages:

- **Primary weed control -** target removal of noxious weeds and other most invasive species.

- **Follow-up weed control** - following on from primary weed control to treat regenerating weed species. To be carried out during general maintenance visits.

Weed control will involve the use of mechanical and/or chemical approaches. Chemical approaches should only be undertaken in August, which is when *Diuris praecox* (Rough Doubletail) is in flower. The suggested control of individual weed species is contained in Appendix A of the Rehabilitation Plan.

4.4 DUNE STABILISING FENCES

Dune stabilising fences will be constructed within Management Zone 5 during vegetation establishment at the completion of the sand extraction facility licence. The fences are to be constructed along the southern boundary of the site, midway down along the length of the batter and at the toe of the batter to slow dune transgression. The fencing should be constructed with preferably natural fibres/products with a 40% porosity (NSW Department of Land and Water Conservation, 2001).

4.5 REHABILITATION PLANTINGS

4.5.1 SPECIES COMPOSITION

The recommended species composition for Management Zones 2, 3, 4 and 5 are shown below in Tables 4.1 & 4.2.

Table 4.1: Management Zone 2, 3 & 4: Recommended species list for the revegetation planting works and the source of plant material

Plant Species	Source of plant material
Canopy Species	
Eucalyptus pilularis (Blackbutt)	Tubestock
Angophora costata (Smooth-barked Apple)	Tubestock
Mid-Storey Species	
Banksia serrata (Old Man Banksia)	Tubestock
Pittosporum undulatum (Sweet Pittosporum)	Tubestock
Glochidion ferdinandi (Cheese Tree)	Tubestock
Shrub Species	
Bossiaea rhombifolia	hiko or enviro cells
Dillwynia retorta (Heathy Parrot Pea)	hiko or enviro cells
Acacia suaveolens (Sweet-scented Wattle)	hiko or enviro cells
Ricinocarpus pinifolius (Wedding Bush)	hiko or enviro cells
Acacia ulicifolia (Prickly Moses)	hiko or enviro cells
Persoonia levis (Cheese Tree)	hiko or enviro cells
Ground Species	
Themeda australis (Kangaroo Grass)	hiko or enviro cells
Pteridium esculentum (Bracken)	hiko or enviro cells

MANAGEMENT ZONE 5 – Revegetation of Spinifex beach strand grassland

Table 4.2: Management Zone 5: Recommended species list for the revegetation planting works and the source of plant material

Plant Species	Source of plant material
Spinifex sericeus (Coastal Spinifex)	hiko or enviro cells

4.5.2 SOURCE NATIVE TUBESTOCK

The required plants should be sourced from a suitably experienced plant production nursery. Specimens will be required to be of local providence, and will likely involve seed collection and propagation. Plants will be planted as tubestock and hiko or enviro cells.

4.5.3 PLANTING METHODS

It is recommended that manual planting be carried out within Management Zones 2, 3, 4 & 5. Planting will involve preparing the ground by such means of auger holes. All tubestock will be required to be suitably guarded to prevent herbivory. Plantings are to be well watered on installation. Follow-up watering is also to be undertaken. Spinifex is best established between October and March inclusive.

4.5.4 ESTIMATED COSTINGS AND PLANTING DENSITIES

The cost per plant is estimated at:

- Tubestock - $3.50
- Hiko or enviro cell - $2.50

MANAGEMENT ZONE 3 - Stage 2 plantings of Smooth-barked Apple - Blackbutt heathy open forest

It is recommended that species be planted at the following densities:

- Canopy species - 1 plant per 4m x 4m;
- Mid-storey species - 1 plant per 3m x 3m;
- Shrub species - 1 plant per 2m x 2m;
- Ground cover species - 2 plant per 1m x 1m.

See Table 4.3 for the number of plants required and the estimated costing for Management Zone 3. *Please note that inflation has not been taken into consideration for these costings.

Table 4.3: Management Zone 3: Numbers of each species required for the revegetation works and costings.

Plant Species	Number required	Estimated Total Cost*
Canopy Species		
Eucalyptus pilularis (Blackbutt)	184	$644.00
Angophora costata (Smooth-barked Apple)	184	$644.00
Mid-storey Species		
Banksia serrata (Old Man Banksia)	164	$574.00
Pittosporum undulatum (Sweet Pittosporum)	163	$570.50
Glochidion ferdinandi (Cheese Tree)	163	$570.50
Shrub Species		
Bossiaea rhombifolia	123	$307.50
Dillwynia retorta (Heathy Parrot Pea)	122	$305.00
Acacia suaveolens (Sweet-scented Wattle)	122	$305.00
Ricinocarpus pinifolius (Wedding Bush)	122	$305.00
Acacia ulicifolia (Prickly Moses)	122	$305.00
Persoonia levis (Cheese Tree)	122	$305.00
Ground Cover Species		
Themeda australis (Kangaroo Grass)	1470	$3675.00
Pteridium esculentum (Bracken)	1470	$3675.00

MANAGEMENT ZONE 2 & 4 - Post-operation plantings of Smooth-barked Apple - Blackbutt heathy open forest

It is recommended that species be planted at the following densities:

- Canopy species - 1 plant per 4m x 4m;
- Mid-storey species - 1 plant per 3m x 3m;
- Shrub species - 1 plant per 2m x 2m;
- Ground cover species - 2 plant per 1m x 1m.

See Table 4.4 for the number of plants required and the estimated costing for Management Zones 2 and 4.

*Please note that inflation has not been taken into consideration for these costings.

Table 4.4: Management Zone 2 & 4: Numbers of each species required for the revegetation works and costings.

Plant Species	Number required	Estimated Total Cost*
Canopy Species		
Eucalyptus pilularis (Blackbutt)	494	$1729.00
Angophora costata (Smooth-barked Apple)	494	$1729.00
Mid-storey Species		
Banksia serrata (Old Man Banksia)	439	$1536.50
Pittosporum undulatum (Sweet Pittosporum)	438	$1533.00
Glochidion ferdinandi (Cheese Tree)	438	$1533.00
Shrub Species		
Bossiaea rhombifolia	330	$825.00
Dillwynia retorta (Heathy Parrot Pea)	329	$822.50
Acacia suaveolens (Sweet-scented Wattle)	329	$822.50
Ricinocarpus pinifolius (Wedding Bush)	329	$822.50
Acacia ulicifolia (Prickly Moses)	329	$822.50
Persoonia levis (Cheese Tree)	329	$822.50
Ground Cover Species		
Themeda australis (Kangaroo Grass)	3950	$9875.00
Pteridium esculentum (Bracken)	3950	$9875.00

MANAGEMENT ZONE 5 – Post-Operation plantings of Spinifex beach strand grassland

It is recommended that species be planted at the following densities:

- Ground cover species - 2 plants per 1m x 1m

Table 4.5 for the number of plants required and the estimated costing for Management Zone 5.

*Please note that inflation has not been taken into consideration for these costings.

Table 4.5: Management Zone 5: Numbers of each species required for the revegetation works and costings.

Plant Species	Number required	Estimated Total Cost*
Canopy Species		
Spinifex sericeus (Coastal Spinifex)	6700	$16750.00

4.6 PERFORMANCE TARGETS

Quantifiable performance targets for native species cover (canopy, mid-storey and groundcover) and exotic cover for the primary, secondary and maintenance phases of the Rehabilitation Plan have been given in Table 4.7.

Table 4.7: Quantifiable performance targets for native species cover and exotic cover for the primary, secondary and maintenance phases of the Rehabilitation Plan.

Management Zone	Primary phase			Secondary Phase			Maintenance Phase		
1, 2	Proportion of exotic canopy species no greater than 5%	Proportion of exotic mid-story species no greater than 60%	Proportion of exotic groundcover species no greater than 80%	Proportion of exotic canopy species no greater than 2%	Proportion of exotic mid-story species no greater than 30%	Proportion of exotic groundcover species no greater than 40%	Proportion of exotic canopy species no greater than 0%	Proportion of exotic mid-story species no greater than 5%	Proportion of exotic groundcover species no greater than 5%
1, 2	A demonstrated increase in native cover and diversity and a demonstrated decrease in exotic cover and diversity by the end of year 5								
2, 3, 4, 5	A minimum of 85% survival rate of all plantings								

4.7 MAINTENANCE PROGRAM

4.7.1 GENERAL MAINTENANCE

The completion of the works will be considered as the date of the practical completion of the revegetation plantings for each Management Zone and will signal the commencement of six-monthly maintenance program for a period of two years then annually for a further three years. General maintenance will involve monitoring survival rates, installing replacement plants, guards and continued follow-up weeding. The 5 year maintenance program will commence for Management Zones 1 and 3 upon completion of weeding and plantings, and for Management Zones 2, 4 & 5 once plantings are installed post-operation of the sand extraction facility.

4.7.2 WATERING

All plantings are to be well watered on installation. They will then receive a further two applications of water during the first two months to assist in establishment. Depending on the soil/sand moisture at the time a further watering may be required.

4.7.3 MAINTENANCE WEEDING

Follow-up weed control will be carried out. Noxious weeds and other problem weeds present at the time should be targeted.

4.7.4 INSTALLING REPLACEMENT PLANTS

Plant losses discovered during maintenance visits are to be replaced at the cost of the applicant as per the Port Stephens DCP (2014).

4.7.5 INAPPROPRIATE PRACTICES

It is recommended that the following practices are observed to ensure the continued viability of the Rehabilitation Plan:

- No lawn clippings or other vegetation is to be discarded within any Management Zone;
- No livestock is to be allowed to access within any Management Zone;
- No rubbish is to be retained/stored within any Management Zone once plantings are installed;

5.0 MONITORING AND REPORTING

Monitoring for a period of 5 years after plantings are installed will be conducted to accurately evaluate the success of the rehabilitation works. The 5 year monitoring program will commence for Management Zones 1 and 3 upon completion of weeding and plantings, and for Management Zones 2, 4 & 5 once plantings are installed post-operation of the sand extraction facility. A report is to be submitted to Port Stephens Council by a suitably qualified ecologist or bush regenerator annually for 5 years.

Monitoring should address the following issues:

- Average plant growth
- Plant losses

- Plant replacement
- Weed regrowth and control measures

Nine fixed photo points have been set up to monitor the progress of restoration works within all Management Zones. Photo point details such as GPS location and aspect can be found in Table 5.1 and their locations are shown in Figure 5.1. Star pickets should be placed at each photo point for future reference.

At the end of the 5-year period a final report certifying completion of the Rehabilitation Plan is to be submitted to Port Stephens Council detailing whether the specific objectives of the plan have been met.

Table 5.1: Location and direction of each photo monitoring point.

Photo Number	Management Zone	Photo Point Number	Photo Point GPS Location		Direction
			Easting	Northing	
1	1	1	411957	6373445	Facing north-west
2	1	2	412077	6373455	Facing north-west
3	2	4	411824	6373442	Facing east
4	2	2	412077	6373455	Facing north-east
5	3	1	411957	6373445	Facing north-east
6	3	2	412077	6373455	Facing west
7	4	1	411957	6373445	Facing south-east
8	4	2	412077	6373455	Facing south-west
9	5	3	412099	6373463	Facing south
10	5	4	411824	6373442	Facing south-east

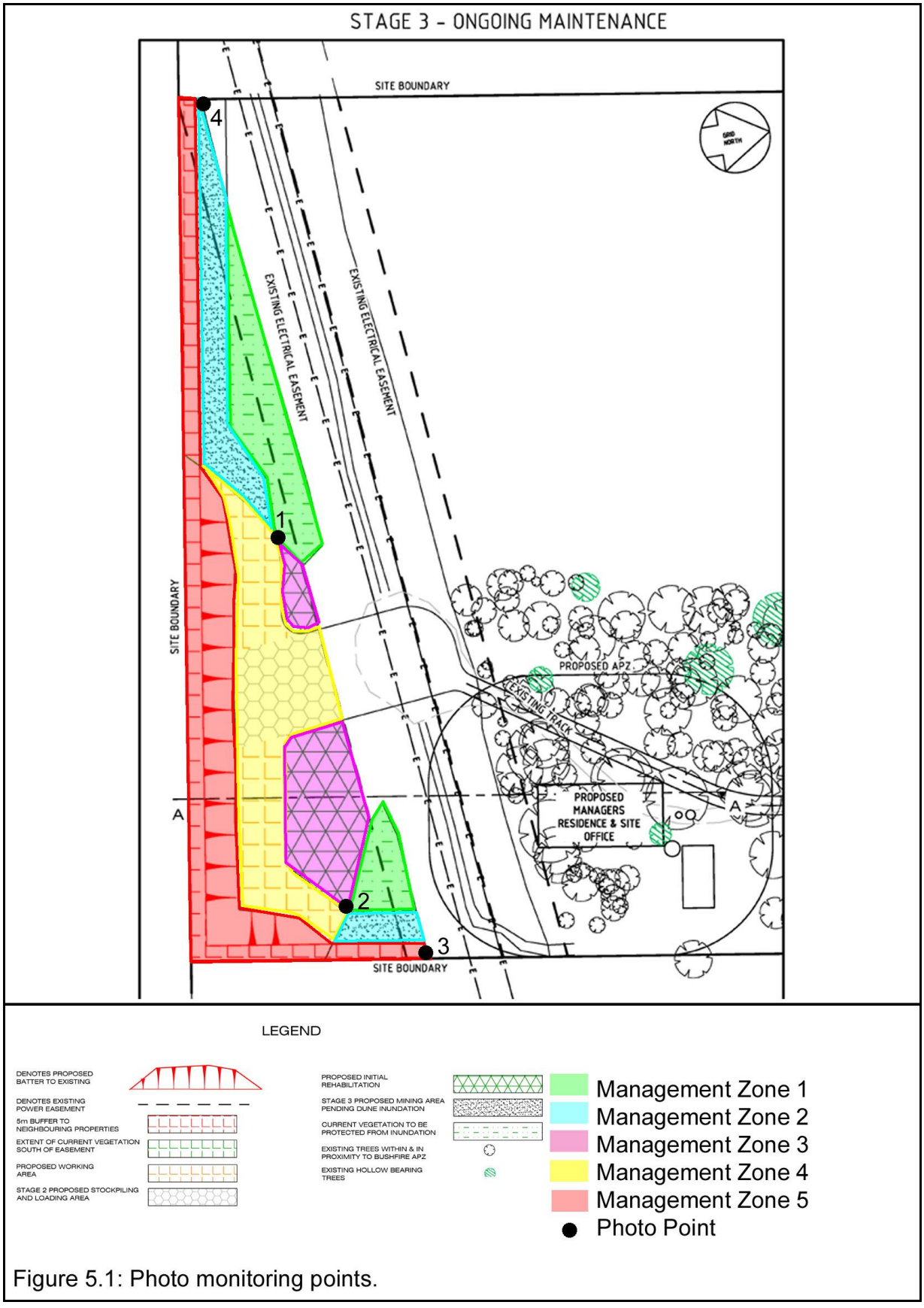

Figure 5.1: Photo monitoring points.

6.0 IMPLEMENTATION PLAN

The Rehabilitation Plan program is detailed in Table 6.1 and will guide the site's management. Weeding, plantings and the long-term up-keep of the vegetation corridor will be undertaken by suitably qualified personnel. Personnel undertaking bush regeneration works must have a Certificate Bushland Regeneration or a Certificate III Natural Area Restoration (or equivalent). Landowners may undertake weed control and rehabilitation work under the guidance/supervision of an appropriately qualified bush regenerator. However, the supervisors must have the relevant Certificate IV or Diploma level qualification in bush regeneration. Restoration works are to be carried out in accordance with these requirements. Technical advice pertaining to the ongoing management of the vegetation, such as information on the plants selected for revegetation and how they are likely to perform can be obtained from a number of agencies and organisations. These providers would include:

- HIP – Hunter Indigenous Plants – Beresfield (02) 4966 0457 hunterindigeplants@aapt.net.au
- Riverdene Nursery – East Gresford (02) 4938 9280 www.riverdenenursery.com.au/
- Muswellbrook Forest Nursery – Muswellbrook (02) 65432622 www.muswellbrookforestnursery.com.au
- Hunter Local Land Services – Paterson (02) 301030 www.hunter.lls.gov.au

7.0 ESTIMATED PROGRAM OF WORKS

An estimated program of works is shown in Table 7.1.

Table 6.1: Rehabilitation Plan Program

IMPLEMENTATION PLAN – REHABILITATION PLAN			
Strategy	**Action**	**Responsibility**	**Performance Measure**
Plant procurement	Seed Collection/Propagation	Plant production nursery/owner	Tubestock and hiko or enviro cells ready to plant.
Site Protection	Installation of silt fencing.	Fencing contractor/owner	Fence in place.
	Installation of clearance zone tape between Management Zones 1 and 2 are clearly marked with tape.	Contractor/owner	Clearance zone clearly marked.
Weed Control	Noxious weed infestations / occurrences. Other weed/infestations/occurrences.	Weeding Contractor/owner	Site largely cleared of weeds.
Planting	Planting of Tubestock and hiko or enviro cells Water all plantings	Revegetation Contractor/owner	Planting in ground.
Maintenance	Follow-up weed control Replacement of planting losses. Watering if required.	Contractor/owner	Site largely cleared of weeds. Plant losses replaced.
Monitoring	Monitor for - Plant losses - Growth of Plantings - Weed regrowth - Plant replacement	Contractor/owner	Report sent to Port Stephens Council

Table 7.1: Estimate program of works to be implemented when applicable for each Management Zone.

Task	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Year 1	Year 1.5	Year 2	Year 2.5	Year 3	Year 4	Year 5
Plant procurement														
Primary Weed Control														
Installation of silt fencing														
Planting														
Maintenance visit and secondary weed control														
Reporting														
Final report														

8.0 BIBLIOGRAPHY

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APPENDIX A
WEED CONTROL MEASURES FOR SPECIFIC SPECIES

SPECIES	LEGAL REQUIREMENTS	CONTROL MEASURES		
		Comment/occurrence within vegetation to the south of the easement	Physical	Chemical
Lantana camara Lantana	General Biosecurity Duty Prohibition on dealings	Clumped and isolated individuals.	Grub out small isolated occurrences. Place removed branches off ground to prevent root formation. Pull out small seedlings.	Spot Spray larger occurrences with a registered herbicide.
Senecio madagascariensis Fireweed	General Biosecurity Duty Prohibition on dealings	Clumped and isolated individuals.	Hand removal.	Spot Spray with a registered herbicide.
Chrysanthemoides monilifera subsp. monilifera Bitou Bush	General Biosecurity Duty	Clumped and isolated individuals.	Mature bitou bush plants can be slashed, whilst seedlings can be hand-pulled to remove the entire root system. Plants are liable to resprout after slashing alone, but applying herbicide to stems immediately after cutting should prevent regrowth.	Herbicides registered for bitou bush can be applied in winter at low rates that effectively kill the weed, yet have minimal impacts on coastal vegetation. Herbicides can be applied by a cut-and-paste method.
Acanthospermum australe Star Burr	General Biosecurity Duty Prohibition on dealings	Clumped	Hand remove isolated plants. Frequent mowing and pulling before the buds open are good ways to keep the plants from going to seed.	Spot Spray with a registered herbicide.
Bidens pilosa Cobblers Pegs	General Biosecurity Duty	Scattered occurrences.	Carefully bag seed heads. Plants and small infestations should be hand pulled when the ground is soft.	Spot Spray with a registered herbicide.
Cirsium vulgare Spear Thistle	General Biosecurity Duty	Scattered individuals	Carefully bag seed heads, dig out with mattock.	Spot Spray with a registered herbicide.
Conyza bonariensis Fleabane *Conyza parva*	General Biosecurity Duty	Scattered individuals.	Carefully bag seed heads. Dig up plant with taproot, with minimal soil disturbance.	Spot Spray with a registered herbicide.

SPECIES	LEGAL REQUIREMENTS	CONTROL MEASURES		
		Comment/occurrence within vegetation to the south of the easement	Physical	Chemical
Whorled Fleabane				
Sonchus oleraceus Common Sowthistle	General Biosecurity Duty	Scattered individuals.	Dig up plant with taproot, with minimal soil disturbance.	Spot Spray with a registered herbicide.
Trifolium repens White Clover	General Biosecurity Duty	Clumped and isolated individuals.	Dig out isolated occurrences. Spray larger areas before flowering.	Spot Spray with a registered herbicide before flowering.
Anagallis arvensis Scarlet Pimpernel	General Biosecurity Duty	Scattered individuals.	Hand remove isolated plants. Frequent mowing and pulling before the buds open are good ways to keep the plants from going to seed.	n/a
Plantago lanceolata Plantain	General Biosecurity Duty	Scattered individuals.	Carefully bag seed heads, dig up plant with taproot, with minimal soil disturbance.	Spot Spray with a registered herbicide.
Solanum mauritianum Wild Tobacco Bush	General Biosecurity Duty	Isolated occurrences	Small plants may be hand-pulled but mature plants will re-sprout if they are cut down.	Easily killed with herbicides applied as foliar, basal bark (painting herbicide onto the bark) or cut stump applications with a registered herbicide.
Verbena bonariensis Purple Topped Verbena	General Biosecurity Duty	Scattered throughout site.	Carefully bag seed heads, dig out with mattock.	Spot Spray with a registered herbicide.
Avena fatua Wild Oats	General Biosecurity Duty	Clumped and isolated individuals.	Carefully bag seed heads. Dig up or pull plant with taproot, with minimal soil disturbance.	Spot Spray with a registered herbicide
Briza maxima Quaking Grass *Briza minor* Quaking *Grass*	General Biosecurity Duty	Clumped and isolated individuals.	Carefully bag seed heads. Dig up or pull plant with taproot, with minimal soil disturbance.	Spot Spray with a registered herbicide
Paspalum dilatatum Paspalum	General Biosecurity Duty	Clumped and isolated individuals.	Carefully bag seed heads. Dig up or pull plant with taproot, with	Spot Spray with a registered herbicide

SPECIES	LEGAL REQUIREMENTS	CONTROL MEASURES		
		Comment/occurrence within vegetation to the south of the easement	**Physical**	**Chemical**
			minimal soil disturbance.	
Andropogon virginicus Whisky Grass *Setaria gracilis* Slender Pigeon Grass *Chloris gayana* Rhodes Grass *Melinis repens* Red Natal Grass	General Biosecurity Duty	Clumped and isolated individuals.	Carefully bag seed heads. Dig up or pull plant with taproot, with minimal soil disturbance.	Spot Spray with a registered herbicide
Cenchrus clandestinum Kikuyu *Axonopus fissifolius* Narrow-leaved Carpet Grass *Stenotaphrum secundatum* Buffalo Grass	General Biosecurity Duty	Dense areas present within site.	Remove isolated plants by hand.	Spot Spray with a registered herbicide
Solanum nigrum Blackberry Nightshade	General Biosecurity Duty	Scattered individuals.	Dig up plant with taproot, with minimal soil disturbance.	Spot Spray with a registered herbicide
Lilium formosum Formosa lily	General Biosecurity Duty	Scattered individuals.	Remove isolated plants by hand.	Spot Spray with a registered herbicide
Medicargo polymorpha Burr Medic	General Biosecurity Duty	Scattered individuals.	Remove isolated plants by hand.	Spot Spray with a registered herbicide
Passiflora edulis Passionfruit	General Biosecurity Duty	Scattered individuals.	Remove isolated plants by hand.	Spot Spray with a registered herbicide
Richardia humistrata	General Biosecurity Duty	Scattered individuals.	Dig up plant with taproot, with minimal soil disturbance.	Spot Spray with a registered herbicide.