

Dalhousie Creek to Hungry Head Headland Vegetation Management Plan

Prepared for Bellingen Shire Council



Bellingen Bush Regenerators

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Bellingen Bush Regenerators 2019

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19/6/2019

1. Introduction

Bellingen Bush Regenerators Pty Ltd. (BBR) has been engaged by Bellingen Shire Council (BSC) to prepare a Vegetation Management Plan (VMP) for the Hungry Head Headland precinct of the Bellinger Heads State Park.

The purpose is to provide a Vegetation Management plan for the Hungry Head Beach Reserve that encompasses the area from the northern bank of Dalhousie Creek to Hungry Head headland, including vegetation communities surrounding the Urunga Surf Lifesaving Club (SLSC), carpark and accesses to Hungry Head beach. This is a sensitive coastal reserve and a significant community resource in terms of conservation of native flora and fauna, public recreation and tourism.

1.1 Background

This VMP has been prepared for Bellingen Shire Council as part of the NSW government's coastal management program. The plan fulfils part of the requirements set out in the *Bellingen Coastal Zone Management Plan* (BMTWBM, 2014), which states as follows;

Table 2-6 Dune and Habitat Management Action Tables

Undertake assessment of all EEC's and important habitat within the coastal erosion and recession hazard zones and determine priority management strategy.

This VMP aims to provide direction for the ongoing management of sensitive coastal vegetation within the Hungry Head section of the Bellinger Heads State Park, including priority management strategies for the rehabilitation of Endangered Ecological Communities (EEC's) within the VMP area.

1.2 Objectives

The aim of this VMP is to provide a concise and plain English document which provides clear directives for the effective management of vegetation between Dalhousie Creek and Hungry Head Headland.

The overall objectives of the VMP are to establish and improve native species cover and improve the resilience and condition of vegetation communities and to assist the natural regeneration by weed control works within the VMP area. This VMP covers the initial five-year period, or until the objectives and performance criteria outlined in this VMP are met. The objectives for the VMP are outlined below in **Table 1**.

Table 1: VMP objectives

Objectives	Approach
Improve ecological health and integrity of coastal vegetation communities within the VMP area	<ul style="list-style-type: none"> Control woody weeds, climbers and ground-layer weeds within VMP area Maintenance weed control
Maintain and enhance habitat values	<ul style="list-style-type: none"> Protect existing native vegetation Control weeds and prevent new outbreaks Assist in the natural regeneration of species across the VMP area. Increase native flora species diversity to provide native fauna habitat
Promote community education regarding the VMP area	<ul style="list-style-type: none"> Installation of signage at key locations within VMP area Promote community involvement in weed control and prevention activities

1.3 Scope of Work

The scope of work for this project, as requested by BSC was limited to:

- Identification of vegetation communities and associated management issues within a limited area extending from Dalhousie Creek entrance to Hungry Head Headland
- Preparation of a VMP Document including site plans denoting existing vegetation communities, management issues faced by these communities and measures for the rehabilitation and enhancement of vegetation within the VMP area.

1.4 Sources of information used

Relevant data from the following documents were used in the preparation of this VMP:

- *Bellingen Coastal Zone Management Plan* (BMTWBM, 2014)
- *Dalhousie Creek entrance management strategy* (Hydrosphere Consulting, 2019)
- *Fine Scale Vegetation Map for the Bellingen Local Government Area. Volume 1: Project Report* (NSW Office of Environment and Heritage, 2014)
- *Fine Scale Vegetation Map for the Bellingen Local Government Area. Volume 2: Vegetation Community Profiles* (NSW Office of Environment and Heritage, 2014)
- *NSW Best Practice Revegetation Guidelines, (Greening Australia 1999)*

1.5 Relevant Legislation

Relevant information from the following legislation was used in the production of this VMP:

- *Coastal Management Act 2016 (CM Act)*
- *Biodiversity Conservation Act 2016 (BC Act)*
- *Biosecurity Act 2015 (BC Act)*
- *Bellingen Local Environment Plan 2010 (Bellingen LEP)*

2. Description of the Environment

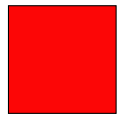
2.1 Location

Hungry Head Beach Reserve is located within Lot 102, DP 755552, approximately 3 Km South East of the Urunga Township (Fig. 1).

The subject land is located between the Urunga Sand mass to the north and the Dalhousie Creek inlet to the south. The Sydney to Brisbane rail line forms the western boundary of the lot. For the purposes of this VMP, the extent of study is confined to the area immediately north of the Dalhousie Creek inlet up to and including the Hungry Head headland, and an area of vegetation immediately surrounding the Urunga SLSC (Fig. 2).



Legend



Site Location



Forestry Estate

Figure 1. Site location and context

0 1 2 km

Prepared by: C.Ormond

2.2 Topography and Hydrology

The VMP area occurs on a varied substrate with Holocene dunes & alluvial deposits occurring on lower flats and beach edge and mixed sedimentary lithology in upper reaches.

2.3 Vegetation

Desktop review of available information and key field observations are noted in the following subsections.

2.3.1 Vegetation communities

The study area consists of a complex and highly variable matrix of vegetation communities exhibiting a high degree of diversity and complexity over a relatively small area. Three remnant vegetation communities have been mapped within the site as part of the *Fine Scale Vegetation Map for the Bellingen Shire Local Government Area* (OEH 2014) as outlined below (**Section 2.3.1**) with field observations identifying an additional three vegetation communities at finer scale, two of which represent Endangered Ecological Communities. A map of vegetation communities identified in this VMP is shown in **Figure 2**.

- **Tuckerroo-Bird’s Eye Alectryon-Beach Acronychia littoral rainforest (BELL_RF07)**

This PCT (Plant Community Type) represents the Littoral Rainforests in the NSW North Coast, Sydney Basin & South East Corner Bioregions EEC. It is listed as an Endangered Ecological Community under the NSW BC Act 2016 and as critically endangered under the EPBC Act 1999.

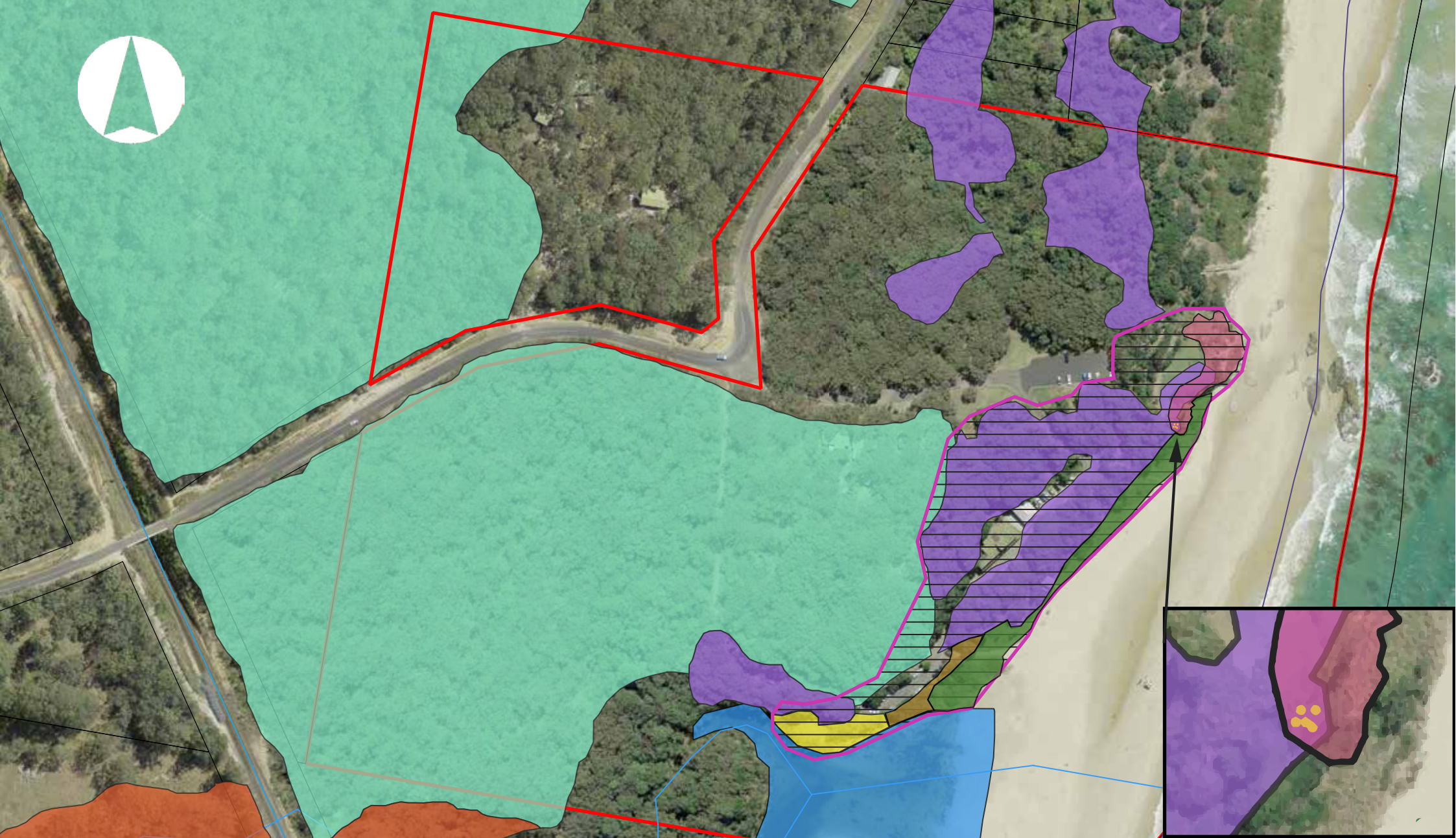
The community occurs mostly on sheltered hind dunes. Stands are generally dominated by Coastal Tuckerroo (*Cupaniopsis anacardioides*), Bird’s-eye Alectryon (*Alectryon coriaceus*) and Beach Acronychia (*Acronychia imperforata*) close to the foredune. Associated species in more protected hind-dune locations and on headlands include Yellow Pear-fruit (*Mischocarpus pyriformis* subsp. *pyriformis*), Saffron heart (*Halfordia kendack*), Bennett’s Ash (*Flindersia bennettiana*), Brown Bolly Gum (*Litsea australis*), Coastal Cheese-tree (*Glochidion sumatranum*), Domatia Tree (*Endiandra discolor*), Three-veined Laurel (*Cryptocarya triplinervis*), Grey Ebony (*Diospyros fasciculosa*). Shrubs include narrow-leaved Palm Lily (*Cordyline stricta*), Chain Fruit (*Alyxia ruscifolia*) and Red Olive-berry (*Elaeodendron australe*). The ground-layer is very sparse with Blue Flax Lilly (*Dianella caerulea*) and Blue Commelina (*Commelina cyanea*)(OEH 2014).

Patches of this PCT represented within the VMP area are generally in good condition, with little presence of invasive species in the mid-storey and canopy and high recruitment of native species. Some invasive species are present within the ground layer and impede the further recovery of vegetation.

- **Swamp Box-Forest Red Gum-Pink Bloodwood seasonal swamp forest (BELL_DOF06)**

This PCT represents the Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion EEC. It is listed as an Endangered Ecological Community under the NSW BC Act 2016.

An open forest community occurring on sandy alluvial sediments on floodplains or sedimentary bedrocks on low rises. The overstorey is dominated by Swamp Box (*Lophostemon suaveolens*), Forest Red Gum (*Eucalyptus tereticornis*) and Pink Bloodwood (*Corymbia intermedia*), with associate species including Broad-leaved Paperbark (*Melaleuca quinquenervia*), Swamp Oak



OEH Fine Scale

- Tuckeroo-Bird's Eye-Beach Acronychia Littoral Rainforest (EEC)
- Spinifex strandline grassland

- Kangaroo Grass sod grassland of North Coast Headlands (EEC)
- Swamp Box-Forest Red gum - Pink Bloodwood seasonal swamp forest (EEC)

Observed

- Coast Wattle shrubland on coastal foredunes
- Swamp Oak Forested Wetland of Estuaries (EEC)

- Lot boundary
- VMP area

Legend

- Threatened plant population - *Pultenaea maritima*

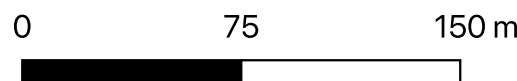


Figure 2. Plant Community Types (PCTs), Endangered Ecological Communities and threatened plants populations recorded in the VMP area.

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(*Casuarina glauca*), Willow Bottlebrush (*Callistemon salignus*) and Grey Ironbark (*Eucalyptus siderophloia*). There is usually a sparse layer of small trees such as Red Ash (*Alphitonia excelsa*) with less frequent occurrences of Coffee Bush (*Breynia oblongifolia*), Cheese Tree (*Glochidion ferdinandi*) and Large Mock-olive (*Notelaea longifolia*). The climbers Common Silkpod (*Parsonsia straminea*), Scrambling Lily (*Geitonoplesium cymosum*) and Sweet Morinda (*Morinda jasminoides*) are common. The ground cover is mid-dense to dense and comprises a mix of grasses and forbs including *Ottochloa gracillima*, Blady Grass (*Imperata cylindrica*), Spiny-headed Mat-rush (*Lomandra longifolia*), *Vernonia cinerea*, Rough Saw-sedge (*Gahnia aspera*), Weeping Grass (*Microlaena stipoides* var. *stipoides*), *Oplismenus aemulus*, Bordered Panic (*Entolasia marginata*), Kidney Weed (*Dichondra repens*) and *Viola banksia* (OEH 2014).

A small section of this vegetation community occurs within the study area to the south-west of the Urunga SLSC building, it is in good condition, with little evidence of disturbance or weed impacts and a high degree of native recruitment.

- **Spinifex strandline grassland (BELL_G01)**

A strandline grassland community which occupies beach foredunes. Coastal Spinifex (*Spinifex sericeus*) is abundant. Other herbs and prostrate shrubs include Pig Face (*Carpobrotus glaucescens*), *Ipomoea brasiliensis* and the introduced *Hydrocotyle bonariensis* and American Sea Rocket (*Cakile edentula*). There are also scattered shrubs of Coast Wattle (*Acacia longifolia* subsp. *Sophora*) (OEH 2014).

This vegetation community dominates the foredune along the length of Hungry Head beach, and is generally in good condition. Beach access paths intersect the community in a number of locations and there is evidence of trampling & compaction.

- **Swamp Oak forested wetland of estuaries (BELL_ForW10) (Derived vegetation community)**
This PCT represents the Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC. It is listed as an Endangered Ecological Community under the NSW BC Act 2016. It is also listed as Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community, which is listed as Endangered under the EPBC Act 1999.

Open to tall open swamp sclerophyll forest with an overstorey of Broad-leaved Paperbark (*Melaleuca quinquenervia*) with Swamp Oak (*Casuarina glauca*). There is an open mid-layer consisting of Broad-leaved Paperbark. The lower layer consists of a dense cover of Bare Twig Rush (*Baumea juncea*), sometimes with Common Reed (*Phragmites australis*) and *Fimbristylis ferruginea*. Occurs on alluvial backswamps, fans and floodplains and occasionally on estuarine channels in the catchments of coastal creeks and rivers occupying slightly raised less regularly inundated areas on the floodplain (OEH 2014).

This community occurs along the northern bank of Dalhousie Creek within the study area, and is generally in poor condition due to heavy recreational use, the presence of grasses and historic management practices. Evidence of erosion along Dalhousie Creek is also present due to a reduction in riparian vegetation. Due to its condition and size, it is unlikely to satisfy the criteria for listing under the EPBC Act.

- **Coast wattle shrubland on coastal foredunes (BELL_H02)**

A shrubland to heathland found on coastal foredunes. The upper stratum is dominated by Coast Wattle (*Acacia longifolia* subsp. *sophorae*) and Coast Banksia (*Banksia integrifolia* subsp. *integrifolia*) is also present. Coast Teatree (*Leptospermum laevigatum*) is sometimes present. In disturbed sites the ground cover is dominated by Blady Grass (*Imperata cylindrica*), but more often the species composition includes Club Rush (*Ficinia nodosa*), Coastal Spinifex (*Spinifex sericeus*) and *Zoysia macrantha* (OEH 2014).

This community occurs within the study area immediately to the east of the lower carpark, and is in moderate condition within the site. Some erosion, trampling and destruction of native recruits is visible due to its location adjacent to the carpark and as an access to Hungry Head beach.

- **Kangaroo Grass sod grassland of North Coast headlands (BELL_H03)**

This PCT represents the Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions EEC. It is listed as an Endangered Ecological Community under the NSW BC Act 2016.

Tall closed sod grassland occurring on seaward slopes of coastal headlands that are directly exposed to prevailing moist, salt-laden winds, in heavy black soils formed from metasedimentary rocks. Scattered shrubs of Coast Banksia (*Banksia integrifolia* subsp. *integrifolia*), Black She-oak (*Allocasuarina littoralis*) and Swamp Oak (*Casuarina glauca*) are occasionally present. The ground layer is very dense and dominated by Kangaroo Grass (*Themeda australis*), Dogwood (*Jacksonia scoparia*) with other frequently recorded Slender Rice Flower (*Pimelea linifolia*), Golden Everlasting (*Xerochrysum bracteatum*), Indian Pennywort (*Centella asiatica*), *Viola banksii*, Prickly Couch (*Zoysia macrantha*) and *Lobelia anceps*. Less common species include *Pultenaea paleacea*, *Hibbertia vestita*, *Melanthera biflora*, Small Poranthera (*Poranthera microphylla*) and Yellow Autumn-lily (*Tricoryne elatior*)(OEH 2014).

This vegetation community occurs along the faces and top of Hungry Head headland, and is in moderate-poor condition due to a number of factors including weed invasion, historic management practices resulting in invasion of non-native grasses, informal access tracks causing trampling and disturbance and a number of erosion events along the cliff face. It is one of only two patches of this PCT in the Bellingen Shire (the second patch occurring at Wenonah Head), and is at high risk of extinction without management action to facilitate its recovery. Flora surveys identified a population of the prostrate shrub *Pultenaea maritima* on the southern face of the headland. It is listed as *Vulnerable* under the NSW BC act. This population is indicated in the inset of **Figure 2**.

2.3.2 Vegetation species

A species list from field observations has been compiled in **Appendix I**.

2.3.3 Site Observations

- The site exhibits evidence of historic and current disturbance. Evidence of past and current land uses include prepared areas for public use, access routes to the beach, a previous and a current SLSC clubhouse and a caretakers cottage with public amenities building.
- Native vegetation throughout the site is relatively undisturbed, with sporadic maintenance over time including Bush regeneration and park maintenance

- Native remnant vegetation occurs in patches around the headland. Regrowth of native vegetation within these patches is impeded by invasive species.
- Native vegetation has been removed from sections of the headland to make way for public access. The majority of the site shows sign of recovery where regeneration work has been undertaken.

2.3.4 Weeds

Several areas of high weed density were observed within the site. Exotic species observed are listed in table 2 below.

Table 2. Observed weed species

Botanical Name	Common Name
<i>Acetosa sagittata</i>	Turkey rhubarb
<i>Ipomea purpurea</i>	Morning glory
<i>Ipomea cairica</i>	Cairo Morning Glory, Coast Morning Glory
<i>Gloriosa superba</i>	Glory lilly
<i>Lantana camara</i>	Lantana
<i>Paspalum dilatatum</i>	Paspalum
<i>Senna pendula var. glabrata</i>	Winter Senna
<i>Ochna serrulata</i>	Ochna
<i>Chrysanthemoides monilifera</i>	Bitou
<i>Baccharis halimifolia</i>	Groundsel
<i>Pennisetum clandestinum</i>	Kykuyu grass
<i>Senecio madagascariensis</i>	Fire weed
<i>Paspalum dilatatum</i>	Broad leaf paspalum
<i>Paspalum urvillei</i>	Giant paspalum
<i>Melinis minutiflora</i>	Molasses grass
<i>Elymus repens</i>	Couch grass
<i>Solanum nigrum</i>	Black nightshade
<i>Physalis peruviana</i>	Cape gooseberry
<i>Sida rhombifolia</i>	Paddy's Lucerne
<i>Hypoestes phyllostachya</i>	Freckle face plant
<i>Nephrolepis cordifolia</i>	Fishbone fern

3. Construction Works

Council shall be responsible for the following works.

3.1 Permanent fencing and signage

Areas which are vulnerable to the impacts of disturbance including informal access, trampling & inappropriate management practices are to be protected by the installation of permanent fencing or access controls. This includes the headland of Hungry Head, which exhibits a high degree of trampling and a number of informal tracks across the cliff face.

Fencing will limit the creation and use of informal tracks and facilitate the alteration of management practices to enable the recovery of sensitive coastal ecosystems.

Interpretive signage may be placed strategically to advise visitors of habitat rehabilitation works and the importance of coastal vegetation communities.

3.2 Erosion Control Works

A number of significant land slips have occurred along the face of Hungry Head headland resulting in moderate erosion and a significant loss of topsoil & vegetation along the cliff face. This is due to a number of factors including weed invasion, historic management practices and a loss of endemic vegetation reducing the capacity of the headland to retain stability during extreme weather events. In particular, a loss of large areas of *Themeda australis* due to invasion by exotic grasses & the associated structural features of its deep and complex root system have resulted in a loss of structural integrity of vegetation along the headland.

Erosion control works should be carried out along the cliff face of the headland in order to reduce or eliminate erosion occurring within the Themeda grassland on seacliffs & coastal headlands EEC and improve the stability of the cliff face.

The following methods may be used in order to reduce the impact of erosion and facilitate the recovery of headland vegetation. Vegetation management works to be carried out in addition to erosion control works outlined in **Section 4.1.3**.

- Installation of coir logs in areas where slippage has occurred in order to reduce further loss of topsoil & facilitate the establishment of headland vegetation. Coir logs should be installed horizontally across the cliff face and pegged into the substrate using metal or hardwood pegs. Topsoil addition and direct seeding/planting of headland vegetation will be required to re-establish vegetation and improve structural resilience of the headland.
- Installation of erosion/siltation fencing to reduce the likelihood of further land slips and loss of topsoil across the cliff face. Fencing should be installed below intact topsoil in areas where further slippage is likely to occur and in conjunction with installation of coir logs, planting and direct seeding of headland vegetation.
- Addition of topsoil in areas where slippage has resulted in a loss of topsoil and exposure of substrate. Topsoil addition should be carried out in conjunction with installation of coir logs, erosion control fencing & direct seeding or planting of headland vegetation.

- Reshaping of areas of the headland where erosion has occurred and redistribution of topsoil over exposed areas in order to limit future erosion and facilitate the recovery of headland vegetation. Shaping should be carried out by suitably qualified specialists (e.g NSW Soil Conservation Service, Nambucca Valley Landcare) and in conjunction with installation of erosion control fencing, coir logs, jute/geotextile erosion control mats & direct seeding or planting of headland vegetation.

The relative costs and likelihood of success of erosion control methods are outlined below in **Table 3**.

Table 3. Relative cost and likelihood of success of rehabilitation methods for Hungry Head headland.

Erosion control method	Cost	Likelihood of success
<ul style="list-style-type: none"> • Installation of erosion control fencing, coir logs, topsoil and direct seeding or planting of headland vegetation to slow or reduce erosion 	Low	Low-Moderate
<ul style="list-style-type: none"> • Shaping of eroded areas of headland in addition to installation of coir logs, erosion control fencing, geotextile erosion control mats and direct seeding or planting of headland vegetation 	Moderate-High	High

Additional grant funding may be required to complete erosion control works and rehabilitation of the cliff face of hungry head headland, particularly in the case of earth works. All erosion control works on the headland should be carried out with the relevant permits for working in EECs under the BC act, and be supervised by a suitably qualified ecologist. Consultation with groups interested in the rehabilitation of the headland (e.g Landcare, Dunecare, Urunga SLSC) may be carried out in order to secure additional funding streams & promote long term management of the headland.

4. Vegetation Management Works

4.1 Management zones

The management of landscapes with differing environmental, planning and social issues can be complex. By treating areas with similar features, habitats or management issues as a single management unit, the complexity of differing and often competing priorities can be more easily managed. Three management zones have been identified which, based on similar environmental features or management issues facilitate communication of issues the site faces with stakeholders and project implementation with contractors. Management zones of this VMP are outlined below and shown in **Figure 3**.





Zone 1 – Assisted Regeneration

This zone represents the largest management unit within this VMP, and is characterised by vegetation which is in generally good condition, exhibits minimal disturbance and shows a high degree of recovery potential with minimal intervention. It encompasses all of the littoral rainforest surrounding the Urunga SLSC and frontal & dune vegetation in the immediate vicinity of the Hungry Head watch tower. Although this management unit is comprised of a number of vegetation communities, management issues within this zone are similar due to a lack of historic disturbance or previous bush regeneration works occurring within the area.

Weed management works within this zone should focus on the control of mid-storey woody weeds if present, and the control of ground-layer invasive species impeding native species recruitment and



Legend

- | | | | | | |
|--|---|---|----------------------------|---|--------------|
|  | Zone 1 - Assisted Regeneration |  | Zone 3 - Headland |  | Lot boundary |
|  | Zone 2 - Assisted Regeneration/Planting |  | Zone 4 - Public Recreation | | |

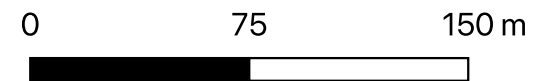


Figure 3. VMP Management Zones

successional processes in order to assist the recovery of native vegetation present. Weed species should be controlled within the ground layer with care to be taken by contractors to ensure the survival of the high diversity of native seedlings present within this management zone, particularly within the littoral rainforest. Fishbone Fern (*Nephrolepis cordifolia*) should be controlled along the rock face behind the SLSC with care taken to ensure survival of Prickly Rasp Fern (*Doodia aspera*) also present.

Zone 2 – Assisted regeneration with supplementary planting

This zone occupies the area immediately to the south and east of the lower carpark and the northern bank of Dalhousie Creek and is characterised by two vegetation communities – a small patch of Swamp Oak Swamp Forest and Coast Wattle shrubland on coastal foredunes. It is used extensively for recreation and includes a mown patch as well as frequent disturbance, soil compaction and trampling, which inhibits the recovery of native vegetation. The size of the mown area will be reduced in order to facilitate the recovery of streamside vegetation and reduce erosion along the bank of Dalhousie Creek. Exotic grasses should then be controlled in the newly established riparian buffer using herbicide by an appropriately qualified bush regeneration practitioner. Supplementary planting is to occur in addition to control of invasive species and reductions in mown area to maintain the stability of the bank of Dalhousie Creek. Species selected for planting will be characteristic of the vegetation communities present and will be planted in high density clusters with gaps to facilitate recreational access to the waterway. A list of appropriate species for supplementary planting in each vegetation community is listed in **Appendix II**.

Zone 3 – Hungry Head Headland

Hungry Head headland has been defined as a separate management unit due to the complex nature of management issues faced in this area. The management unit occupies all cliff faces and a portion of the top of the headland. It is characterised by a number of patches of remnant Kangaroo Grass sod grassland (EEC) in varying condition and with varying densities of weed invasion due to past management practices and historic disturbance. A number of land slips have resulted in a significant loss of remnant vegetation and a reduction in the condition of Kangaroo Grass sod grassland along the cliff face, and management practices encouraging the expansion of invasive grasses have resulted in a reduction in the area of EEC across the top of the headland. Control of weed species across the cliff face and of grasses encroaching on native vegetation on the top of the headland should be carried out in order to facilitate recovery of native vegetation. This should be carried out prior to or in conjunction with construction of access controls outlined in **Section 3.1** and erosion control measures outlined in **Section 3.2**. A priority in the recovery of this vegetation community is the control of invasive grasses outcompeting Kangaroo Grass and the installation of access controls to reduce incidence of trampling and the creation or expansion of informal tracks.

Primary weed control should be carried out using a non-selective herbicide such as glyphosate to treat all non-native species in the target area in order to facilitate the recovery of native vegetation. **Extreme** caution is to be taken to reduce the possibility of off target damage to a population of the threatened prostrate herb *Pultenaea maritima* occurring on the southern face of the headland (**Fig. 3 inset**). This population should be identified to bush regenerators by a suitably qualified ecologist and tagged prior to commencement of works.

Supplementary planting may be carried out in order to enhance recovery potential and may be completed in conjunction with erosion control measures outlined in **Section 3.2**. Direct seeding of *Themeda australis* should only be carried out using seed stock collected from populations at Hungry Head or Wenonah Head due to the genetically distinct nature of headland *Themeda* communities. Similarly, individual plants sourced for rehabilitation are to be of local provenance and from headland *Themeda* communities. It is recommended that a contract for seed collection and propagation be established with a local nursery or

bush regeneration contractor for the rehabilitation of *Themeda australis* vegetation. A list of suitable plant species for supplementary planting of headland vegetation is outlined in **Appendix II**.

Zone 4 – Public Recreation

Two mown areas used regularly for public recreation were identified within the VMP area. These areas occur along the top of Hungry Head headland and the bank of Dalhousie Creek adjacent to the lower carpark. Recommended management actions for these areas remains similar to current actions, with a slight reduction in area and installation of access controls to be carried out at the headland and a slight reduction in mown area and supplementary planting to be carried out in the area adjacent to Dalhousie Creek. Liaison with council ground staff is recommended to improve management practices and reduce the impact of current practices on sensitive native vegetation.

4.2 Weed Control

4.2.1 Primary & secondary weed control

Weed control will be completed by a suitably qualified and experienced specialist (bush regeneration practitioner) in order to control established weeds in native remnant vegetation and proposed areas of revegetation or supplementary planting. Primary weed control shall include the control of all weeds within all management zones of the VMP area. Secondary weed control will be required to control recruiting weeds on a regular basis.

Indicative methods of weed control include:

- The use of back packs/spray unit to spray areas of moderate infestation and small weeds with Glyphosate or Metsulfuron herbicides.
- Cut/paint or scrape smaller weeds unsuitable for spraying with undiluted herbicide as determined to be appropriate by the bush regeneration practitioner.
- Hand pull individual weed/vines as determined to be appropriate by the bush regeneration practitioner.

4.3 Revegetation/Supplementary Planting

Revegetation/supplementary planting is required for Zones 2 & 3. Supplementary planting is unlikely to be required in other zones due to the high degree of native recruitment observed.

The vegetation to be restored within the VMP area will consist of appropriate mixes of canopy, mid-storey and groundcover species characteristic of a vegetation community and indicative of the typical structure and composition of individual communities within the site. Species selection will differ between vegetation communities. Fast growing pioneer species will be included in species mix in order to facilitate rapid recovery, provide protection from winds and cover to sensitive species. A list of appropriate revegetation species for each works zone where planting is required is provided in **Appendix II & Appendix III**. Direct seeding of *Themeda* headland species may be used where appropriate and may be a preferable option over planting. Planting densities for this VMP have not been provided due to the complex nature of rehabilitation requirements in Zone 3 and the fact that only some supplementary planting is required for

zone 2. It is recommended that the author of this report or a suitably qualified ecologist be consulted following the determination of which rehabilitation method is to be used for Zone 3 in order to obtain required planting densities. The total number of plants recommended for supplementary cluster planting along the edges of Dalhousie Creek is in the range of 60-80 plants.

4.4 Target survival rates

The key objective of rehabilitation is to restore functioning native vegetation. An indicative target survival rate to achieve is the survival of 80% of each species planted for a period of two years following planting.

4.5 Timing

Planting is to be carried out at a time of year deemed appropriate by the bush regenerators to be optimal for maximising the survival and growth rates of the plants. Planting may be carried out in stages to maximise survival rates. Primary weed control is to be carried out no more than four weeks prior to the commencement of planting.

5. Maintenance and monitoring program

5.1 Maintenance

Scheduled maintenance is to be carried out for a minimum of three years following the completion of works and until such time as a minimum 80% survival rate of each species planted and a maximum of 5% weed cover for treated remnant vegetation is achieved. Maintenance visits are to be determined as appropriate by the bush regenerators and should include:

- General area weed control/spot spraying or manual weeding within guards if appropriate
- Repairing damage to tree guards (if installed)
- Monitoring survival rates of plants
- Installation of replacement plants as required

5.2 Watering

All plants are to be watered in on installation, with each plant receiving appropriate water as determined by the bush regeneration contractor. In the event of low rainfall, plantings should receive further applications of water during the first 8 weeks following installation. In the event of periods of extended drought following this 8-week period, follow watering should be continued in order to maximise chances of survival and reduce costs due to replacement.

5.3 Follow up weed control

Follow up weed control is to be completed throughout the site in order to control weed re-infestation in rehabilitated areas and prevent competition with newly installed plants in plantings. Appropriate timing for follow-up weed control is to be determined by the bush regenerator and is to extend throughout the maintenance period until native vegetation is established and less than 5% weed cover is achieved.

5.4 Monitoring and evaluation

In order to accurately evaluate the success of the revegetation, a Baseline Revegetation Report will be prepared and then summary reports prepared throughout the maintenance period. The Baseline report

will allow for the evaluation of a number of measures forming the target completion criteria, which when considered to be met will determine the final completion of revegetation and the ending of the maintenance period. No timeframe can be specified for the meeting of target completion criteria, however it is expected that completion of the maintenance period will extend for at least two years and is likely to continue for approximately five years following the initial program. A budget and costings for works (with the exception of erosion control works on Hungry Head headland), including initial weed control and revegetation as well as monitoring and maintenance can be found at the end of this report in **Appendix III**. Additional costs may apply for replacement plants during the maintenance period should stochastic factors impact on the survival of installed plants. Target completion criteria is outlined below in **Table 4**.

Table 4. Target completion criteria

Revegetation Objective	VMP Zones	Target completion criteria
Species composition	2 & 3	The mortality rate of manually planted (tubestock) vegetation is to be less than 20%
Extent of revegetation	3	The following densities are met: <ul style="list-style-type: none"> • Groundcover – 100% • Immature mid-storey species – 30% • Immature canopy species – 10%
Resilience of vegetation	2 & 3	Vegetation is to be self-sustaining such that no future watering is required. This may be demonstrated by vegetation withstanding an autumn/summer period without watering
Weed density	All Zones	The following criteria in relation to weeds are met: <ul style="list-style-type: none"> • The percentage cover of minor weeds is less than 5% of all treated areas and stable or declining. • Major environmental weeds capable of becoming dominant at the expense of native plants are absent

5.5 Management in perpetuity

Upon successful completion of rehabilitation and successful revegetation in accordance with target completion criteria, on-going inspection of vegetation within the VMP area is required to be carried out at least every three years to ensure that areas meet the performance criteria. Areas which do not conform with the performance criteria are to be rehabilitated in accordance with this VMP.

5.6 Contingency plan

Where monitoring indicates that the biodiversity outcomes are not being achieved, or that stochastic factors such as flood or drought indicate a failure in establishment of the revegetation, remedial actions shall be taken to ensure that the objectives of this VMP are achieved.

Appendix I. Observed native plant species

Botanical Name	Common Name	Status
<i>Corymbia intermedia</i>	Pink bloodwood	
<i>Eucalyptus tereticornis</i>	Forest red gum	
<i>Allocasuarina littoralis</i>	Black Oak	
<i>Acmena smithii</i>	Lilly pilly	
<i>Casuarina glauca</i>	Swamp oak	
<i>Jagera pseudorhas</i>	Foambark	
<i>Guoia semiglauca</i>	Guoia	
<i>Crinum pedunculatum</i>	Beach Lilly	
<i>Synoum glandulosum</i> subsp. <i>glandulosum</i>	Scentless Rosewood	
<i>Pittosporum undulatum</i>	Sweet Pittosporum	
<i>Cryptocarya triplinervis</i>	Three-Veined Laurel	
<i>Melaleuca quinquenervia</i>	Broad Leaf Paperbark	
<i>Lephostemon confertus</i>	Brush Box	
<i>Acacia melanoxylon</i>	Blackwood	
<i>Glochidion ferdinandi</i>	Cheese Tree	
<i>Banksia integrifolia</i>	Banksia	
<i>Dysoxylum mollissimum</i>	Red Bean	
<i>Ficus coranata</i>	Creek Sandpaper Fig	
<i>Ficus fraseri</i>	Sandpaper Fig	
<i>Ficus watkinsiana</i>	Strangler Fig	
<i>Acacia sophorae</i>	Coastal Wattle	
<i>Cupaniopsis anacardioides</i>	Tuckeroo	
<i>Smilax australis</i>	Prickly Smilax	
<i>Imperata cylindrica</i>	Blady Grass	
<i>Tabernaemontana pandacaquii</i>	Banana Bush	
<i>Gahnia grandis</i>	Saw Sedge	
<i>Lastreopsis acuminata</i>	Shield Fern	
<i>Cissus hypoglauca</i>	Water Vine	
<i>Alectryon coriaceus</i>	Beach Birdseye	
<i>Cyathea cooperi</i>	Straw Treefern	
<i>Cyathea leichardtiana</i>	Prickly Treefern	
<i>Cyathea cunninghamiana</i>	Slender Treefern	
<i>Pteridium esculentum</i>	Austral Bracken	
<i>Dianella caerulea</i>	Blue Flax Lily	
<i>Lomandra longifolia</i>	Spiny Mat-Rush	
<i>Lomandra hystrix</i>	Scented Mat-Rush	
<i>Idiospermum australiense</i>	Ribbonwood	
<i>Polyscias sambucifolia</i>	Elderberry Panax	
<i>Eustrphus latifolius</i>	Wombat Berry	
<i>Themeda tirandra</i>	Kangaroo Grass	
<i>Oplismenus imbecillus</i>	Basket Grass	
<i>Dichondra repens</i>	Dichondra	
<i>Hibbertia scandens</i>	Climbing Guinea Flower	
<i>Parsonia straminea</i>	Silk Pod Vine	
<i>Austromyrtus dulcis</i>	Midyum Berry	
<i>Dodonaea viscosa</i>	Hop Bush	

<i>Trochocarpa laurina</i>	Tree Heath	
<i>Flagellaria indica</i>	Whip Vine, Supplejack	
<i>Doodia aspera</i>	Prickly Rasp Fern	
<i>Calamus muelleri</i>	Lawyer Vine	
<i>Smilax australis</i>	Sarsparilla Vine	
<i>Dysoxylum mollissimum</i> subsp. <i>Molle</i>	Red bean	
<i>Dioscorea transversa</i>	Native Yam	
<i>Cynanchum carnosum</i>	Mangrove Milkpod	
<i>Platycterium superbum</i>	Staghorn Fern	
<i>Dampiera stricta</i>	Blue Dampiera	
<i>Hydrocotyle sibthorpioides</i>	Lawn Pennywort	
<i>Cissus sterculiifolia</i>	Long-leaf Watervine	
<i>Pultenaea maritima</i>	Coast Headland Pea	Vulnerable

Appendix II. Recommended planting list

Swamp Oak forested wetland of estuaries (BELL_Frw11)		
Scientific Name	Common Name	Status
<i>Casuarina glauca</i>	Swamp Oak	
<i>Melaleuca quinquenervia</i>	Broad Leaved Paperbark	
<i>Baumea juncea</i>	Bare Twig Rush	
<i>Crinum pedunculatum</i>	Beach Lily	
<i>Fimbristylis ferruginea</i>	Rusty Sedge	
<i>Lomandra longifolia</i>	Spiny Mat Rush	
<i>Gahnia aspera</i>	Rough Saw-sedge	
Kangaroo Grass sod grassland of North Coast Headlands (BEL_H03)		
Scientific Name	Common Name	Status
<i>Themeda australis</i>	Kangaroo Grass	
<i>Banksia integrifolia</i> subsp. <i>Integrifolia</i>	Coast Banksia	
<i>Allocasuarina littoralis</i>	Black She-Oak	
<i>Jacksonia scoparia</i>	Dogwood	
<i>Pimelea linifolia</i>	Slender Rice flower	
<i>Xerochrysum braceatatum</i>	Golden Everlasting	
<i>Dampiera stricta</i>	Blue Dampiera	
<i>Hydrocotyle sibthorpioides</i>	Lawn Pennywort	
<i>Pultenaea maritima</i>	Coast Headland Pea	Vulnerable
<i>Centella asiatica</i>	Indian Pennywort	
<i>Viola banksia</i>		
<i>Zoysia macrantha</i>	Prickly Couch	

Appendix III - Table of costings and work schedule										
Step	Approx date	Tasks Performed (& Work Zones)	Area weed control (Ha)	Weed species controlled	Area reveg (Ha)	No. of plants	Herbicide (Product)	Application methods & rates	Total hours estimated	Approx. costings
1	winter 2019	Site induction, set up photo points and base line monitoring.	6ha	woody, vine and invasive grasses					2	\$100
2	Sep-19	Initial walkover entire site hand working woody & vine weeds	6ha	all woody& vine weed on weed list			Glyphosate or equil.	cut&paint/ stem scrape	63	\$3,150
	week 2	Initial treatment of invasive grasses. Spot spray.	6ha	all grasses on weed list where not adorning public access			Glyphosate Biactive or Natural pine oil based herbicide.	spot spray - Backpacks	63	\$3150 Labour + \$200 (herbicide)
3	Nov-19	Prep sites where infill revegetation is identified.			1.2ha				14	\$700
		Plant out required trees with weed mats and predation cages.			1.2ha	300	600 stakes, 300 mats, 300 cages		60	\$3000 labour + \$2130 - materials
4	Dec-19	Watering program as required							8	\$400 x necessity
5	Year 2 - 2020	Commence Maintenance program.								
	Jan-20	Weed around plantings & walkover whole site treating weeds as required	6ha				Glyphosate Biactive or Natural pine oil based herbicide.	Backpacks, Cut&paint, hand pull	42	\$2,100
	Mar-20	Weed around plantings & walkover whole site treating weeds as required	6ha				Glyphosate Biactive or Natural pine oil based herbicide.	Backpacks, Cut&paint, hand pull	42	\$2,100
	Jun-20	as above	6ha				as above		21	\$1,050
	Sep-20	as above	6ha				as above		21	\$1,050
	Dec-20	as above	6ha				as above		21	\$1,050
6	Yr 3 - 2021	Continue Maintenance program and include monitoring/reporting.								
Mar	Mar-21	Continue Maintenance program and include monitoring.	6ha	all on site		Monitor and report on revegetation.	Glyphosate Biactive or Natural pine oil based herbicide.	Spot spray /hand weed	24	\$1,200
4	Jun-21	Weed around plantings & walkover whole site treating weeds as required	6ha	all on site			Glyphosate Biactive or Natural pine oil based herbicide.	spot spray /hand weed	14	\$700
	Nov-21	Final weeding across site	6ha	all on site			as above	Spot spray /hand weed	14	\$700
	Dec-21	Final report to BSC							2	\$100
	Total manual labour hrs								409	22880
	Total hrs assessed & costed								409	22880

Note: The above table is a guide outlining a 3 year workplan for the purpose of generating an outcome and assessing the associated costs. Allowances may need to be made for additional costs of watering if planting is undertaken in a dry year. Additional plants may need to be purchased during the project.