

September 2010

# RESTORATION MANAGEMENT PLAN:

**Byron Clay Heath Sites**

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Prepared for Byron Shire Council

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## LIST OF ABBREVIATIONS AND PREFIXES

<b>BSC</b>	Byron Shire Council
<b>CRA</b>	Comprehensive Regional Assessment (NPWS 1998)
<b>DECC</b>	NSW Department of Environment and Climate Change
<b>DECCW</b>	Department of Environment, Climate Change & Water
<b>EPBC</b>	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
<b>NPWS</b>	NSW National Parks and Wildlife Service
<b>NSW</b>	New South Wales
<b>ROTAP</b>	Rare or Threatened Australian Plants (Briggs and Leigh 1996)
<b>RMP</b>	Restoration Management Plan
<b>SEPP 14</b>	State Environmental Planning Policy 14 - Coastal Wetlands
<b>SEPP 26</b>	State Environmental Planning Policy 26 – Littoral Rainforest
<b>TEC</b>	Threatened Ecological Community
<b>TSC</b>	NSW Threatened Species Conservation Act 1995 (TSC Act)
<b>aff.</b>	affinity; denotes an undescribed species closely related to or similar to a described species
<b>subs.</b>	subspecies
<b>var.</b>	variety; a taxonomic subgroup within a species used to differentiate variable populations
<b>*</b>	denotes an introduced species (when prefix to a species name)
<b>**TSC</b>	denotes a species considered eligible for listing as endangered or vulnerable under the TSC Act
<b>*TSC</b>	denotes a species proposed for listing as endangered or vulnerable under the TSC Act (NPWS 1998)
<b>†</b>	denotes native taxa not believed to be indigenous to the study area



# PART A

## BASIS FOR MANAGEMENT

### 1. INTRODUCTION

#### 1.1 *Background*

Wildsite Ecological Services Pty Ltd (Wildsite) has been engaged by the Byron Shire Council (BSC) to prepare a Restoration Management Plan (RMP) for a group of Council owned/managed lands which support Byron Bay Dwarf Graminoid Clay Heath (Byron Clay Heath) and associated vegetation types.

The RMP will guide the restoration and sustainable management of these sites as part of the Tweed Byron Bush Futures Project which seeks to address the sustainable management of urban and peri-urban bushland in Byron and Tweed Shires.

The extremely high ecological values of these sites are currently threatened by a range of issues including environmental weeds, inappropriate fire regime, stormwater pollution, severe erosion and visitor pressures. An integrated, long-term and strategic approach to vegetation management is required for effective conservation of the biodiversity values of the remnants.

The RMP describes the site's ecological values and their associated threatening processes; describes and prioritises specific ecological restoration and management activities; and outlines a framework for ongoing monitoring and contingency planning and adaptive management.

#### 1.2 *Aims and Objectives*

The overall aim of the restoration project is to:

- *Restore to the maximum extent possible the extent, structure, function, dynamics and integrity of the pre-European clay heath and associated woodlands and forests, and the habitats they support.*

To achieve this aim the project has the following objectives:

- Remove and prevent re-establishment of environmental weeds;
- Reinstate pre-European fire regimes;
- To manually treat encroaching native species currently displacing clay heath vegetation;
- Prevent/reduce the volume of excess stormwater pollution entering the sites;
- To redirect the succession trajectory of areas of clay heath subject to past clearing and soil disturbance;
- Encourage natural regeneration in sparsely vegetated and heavily degraded areas;
- Stop existing occurrences of gully erosion and prevent the development of new erosion areas;
- Encourage appropriate visitor and neighbour behavior through education about biodiversity values and threatening processes

## 2. SITE ATTRIBUTES

### **2.1 *The Study Area***

The study area is located along the eastern edge of the township of Byron Bay on the far north coast of NSW and consists of seven separate sites of remnant coastal vegetation which support Byron Bay Dwarf Graminoid Clay Heath and associated vegetation types (**Figure 1**).

Most of the sites are clustered around Paterson Hill and Honeysuckle Hill and one is located immediately south of Clarkes Beach Caravan Park. While most of the sites have been fragmented by residential development and associated roads, three remnants are contiguous with the coastal vegetation complex of Arakwal National Park.



## 2.2 Site Details

Details for the seven sites are given in **Table 1**, and site locations are shown in **Figure 1**.

Table 1. Site details.

Site Name	Area (ha.)	Lot/DP Number	Tenure	Land Use Zoning (% of site)	Location
BB28 <i>Paterson St. E</i>	0.089	5/846802	Public/Community	7(j) - Scientific Zone (100%)	Small parcel to the east of Paterson St. Water Tower and adjoining Arakwal NP
BB35 <i>Honeysuckle Hill</i>	2.582	138/264638	Public/Community	6(a) - Open Space Zone (54%) 7(b) - Coastal Habitat Zone (44%) 2(a) - Residential Zone (2%)	Between Pacific Vista Drive and Beach Comber Parade and adjoining Arakwal NP at Honeysuckle Hill
BB48 <i>Clarkes Beach Crown Land</i>	2.873	159/755695 2/1046489	Crown	6(a) - Open Space Zone (83%) 7(f1) - Coastal Lands (f1) Zone (13%) 2(a) - Residential Zone (4%)	Area between Clarkes Beach Caravan Park and Lighthouse Road
BB51 <i>West of Paterson Hill</i>	0.857	1/1127339 172/755695	Public/Operational	7(j) - Scientific Zone (77%) 2(a) - Residential Zone (23%)	Below and to west of Water Tower on Paterson St. and bounded by Ruskin and Browning Streets
BB52 <i>Paterson St /Seaview St</i>	0.956	439/729447	Crown	7(k) - Habitat Zone (71%) 2(a) - Residential Zone (29%)	Bounded by Paterson, Browning and Seaview Streets
BB53 <i>Paterson Hill Water Tower</i>	0.847	172/755695	Crown	2(a) - Residential Zone (85%) 7(j) - Scientific Zone (15%)	Area surrounding Paterson St. water tower
BB54 <i>Paterson Hill South</i>	1.139	7017/110801 5	Crown	7(j) - Scientific Zone (90%) 2(a) - Residential Zone (10%)	south-east of Paterson St water tower and bounded by Arakwal NP and Shelley Drive

## 2.3 Land Use Zoning/planning

Importantly, while all the vegetation in the study area is mapped as 'High Conservation Value' vegetation by Byron Shire Council (2004), only 46.5% of the sites are zoned for environmental protection. The remainder of the study area is zoned either 2(a) Residential Development (18.8%) or 6(a) Open Space (34.7%) and provides inadequate planning protection for the significant biodiversity values on the sites.

These zonings may allow for inappropriate development (**Table 2**), including potentially threatening activities such as bush fire hazard reduction and landscaping, which can may be currently undertaken without consent or environmental impact assessment.

**Table 2. Inappropriate Zoning within sites and potential developments allowed.**

Zone	Without development consent	With development consent
2(a) RESIDENTIAL ZONE	Bushfire hazard reduction	Housing and associated neighbourhood facilities
6(a) OPEN SPACE ZONE	Works for the purposes of landscaping and bushfire hazard reduction.	Agriculture (other than animal establishments); child care centres; cycleways; drainage; environmental facilities; markets; primitive camping grounds; recreation areas; restaurants; roads; recreation vehicle areas; showgrounds; utility installations.

## 2.4 Landforms, Geology and Soils

The study area remnants are situated along a low coastal hill complex, which extends approx. 1.4km south-west from Clarkes Beach and is comprised of gently to steeply inclined hills to an elevation of 43m at both Paterson and Honeysuckle Hills. The hill complex is recognised by Morand (1994a, b) as the landscape variant 'bia', which is characterized by very low hills with gently inclined slopes often forming footslopes.

The geology of the bedrock hill complex consists of metamorphosed sediments (metasediments) of the Neranleigh-Fernvale Group from the Carboniferous & Devonian periods. This group consists of thinly bedded fissile shales and siltstones with occasional, more massive units such as greywackes, tuffs, agglomerates, sandstone and massive cobble conglomerates. At lower elevations the hill complex is overlain by Pleistocene beach ridges to the east, and estuarine alluvium intermixed or overlain with aeolian Pleistocene sands to the west.

Soils of the bedrock hill complex falls within the Billinudgel (Bi/Bia) soil landscapes of Morand (1994a, b). Soils within this group include red and yellow podzolics, yellow earths and black prairie or "headland" soils on exposed headland slopes. Soils of the Paterson Hill complex are heavy and seasonally waterlogged.

## 2.5 Site Connectivity and Landscape Context

The sites are generally situated along the interface between the residential area of Byron Bay and the relatively large coastal vegetation complex within Arakwal National Park and Cape Byron State Conservation Area (**Figure 1**). Three sites are contiguous with the vegetation of Arakwal National Park, while the remaining four sites are separated from the National Park and other remnants by roads. All sites share a direct boundary with residential areas, except Clarkes Beach Crown Land which adjoins a caravan park.

The sites contain approx. 37.2% of the total extent of all Byron Clay Heath and associated vegetation (**Figure 1**).

## 2.6 Landuse

Prior to European settlement, the vegetation of the sites would have formed part of a continuous mosaic of coastal vegetation communities that provided habitat for a diverse range of flora and fauna, and provided essential resources for the local Arakwal Aboriginal people.

Since European settlement the sites have never been cleared for agricultural or residential purposes despite increasingly intense development of adjacent lands. Analysis of aerial photographs from 1947, 1966 and 1994 (*see References*) show a considerable amount of vegetation loss from pedestrian, livestock and vehicular tracks and more widespread vegetation thinning presumably from grazing.

Although no evidence of landuse specific to the sites was found in the literature, it is likely that the sites have been subject to minor usage typical of remnant vegetation in rural/suburban settings, such as recreation, grazing, firewood collection, cut-flower collection and rubbish dumping.

## 2.7 Restoration History

Restoration works within the study area are outlined in **Table 3**.

Management plans have been prepared for two of the sites within this project and include Vegetation Management Plans for Paterson St/Seaview St (*See Baker 2007*) and for Clarkes Beach Crown Land (*See Bower 2006*). Relevant recommendations from these plans have been incorporated into this plan, although these original plans should also be consulted by workers on these sites before commencing restoration works.

**Table 3. Restoration history within the study area.**

Site	Restoration Activity	Organisation	Date
<b>Clarkes Beach Crown Land</b>	Intermittent weed control along Lighthouse Rd.	Green and Clean Awareness Team	Since 2008
	Primary and follow-up treatment of weeds throughout site	North Coast Holiday Parks and BSC Contractors	Since 2006
<b>Paterson St/Seaview St</b>	Prescribed ecological burn	RFS/Wildsite/Paterson Street Hilltop Reserve Trust	September 2008
	Follow-up from prescribed burn	Wildsite	Spring 2009
	Primary and follow-up treatment of weeds along mesic edge adjacent to APZ	BSC Regeneration Team	Since Spring 2008
<b>Paterson Street South</b>	Intermittent weed control along APZ	Department of Lands contractor; DECC	March 2008
	Primary control of selected weeds along walking track	Wildsite	June 2008
<b>Honeysuckle Hill</b>	Prescribed ecological burn	RFS/Byron Shire Council/Wildsite	August 2009

## 2.8 Modern Fire history

Two significant wildfires have been recorded within the study area. In 1977/78 an escaped hazard reduction burn entered the study area from the south-west burning the vast majority of Arakwal NP and immediately adjacent lands over a period of two days. The fire was intense and anecdotal evidence suggests that the fire burnt 'clean' and left few unburnt patches (Tandy, C. pers. comm., as cited in DECC et al. 2004.).

A very small fire in November 2002 (c. 0.1 ha.) burnt an area of Byron Clay Heath and associated woodlands in the Paterson Hill South site (See **Figure 5**).

The area around Cibum Margil Swamp is believed to have been burnt regularly (>5 years) in the early to mid 1900s by a local shooting club (Hamilton, P. 2003, pers. comm.).

Fire scarred trees and stumps are relatively common in all dry, wet and swamp sclerophyll forests throughout the study area indicating that fire has previously occurred within most occurrences of these forest types within the last 100 years. The regular passage of fire (at least every 60 years) is indicated in forests dominated by *Eucalyptus* spp., *Melaleuca quinquenervia* or *Lophostemon suaveolens*.

There have been and two prescribed ecological burns within the study area, including within the Paterson St / Seaview St site (September 2008), and Honeysuckle Hill site (August 2009)(See **Figure 5**).

Recommendations for Pre-European fire intervals in the region are outlined in **Table 11** in Part C.

## 2.9 Site constraints

### 2.9.1 Physical constraints

#### BUSHFIRE PRONE LANDS

All sites are considered bushfire prone under the NSW Rural Fire Service guidelines (RFS 2006).

While the three sites to the west of Paterson Street are less than 1 ha. and are therefore not mapped as bushfire prone by Byron Shire (BSC 2005), they are still classed as bushfire prone under RFS (2006) given they are within the buffer zones of other parcels mapped as bushfire prone.

These constraints are relevant to the restoration project as follows:

- *Workers are prohibited from accessing the sites when bushfires are known to be active in the locality.*

#### SLOPE / EROSION POTENTIAL

The slopes throughout the study area range between approx. 2-37°. Morand (1994a) states that the clay soils of the study area are highly erodable and hence are extremely susceptible to disturbance.

Severe erosion is frequently observed along informal walking tracks locally, such as around Paterson Hill and within Paterson Street Hilltop Reserve (pers. obs.).

The abovementioned constraints are relevant to the restoration project as follows:

- *All weed removal and site access should avoid exacerbating erosion and the development of informal walking tracks.*

#### ACID SULPHATE SOILS

None of the sites occur within lands identified as Acid Sulphate Soil Risk by the Department of Land and Water Conservation (1997).

#### FLOODING

None of the sites occur within lands identified as flood prone (1 in 100yr) by Byron Shire Council (2005).

## 2.9.2 Planning & Legal Constraints

### STATE ENVIRONMENTAL PLANNING POLICIES 14/26/44

Regarding State Environmental Planning Policies (SEPPs), none of the sites:

- occur within lands mapped as *State Environmental Planning Policy No. 26 Littoral Rainforests* or their buffers;
- occur within lands mapped as *State Environmental Planning Policy No. 14 Coastal Wetlands*;
- contain potential or core koala habitat under *State Environmental Planning Policy 44 Koala Habitat Protection*

Accordingly, no constraints apply to the restoration project from these SEPPs.

### BUSHFIRE ASSET PROTECTION ZONES

A total of 5 sites have existing Asset protection Zones (APZs) along the interface with residential areas, while the remaining 2 may require the establishment of APZs in the future. **Table 4** shows the presence of APZs within the sites.

**Table 4. Status of Asset protection Zones within sites.**

Asset Protection Zone Status	Site Name
<b>Existing</b>	<ul style="list-style-type: none"> <li>• Paterson St. E</li> <li>• Honeysuckle Hill</li> <li>• West of Paterson Hill</li> <li>• Paterson St /Seaview St</li> <li>• Paterson Hill South</li> </ul>
<b>May be required in the future</b>	<ul style="list-style-type: none"> <li>• Clarkes Beach Crown Land</li> <li>• Paterson Hill Water Tower</li> </ul>

The abovementioned constraints are relevant to the restoration project as follows:

- *In order to remain effective as fire breaks, the extent and volume of vegetation within APZ's must be maintained below specifications, and the restoration of the original vegetation type within these areas is therefore impractical.*
- *APZ's often require special vegetation management, as periodic slashing, reduced canopy cover and proximity to residential gardens create conditions which favour weed establishment and persistence.*
- *The establishment and maintenance of new APZ's are to be subject to the appropriate environmental impact assessment and approval processes.*

## THREATENED SPECIES CONSERVATION ACT 1995 TEC, THREATENED SPECIES

Threatened species values listed under the *Threatened Species Conservation Act 1995* (NSW) are summarised in **Table 5**.

**Table 5. Threatened species values (TSC Act) of the study area.**

<b>Class</b>	<b>Value</b>
<b>Recorded Flora</b>	<i>Allocasuarina defungens</i> , <i>Cryptocarya foetida</i> and <i>Diuris byronensis</i>
<b>Potential Flora Habitat</b>	<i>Archidendron hendersonii</i> , <i>Endiandra muelleri</i> subsp. <i>bracteata</i> , <i>Geodorum densiflorum</i> , <i>Xylosma terrae-reginae</i>
<b>Recorded Fauna / Potential Habitat</b>	<i>Australasian Bittern</i> , <i>Black Bittern</i> , <i>Black Flying-fox</i> , <i>Bush-hen</i> , <i>Common Blossom-bat</i> , <i>Common Planigale</i> , <i>Eastern Chestnut Mouse</i> , <i>Eastern Long-eared Bat</i> , <i>Greater Broad-Nosed Bat</i> , <i>Grey-headed Flying-fox</i> , <i>Little Bentwing-bat</i> , <i>Long-nosed Potoroo</i> , <i>Masked Owl</i> , <i>Olongburra Frog</i> , <i>Spotted-tailed Quoll</i> and <i>Wallum Froglet</i> ,
<b>Threatened Ecological Communities</b>	<i>Byron Bay Dwarf Graminoid Clay Heath</i>

The abovementioned constraints are relevant to the restoration project as follows:

- A s.132C licence required under *National Parks and Wildlife Act* to work in TECs and threatened species habitat.
- All habitat restoration works are to comply with the 'NPWS checklist for bush regeneration in threatened species habitat or an endangered ecological community' (**Appendix C**).
- All works other than habitat restoration (e.g. bushfire hazard reduction) are to be subject to the appropriate environmental impact assessment and approval processes.

### 2.9.3 Sites of Aboriginal & European cultural heritage

No significant sites of Aboriginal or European cultural heritage have been identified within the project sites.

Importantly however, Clay Heath is believed to be a disclimax community maintained primarily by aboriginal burning, and therefore has aboriginal cultural significance.

## 3. BIODIVERSITY VALUES

### 3.1 Vegetation

#### 3.1.1 Plant communities

A total of 8 vegetation types are recognised to occur within the area of survey. The vegetation types of the area of survey are outlined below and mapped in **Figures 2a & 2b**. The extent of each type is given in **Table 6** and detailed profiles for each community are included in **Table 7**.

Table 6. Vegetation Types within the Study Area.

Vegetation Type	Extent within Area of survey	
	Ha.	(%)
1 Clay Heath	1.78	(18.5%)
2 Coral Fern Fernland	0.05	(0.5%)
3 Dry / Swamp Sclerophyll Woodland w/ Clay Heath understorey or indicators	2.37	(24.5%)
4 Dry /Swamp Sclerophyll Forest w/ Clay Heath understorey or indicators	1.79	(18.5%)
5 Dry / Swamp Sclerophyll Forest w/ mesic understorey	1.75	(18.1%)
6 Mixed Regrowth	0.54	(5.3%)
7 Highly Modified	0.75	(7.8%)
8 Developed/Mown Areas	0.60	(6.2%)
<b>TOTAL</b>	<b>9.69</b>	<b>(100%)</b>

Table 7. Vegetation Community Profiles.

## 1. Clay Heath



**Scientific Name:** *Banksia oblongifolia*-*Hibbertia vestita*-*Austromyrtus dulcis*-*Schoenus brevifolius*-*Allocasuarina defungens* Graminoid Clay Heathland.

### Overview

**Sites:** (6) Paterson St. E, Honeysuckle Hill, West of Paterson Hill, Paterson St /Seaview St, Paterson Hill South, Paterson Hill Water Tower and Clarkes Beach Crown Land

**Area:** 1.78ha.

**Structure:** dwarf to tall closed heathland. Tallest stratum: 0.2-1.3m; dense cover. Emergent: 0.5-4.5m; very sparse cover, +/- continuous with tallest stratum.

**Floristic overview:** Floristically variable, although 3 or more of Dwarf Banksia (*Banksia oblongifolia*), Hairy Guinea Flower (*Hibbertia vestita*), Midgen Berry (*Austromyrtus dulcis*), Zig Zag Bog-Rush (*Schoenus brevifolius*) and Dwarf Heath Casuarina (*Allocasuarina defungens*) usually co-dominate. Dwarf Heath Casuarina (*Allocasuarina defungens*) is occasionally mono-dominant and more or less emergent, particularly along ecotones with taller communities. Other subsidiary to co-dominant species are Broad Sword Sedge (*Lepidosperma laterale*), Screw Fern (*Lindsaea linearis*), Sprawling Mat-Rush (*Lomandra laxa*), *L. longifolia*, *L. multiflora* subsp. *multiflora*, *Melaleuca nodosa*, Silky Purple Flag (*Patersonia sericea*), Hairy Bush-pea (*Pultenaea villosa*) and Kangaroo Grass (*Themeda australis*). A range of species may be present as emergents including Pink Bloodwood (*Corymbia intermedia*), Coastal Wattle (*Acacia longifolia* subsp. *sophorae*), Curracabah (*A. leiocalyx*), Large-Leaf Hop-Bush (*Dodonaea triquetra*), Yellow Teatree (*Leptospermum polygalifolium* subsp. *cismontanum*), Swamp Box (*Lophostemon suaveolens*) and Paperbark (*Melaleuca quinquenervia*). Pouched Coral Fern (*Gleichenia dicarpa*) may become locally dominant in areas with higher soil moisture.

**Variants:** Variant 1a includes areas of Clay Heath whose structural and floristic composition is modified by periodic slashing for hazard reduction purposes.

### Conservation

**Endangered Ecological Community (EPBC Act)** - not listed

**Endangered Ecological Community (TSC Act)** - included in Byron Bay Dwarf Graminoid Clay Heath TEC

**Significant taxa:** *Allocasuarina defungens* (EPBC, TSC, ROTAP, CRA), *Diuris byronensis* (TSC), *Geodorum densiflorum* (TSC, CRA) and *Lindsaea ensifolia* subsp. *ensifolia* (\*\*TSC).



## 2. Coral Fern Fernland



**Scientific Name:** *Gleichenia dicarpa* Fernland.

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### Overview

**Sites:** (2) Paterson St. E and Paterson Hill South

**Area:** 0.05ha.

**Structure:** tall to very tall closed fernland. Tallest stratum: 0.7-1.2m; dense cover.

**Floristic overview:** Pouched Coral Fern (*Gleichenia dicarpa*) dominates. Other species which may be subsidiary to minor associates (30% to < 10%) include Dwarf Banksia (*Banksia oblongifolia*), Zig Zag Bog-Rush (*Schoenus brevifolius*) and Midgen Berry (*Austromyrtus dulcis*). Paperbark (*Melaleuca quinquenervia*), Pink Bloodwood (*Corymbia intermedia*), Swamp Box (*Lophostemon suaveolens*) and Coastal Wattle (*Acacia longifolia* subsp. *sophorae*) may be present as scattered emergents (<5%).

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### Conservation

**Endangered Ecological Community (EPBC Act)** - not listed

**Endangered Ecological Community (TSC Act)** - broadly included in Byron Bay Dwarf Graminoid Clay Heath TEC (See **Section 3.1.2**).

**Significant taxa:** None recorded

### 3. Dry / Swamp Sclerophyll Woodland w/ Clay Heath understorey or indicators



**SCIENTIFIC NAME:** *Corymbia intermedia*-*Allocasuarina defungens*-*Lophostemon suaveolens*, *Melaleuca quinquenervia* Dry Sclerophyll Woodland.

#### Overview

**Sites:** (7) Paterson St. E, Honeysuckle Hill, West of Paterson Hill, Paterson St /Seaview St, Paterson Hill South, Paterson Hill Water Tower and Clarkes Beach Crown Land

**Area:** 2.37ha.

**Structure:** dwarf to low, sparse woodland to woodland. Tallest stratum: 1-4m; very sparse to mid-dense cover. Lower stratum: 0.3-2.2m; dense cover, +/- continuous with stratum above.

**Floristic overview:** Floristically variable, although two or more of Pink Bloodwood (*Corymbia intermedia*), Dwarf Heath Casuarina (*Allocasuarina defungens*), Swamp Box (*Lophostemon suaveolens*), Paperbark (*Melaleuca quinquenervia*) and Curracabah (*Acacia leiocalyx*) usually co-dominate. Occasionally one or other of these species is mono-dominant over small area, including Dwarf Heath Casuarina (*Allocasuarina defungens*) where the community grades into adjacent heathland or fernland. Yellow Teatree (*Leptospermum polygalifolium* subsp. *cismontanum*) and *Acacia longifolia* subsp. *sophorae* may be minor or subsidiary associates (up to 30%).

Prominent lower stratum species include Dwarf Banksia (*Banksia oblongifolia*), Midgen Berry (*Austromyrtus dulcis*), Hairy Guinea Flower (*Hibbertia vestita*), Zig Zag Bog-Rush (*Schoenus brevifolius*), Large-Leaf Hop-Bush (*Dodonaea triquetra*), Pointed-Leaf Hovea (*Hovea acutifolia*) and Rough Guinea Flower (*Hibbertia aspera*). Pouched Coral Fern (*Gleichenia dicarpa*) may dominate the understorey locally.

#### Conservation

**Endangered Ecological Community (EPBC Act)** - not listed

**Endangered Ecological Community (TSC Act)** - broadly included in Byron Bay Dwarf Graminoid Clay Heath TEC

**Significant taxa:** *Allocasuarina defungens* (EPBC, TSC, ROTAP, CRA), *Diuris byronensis* (TSC), *Geodorum densiflorum* (TSC, CRA) and *Lindsaea ensifolia* subsp. *ensifolia* (\*\*TSC).

## 4. Dry /Swamp Sclerophyll Forest w/ Clay Heath understorey or indicators



**Scientific Name:** *Corymbia intermedia*, *Lophostemon suaveolens*, *Melaleuca quinquenervia* *Banksia oblongifolia* Dry Sclerophyll Forest.

### Overview

**Sites:** (5) Honeysuckle Hill, West of Paterson Hill, Paterson St /Seaview St, Paterson Hill Water Tower and Clarkes Beach Crown Land

**Area:** 1.79 ha.

**Structure:** low to mid-high open forest. Tallest stratum: 3-8m; mid-dense cover. Mid-stratum: 1.3-6m; very sparse to mid-dense cover, +/- continuous with stratum above. Lower stratum: 0.3-2m; sparse to mid-dense cover, +/- continuous with stratum above.

**Floristic overview:** Floristically variable dominant stratum, although two or more of Pink Bloodwood (*Corymbia intermedia*), Swamp Box (*Lophostemon suaveolens*) and Paperbark (*Melaleuca quinquenervia*) usually co-dominate. Dwarf Heath Casuarina (*Allocasuarina defungens*) may be locally dominant where the community grades into adjacent heathland or fernland. Mid-stratum species include Red Cluster Heath (*Acrotriche aggregata*) and Dwarf Banksia (*Banksia oblongifolia*). Lower stratum species include Midgen Berry (*Austromyrtus dulcis*), Zig Zag Bog-Rush (*Schoenus brevifolius*), Rough Guinea Flower (*Hibbertia aspera*), Broad Sword Sedge (*Lepidosperma laterale*) and Spiny-Headed Mat-Rush (*Lomandra longifolia*). Pouched Coral Fern (*Gleichenia dicarpa*) may dominate the understorey locally. Common Silkpod (*Parsonsia straminea*) is a common vine.

### Conservation

**Endangered Ecological Community (EPBC Act)** - not listed

**Endangered Ecological Community (TSC Act)** - broadly included in Byron Bay Dwarf Graminoid Clay Heath TEC

**Significant taxa:** *Allocasuarina defungens* (EPBC, TSC, ROTAP, CRA), *Exocarpos latifolius* (CRA), *Geodorum densiflorum* (TSC, CRA) and *Lindsaea ensifolia* subsp. *ensifolia* (\*\*TSC).

## 5. Dry / Swamp Sclerophyll Forest w/ mesic understorey



**Scientific Name:** *Corymbia intermedia*, *Lophostemon suaveolens*, *Melaleuca quinquenervia*  
**Sclerophyll Forest with mesic understorey.**

### Overview

**Sites:** (4) Honeysuckle Hill, West of Paterson Hill, Paterson St /Seaview St and Clarkes Beach Crown Land

**Area:** 1.75 ha.

**Structure:** low to mid-high, open to closed forest. Tallest stratum: 3.5-12m; mid-dense to dense cover. Mid-stratum: 1.2-9m; sparse to mid-dense cover, +/- continuous with stratum above. Lower stratum: 0.3-1.2m; sparse to dense cover, +/- continuous with stratum above.

**Floristic overview:** Floristically variable dominant stratum, although two or more of Swamp Box (*Lophostemon suaveolens*), Paperbark (*Melaleuca quinquenervia*) and Pink Bloodwood (*Corymbia intermedia*), usually co-dominate. Mid-stratum species include Tuckeroo (*Cupaniopsis anacardioides*) and Scentless Rosewood (*Synoum glandulosum* subsp. *glandulosum*), Sweet Pittosporum (*Pittosporum undulatum*), Umbrella Cheese Tree (*Glochidion sumatranum*), Camphor Laurel (*Cinnamomum camphora*), Red Cluster Heath (*Acrotriche aggregata*) and Bitou Bush (*\*Chrysanthemoides monilifera* subsp. *rotundata*).

Lower stratum species include False Bracken (*Calochlaena dubia*), Midgen Berry (*Austromyrtus dulcis*), Harsh Ground Fern (*Hypolepis muelleri*), Bladey Grass (*Imperata cylindrica* var. *major*), Sprawling Mat-Rush (*Lomandra laxa*), Spiny-Headed Mat-Rush (*Lomandra longifolia*) and Bracken Fern (*Pteridium esculentum*).

### Conservation

**Endangered Ecological Community (EPBC Act)** - not listed

**Endangered Ecological Community (TSC Act)** - not listed

**Significant taxa:** *Allocasuarina defungens* (EPBC, TSC, ROTAP, CRA), *Cryptocarya foetida* (EPBC, TSC, ROTAP, CRA), *Geodorum densiflorum* (TSC, CRA), *Mucuna gigantea* (CRA).

## 6. Mixed Regrowth



### Overview

**Sites:** (4) Paterson St /Seaview St, Paterson Hill South, Paterson Hill Water Tower and Clarkes Beach Crown Land

**Area:** 0.36 ha.

**Structure:** Variable structure, low to mid-high open woodland to closed forest. Tallest stratum: 3-8m; sparse-dense cover. Mid-stratum: 1.3-6m; very sparse to mid-dense cover, +/- continuous with stratum above. Lower stratum: 0.3-2m; sparse to mid-dense cover, +/- continuous with stratum above.

**Floristic overview:** Floristically variable with Common species including Coast Banksia (*Banksia integrifolia*), Paperbark (*Melaleuca quinquenervia*), Native Guava (*Rhodomyrtus psidioides*), Pink Bloodwood (*Corymbia intermedia*), and Tuckeroo (*Cupaniopsis anacardioides*).

The mid-stratum is typically dominated by Coastal Wattle (*Acacia longifolia* subsp. *sophorae*), Bitou Bush (*Chrysanthemoides monilifera* subsp. *rotundata*) and Sweet Pittosporum (*Pittosporum undulatum*). Common species in the sparse to dense lower stratum (0.5-1.5m) include Bladey Grass (*Imperata cylindrica* var. *major*), Bugle Lily (*Watsonia meriana* cv. *Bulbillifera*) and Crofton Weed (*Ageratina adenophora*).

### Conservation

**Endangered Ecological Community (EPBC Act)** - not listed.

**Endangered Ecological Community (TSC Act)** - not listed.

**Significant taxa:** none recorded.

## 7. Highly Modified



### Overview

*This broad category includes all areas of highly modified vegetation including mown grasslands, slashed asset protection zones, road verges and highly degraded vegetation dominated by weeds along the interface with residential areas.*

**Sites:** (7) Paterson St. E, Honeysuckle Hill, West of Paterson Hill, Paterson St /Seaview St, Paterson Hill South, Paterson Hill Water Tower and Clarkes Beach Crown Land

**Area:** 0.75 ha.

**Structure:** Extremely diverse structure including: bare ground interspersed with low grasses and forbs; very low sod grassland; closed shrubland and mid-high closed forest with understorey strata removed by slashing.

**Floristic overview:** Extremely diverse floristic composition dominated by introduced species. See **Appendix 1** for indication of floristic composition.

### 3.1.2 Conservation Significance

#### I) OVERVIEW

One Threatened Ecological Community (TEC) listed under the *Threatened Species Conservation Act, 1995* (NSW)(TSC Act) occurs within the study area, being:

- *Byron Bay Dwarf Graminoid Clay Heath*

All vegetation throughout the sites is mapped as 'High Conservation Value' vegetation by Byron Shire Council (2004).

#### II) THREATENED ECOLOGICAL COMMUNITIES (TSC ACT)

##### CLAY HEATH

###### *General*

Vegetation type 1 (**Figure 1**) forms part of the '*Byron Bay Dwarf Graminoid Clay Heath*' TEC (Clay Heath) under the NSW Threatened Species Conservation Act 1995 (TSC Act).

Vegetation type 1 forms the core areas of Clay Heath within the study area, having a structural and floristic composition generally consistent with the description as described in the Final Determination for listing (NSWSC 2000). However, additional areas are believed to constitute 'encroached' Clay Heath (Types 2, 3 & 4) as discussed below.

###### *Encroached Clay Heath*

Vegetation types 2, 3 & 4 are considered to be modified or variant forms of the Clay Heath whose floristic and structural composition has been altered through encroachment by woodland/forest species and/or Coral Fern. Importantly, while areas of woodland with clay heath understorey are believed to have formed part of the pre-European vegetation of the area, environmental changes since European settlement have facilitated widespread expansion of woodland, forest and fernland at the expense of typical clay heath. Within Types 2 and 4, trees have progressively colonised the Clay Heath and developed a recognisable, although variable, upper stratum above the shorter heath species. Type 3 includes areas where clay heath has been displaced by Coral Fern as a result of prolonged fire interval and in most cases, stormwater discharge.

Encroachment of clay heath is facilitated by a combination of prolonged soil disturbance, fire interval and stormwater pollution. For an outline of the processes of encroachment see '*Encroachment of Clay Heath by Fernland, Woodland and Forest*' in Part C.

These structural and floristic changes are typical wherever soil disturbance and similar alterations to the fire and hydrological regimes occur throughout the Clay Heath community's range (Baker 2007, Baker 2009, Stewart & McKinley 2007, and DEC 2004).

Despite the atypical structure and floristics, these vegetation types are still believed to constitute Clay Heath, and therefore have the same conservation significance, given:

- The vegetation is believed to have originally been Clay Heath before soil disturbance and alteration of the sites' fire and hydrological regimes;
- Soil disturbance and alteration of the sites' fire and hydrological regimes are modern anthropogenic disturbances; and
- Restoration of more typical Clay Heath vegetation is believed possible through re-establishment of the original fire/hydrological regimes and treatment of encroaching vegetation.

While most occurrences of these communities are likely to have originally been typical Clay Heath without an overstorey stratum, it is highly likely that all occurrences would at least have had a ground stratum of typical Clay Heath with or without the presence of an overstorey stratum.

This Plan proposes to restore areas identified as 'encroached' Clay Heath through restoration of original fire and hydrological regimes, and the removal of encroaching species in selected areas.

Several threatened plant species are found only in association with the Clay Heath and include:

- *Diuris byronensis*
- *Allocasuarina defungens complex (including specimens identified as A. defungens X simulans & A. defungens x littoralis).*

#### COASTAL FLOODPLAIN TECs

While some occurrences of vegetation types 4 and 5 have floristic and structural affinities with 'Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions', the study area does not occur on floodplain landforms, and the community is therefore **not** considered to form part of these TECs.

### III) CRITICAL HABITAT DECLARED UNDER THE TSC ACT

No critical habitat occurs within the subject site.



## 3.2 Flora

### 3.2.1 Overview

The survey identified 217 species (**Appendix 1**) from 84 families and includes 65 introduced species.

### 3.2.2 Species of Conservation Significance

**Table 8. Taxa of conservation significance recorded within the study area.**

EPBC Act (*Environment Protection and Biodiversity Conservation Act 1999*); TSC Act (*NSW Threatened Species Conservation Act 1995*); ROTAP (Rare or Threatened Australian Plants)(Briggs and Leigh 1996); CRA (Comprehensive Regional Assessment)(NPWS 1998).

Taxon	Common Name	EPBC Act	TSC Act	ROTAP	CRA	Community	Habitat within the locality.
<i>Allocasuarina defungens</i>	Dwarf Heath Casuarina	Endangered	Endangered	2E	C1 Critically Threatened	1, 2, 3 & 4	Restricted to graminoid clay heath and associated woodlands and forests.
<i>Cryptocarya foetida</i>	Stinking Cryptocarya	Vulnerable	Vulnerable	3VCi	C1 Critically Threatened	4, 7	Locally abundant in littoral rainforest and wet sclerophyll forests, although often sparsely distributed throughout a range of other communities including dry sclerophyll forest, woodland and shrubland as saplings.
<i>Diuris byronensis</i>	Byron Bay Diuris		Endangered			1, 3	Restricted to graminoid clay heath and associated woodlands and forests.
<i>Geodorum densiflorum</i>	Pink Nodding Orchid		Endangered		C1 Critically Threatened	2c, 3e, 3f, 4b, 8a	Recorded in graminoid clay heath and associated woodlands and forests, and in dry sclerophyll forest on sand. (Recorded immediately adjacent to the Honeysuckle Hill site)
<i>Lindsaea ensifolia</i> subsp. <i>ensifolia</i>			Candidate for listing as only known from 2 records in NSW.			1, 3, 4	Restricted to sedgeland and graminoid clay heath and associated woodlands and forests.

### 3.2.3 Profiles

This section lists all taxa of high conservation significance recorded within the study area, outlining the communities and habitat in which it was recorded, and local population estimates within the study area. Conservation status is also given according to the EPBC Act, TSC Act, ROTAP (Briggs and Leigh, 1996) and CRA (NPWS 1998).

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#### ***Allocasuarina defungens***

#### Dwarf Heath Casuarina

##### **Conservation significance:**

Endangered (EPBC), 2E (ROTAP), Endangered (TSC), C1 - Critically Threatened (CRA)

Byron Bay records represent a disjunct northern occurrence of the species. Taxonomic uncertainty surrounds local records, with some specimens indicating possible hybridisation with other *Allocasuarina* species (e.g. *A. littoralis* and *A. simulans*) (see Baker 2003, Clements *et al.* 1999, Stewart and McKinley 2007). The complex of taxa requires detailed genetic research, and it is possible that a new taxon could be involved (Wilson, K. 2003. pers. comm.).

##### **Habitat:**

In the locality, the taxon appears to be restricted to areas of graminoid clay heath and associated woodlands and forests on meta-sedimentary clays around Paterson and Honeysuckle Hills, and at Clarkes Beach (adjacent to the study area).

##### **Local population:**

Known from approx. 2 275 recorded ramets (stems) (see Baker 2008b). Population estimated at >5000 ramets (stems). The number of stems recorded is likely to be an overestimate of the number of genetically distinct individuals, as the taxon is known to reproduce by vegetative means, sending up new ramets from the underground root system (Benwell & Steed 1997, Clements *et al.* 1999).

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#### ***Cryptocarya foetida***

#### Stinking Cryptocarya

##### **Conservation significance:**

Vulnerable (EPBC), 3VCi (ROTAP), Vulnerable (TSC), C1 - Critically Threatened (CRA)

##### **Habitat:**

Locally abundant in most types of littoral rainforest and wet sclerophyll forests on sand and meta-sedimentary clays, although often sparsely distributed throughout a range of other communities including dry sclerophyll forest, woodland and shrubland as seedlings and saplings.

##### **Local population:**

Known from at least 111 recorded individuals, although additional observations frequently not recorded (Baker, A, pers. obs.). Population estimated at > 4000 individuals.

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#### ***Diuris byronensis***

#### Byron Bay Diuris

##### **Conservation significance:**

Endangered (TSC)

##### **Habitat:**

Restricted to graminoid clay heath and associated woodlands and forests on meta-sedimentary clays around Paterson and Honeysuckle Hills.

One individual also recorded from Broken Head NR.

**Local population:** Known from at least 23 individuals, from 45 records. Population not estimated.



Plate 1. *Allocasuarina defungens*.



Plate 2. *Cryptocarya foetida*.



Plate 3. *Diuris byronensis*.



Plate 4. *Lindsaea ensifolia* subsp. *ensifolia*.

***Geodorum densiflorum***

## Pink Nodding Orchid

**Conservation significance:**

Endangered (TSC), C1 - Critically Threatened (CRA)

**Habitat:**

Occurs occasionally in graminoid clay heath, but more frequently in woodlands and forests with graminoid clay heath species in the understorey. Majority of occurrences on meta-sedimentary clays around Paterson and Honeysuckle Hills, although one specimen has also been located on sand at Clarkes Beach.

**Study area population:**

Known from at least 116 recorded individuals. Population estimated at >300 individuals (see Baker 2008b) and represents the largest known in NSW.

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***Lindsaea ensifolia* subsp. *ensifolia*****Conservation significance:**

Candidate for listing under the TSC Act as only known from 2 records in NSW.

**Habitat:**

Recorded from clay heath and associated woodlands and forests in one location.

**Study area population:**

Restricted to one site immediately adjacent to the study area. Occurs as at least 13 apparently separate clumps with a combined area of approx. 180m<sup>2</sup>. Number of ramets (fronds) estimated at c. 5000.

This record represents southern limit for species and the largest known population in NSW. Also recorded near Belongil Creek (Baker 2008a).



Plate 5. *Geodorum densiflorum*

### 3.2.4 Introduced Species

The survey identified 65 introduced species of which 43 are recognised environmental weeds, 8 are listed as Noxious within Byron Shire and 24 are listed, or consistent with, Key Threatening Processes (KTPs) under the TSC Act (**Table 9**). Under the NSW *Noxious Weeds Act* (1993) occupiers of land are required to control noxious weeds in accordance with the Control Class as designated in the declaration (see **Table 9**).

The relative abundance of introduced species within the sites is indicated in **Figures 4a & 4b** and within different vegetation types, in **Appendix A**.

**Table 9. Introduced flora recorded within the area of survey**

(\*denotes introduced species, †denotes non-indigenous species native elsewhere in Australia).

Scientific Name	Common Name	Environmental Weed <sup>1</sup>	Noxious Weed Control Class <sup>2</sup>	Listed KTP <sup>3</sup> (TSC ACT)
** <i>Acacia saligna</i>	Golden Wreath Wattle			
* <i>Ageratina adenophora</i>	Crofton Weed		4	
* <i>Ageratina riparia</i>	Mistflower		4	
* <i>Ageratum houstonianum</i>	Blue Billygoat Weed	✓		
* <i>Ambrosia artemisiifolia</i>	Annual Ragweed	✓	5	
* <i>Andropogon virginicus</i>	Whisky Grass	✓		✓
* <i>Ardisia elliptica</i>	Shoebuttan Ardisia			
* <i>Asparagus aethiopicus</i>	Asparagus Fern	✓		✓
* <i>Axonopus compressus</i>	Broad-leaved Carpet Grass	✓		✓
* <i>Baccharis halimifolia</i>	Groundsel Bush	✓	3	
** <i>Banksia ericifolia</i>	Heath-leaved Banksia			
* <i>Bidens pilosa</i>	Farmer's Friends/Cobbler's Pegs	✓		
† <i>Callistemon spp.</i>	Bottlebrush			
* <i>Chloris gayana</i>	Rhodes Grass	✓		✓
* <i>Chrysanthemoides monilifera subsp. rotundata</i>	Bitou Bush	✓	4	✓
* <i>Cinnamomum camphora</i>	Camphor Laurel	✓	4	
* <i>Citrus limon</i>	Lemon			
* <i>Commelina benghalensis</i>	Hairy Wandering Jew	✓		✓
* <i>Conyza bonariensis</i>	Fleabane	✓		
* <i>Crotalaria incana</i>	Woolly Rattlepod			
* <i>Crotalaria lanceolata subsp. lanceolata</i>	-			
* <i>Cyclospermum leptophyllum</i>	Slender Celery			✓
* <i>Desmodium uncinatum</i>	Silver-leaved Desmodium	✓		✓
* <i>Digitaria ciliaris</i>	A Summer Grass	✓		✓
* <i>Digitaria sanguinalis</i>	Summer Grass	✓		✓
* <i>Duranta erecta</i>	Sky Flower			
* <i>Epidendrum ibaguense</i>	Crucifix Orchid			✓
* <i>Galinsoga parviflora</i>	Potato Weed			
* <i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	✓		
† <i>Grevillea spp.</i>	Grevillea			
* <i>Hypochaeris radicata</i>	Catsear/Flatweed	✓		
* <i>Ipomoea indica</i>	Blue Morning Glory	✓		✓
† <i>Kunzea ambigua</i>	Tick Bush			
* <i>Lantana camara</i>	Lantana	✓	4	✓

Scientific Name	Common Name	Environmental Weed <sup>1</sup>	Noxious Weed Control Class <sup>2</sup>	Listed KTP <sup>3</sup> (TSC ACT)
** <i>Leptospermum laevigatum</i>	Coast Teatree			
* <i>Ligustrum lucidum</i>	Large-leaved Privet			
* <i>Ligustrum sinense</i>	Small-leaved Privet			
* <i>Macroptilium atropurpureum</i>	Siratro	✓		✓
* <i>Melinis minutiflora</i>	Molasses Grass	✓		✓
* <i>Melinis repens</i>	Red Natal Grass	✓		✓
* <i>Murraya paniculata</i>	Orange Jessamine	✓		
† <i>Nephrolepis cordifolia</i>	Fishbone Fern	✓		
* <i>Nephrolepis exaltata</i>	Boston Fern	✓		
* <i>Nerium oleander</i>	Oleander			
* <i>Ochna serrulata</i>	Mickey Mouse Plant	✓		
* <i>Paspalum urvillei</i>	Vasey Grass	✓		✓
* <i>Paspalum wettsteinii</i>	Broad-Leaved Paspalum	✓		✓
* <i>Passiflora edulis</i>				✓
* <i>Passiflora suberosa</i>	Cork Passionflower	✓		✓
* <i>Pennisetum clandestinum</i>	Kikuyu Grass	✓		✓
* <i>Phyllanthus tenellus</i>	Hen and Chicken			
* <i>Psidium cattleianum</i> var. <i>cattleianum</i>	Strawberry Guava	✓		
* <i>Raphiolepis indica</i>	Indian Hawthorn	✓		
† <i>Schefflera actinophylla</i>	Umbrella Tree	✓		
* <i>Schinus terebinthifolius</i>	Broadleaved Pepper Tree	✓	3	
* <i>Senna pendula</i> var. <i>glabrata</i>	Winter Senna, Easter Cassia	✓		
* <i>Setaria sphacelata</i>	South African Pigeon Grass	✓		✓
* <i>Sida rhombifolia</i>	Paddy's' Lucerne	✓		
* <i>Solanum mauritianum</i>	Wild Tobacco	✓		
* <i>Solanum nigrum</i>	Blackberry Nightshade	✓		
* <i>Spathodea campanulata</i>	African Tulip Tree	✓		
* <i>Stenotaphrum secundatum</i>	Buffalo Grass	✓		✓
* <i>Syagrus romanzoffiana</i>	Cocos palm			
* <i>Watsonia meriana</i> cv. <i>Bulbillifera</i>	Bugle Lily	✓		
* <i>Wedelia trilobata</i>	Singapore Daisy	✓		✓

<sup>1</sup> Environmental Weeds FNCCC 2000 ([http://www.fncw.nsw.gov.au/doc\\_downloads/weed\\_list\\_187.pdf](http://www.fncw.nsw.gov.au/doc_downloads/weed_list_187.pdf)) accessed 07/09/2007

<sup>2</sup>

**Class 3 - Regionally Controlled Weeds.**

"The plant must be fully and continuously suppressed and destroyed."

**Class 4 - Locally Controlled Weeds.**

"The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority" and in addition for some Class 4 weeds "and the plant may not be sold, propagated or knowingly distributed".

**Class 5 - Restricted Plants.**

"There are no requirements to control existing plants of Class 5 weeds. However, the weeds are "notifiable" and a range of restrictions on their sale and movement exists."

<sup>3</sup> Relevant Key Threatening Processes under the TSC Act include: Invasion of native plant communities by Bitou bush & boneseed; Invasion, establishment and spread of *Lantana camara*; Invasion of native plant communities by exotic perennial grasses; and Invasion and establishment of exotic vines and scramblers.

### 3.3 Fauna

#### 3.3.1 Terrestrial Fauna

The review of recent (within last 20 yrs) DECCW Wildlife Atlas records and habitat requirements identified 20 threatened fauna species for which the area of survey forms potential habitat (**Table 10**).

**Table 10. Threatened fauna potentially utilising the subject site.**

Common Name	EPBS Status	TSC Status	Habitat Availability
<i>Australasian Bittern</i>		V	Marginal foraging habitat in swamp sclerophyll forest and woodland
<i>Black Bittern</i>		V	Marginal foraging habitat in swamp sclerophyll forest and woodland
<i>Black Flying-fox</i>			Foraging habitat in woodland and forest, including nectar from flowering eucalypts, paperbarks and banksias.
<i>Bush-hen</i>		V	All vegetation with dense understorey
<i>Common Blossom-bat</i>		V	Potential foraging habitat in heathland, woodland and forest, including nectar from flowering Melaleuca and Banksia.
<i>Common Planigale</i>		V	Marginal foraging & nesting habitat in dense ground stratum in woodland and forest areas, although limited by distance to water and limited woody debris.
<i>Eastern Chestnut Mouse</i>			Potential foraging & nesting habitat, including dense ground stratum throughout site. Recently recorded in the south western corner of Arakwal NP (Phillips and Forsman 2003b).
<i>Eastern Long-eared Bat</i>		V	Potential foraging habitat in woodland and all forest types
<i>Greater Broad-Nosed Bat</i>		V	Potential foraging habitat in open woodland and above heathland; Very marginal roosting habitat as tree hollows virtually absent in forest and woodland.
<i>Grey-headed Flying-fox</i>	V	V	Potential foraging habitat in woodland and forest, including nectar from flowering eucalypts, paperbarks and banksias. A camp with approx. 50 individuals was observed in the swamp sclerophyll forest in the Honeysuckle Hill site.
<i>Little Bentwing-bat</i>		V	Potential foraging habitat between understorey and canopy in forest and woodland areas.
<i>Long-nosed Potoroo</i>			Potential habitat in dense ground cover throughout site. Recently recorded in Arakwal NP by Phillips and Forsman (2003b).
<i>Masked Owl</i>			Potential foraging habitat in swamp forest
<i>Olongburra Frog</i>	V	V	Potential habitat in swamp sclerophyll and adjacent immediately areas of clay heath and woodland
<i>Spotted-tailed Quoll</i>		V	Potential habitat in all forest, woodland and heath communities.
<i>Wallum Froglet</i>		V	Potential habitat in swamp sclerophyll and adjacent immediately areas of clay heath and woodland

#### 3.3.2 Aquatic Fauna

No threatened species listed under the *Fisheries Management Act 1994* are considered likely to occur within the area of survey.



**SITE ACTION PLAN**

**Byron Clay Heath Sites  
Byron Bay**

-  Restoration Site
-  Clay Heath Vegetation Extent
-  National Parks Estate



Prepared by Andy Baker  
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August 2010



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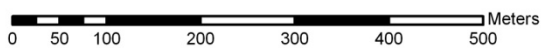
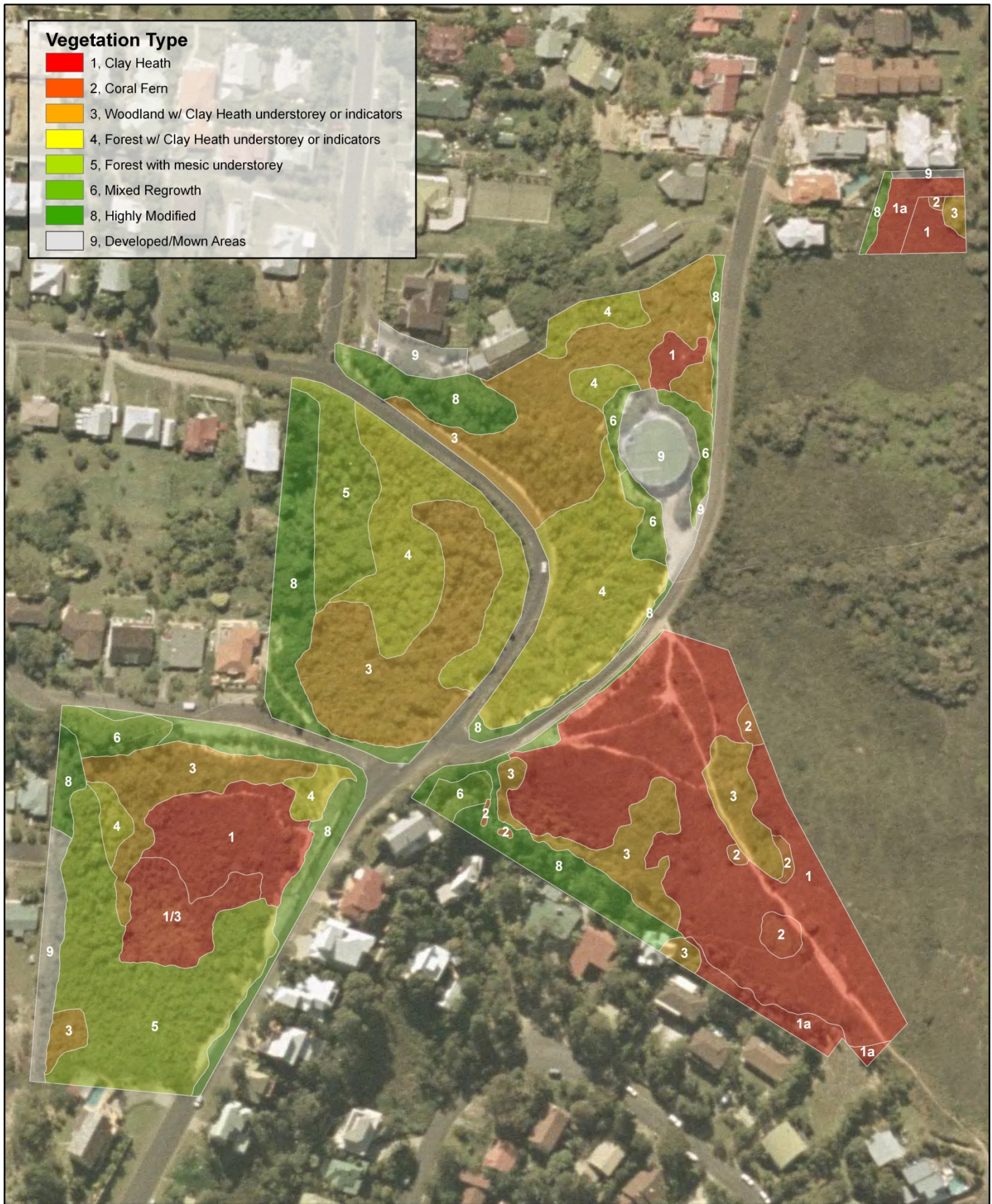


Figure 1  
**Location & Context**



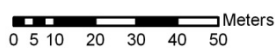


**SITE ACTION PLAN**

**Byron Clay Heath Sites  
Byron Bay**

*See legend inset for vegetation types*

Figure 2A  
**Vegetation Communities**



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**SITE ACTION PLAN**

**Byron Clay Heath Sites  
Byron Bay**

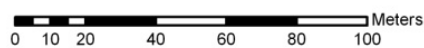
*See legend inset for vegetation types*



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Figure 2B

**Vegetation Communities**



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**SITE ACTION PLAN**




**Byron Clay Heath Sites  
Byron Bay**

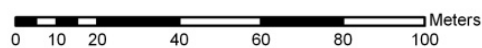
Figure 3A  
**Threatened Flora  
and Ecological Communities**

**Threatened Flora**  
*Allocasuarina defungens*

-  stands
-  individuals
-  *Lindsaea ensifolia*

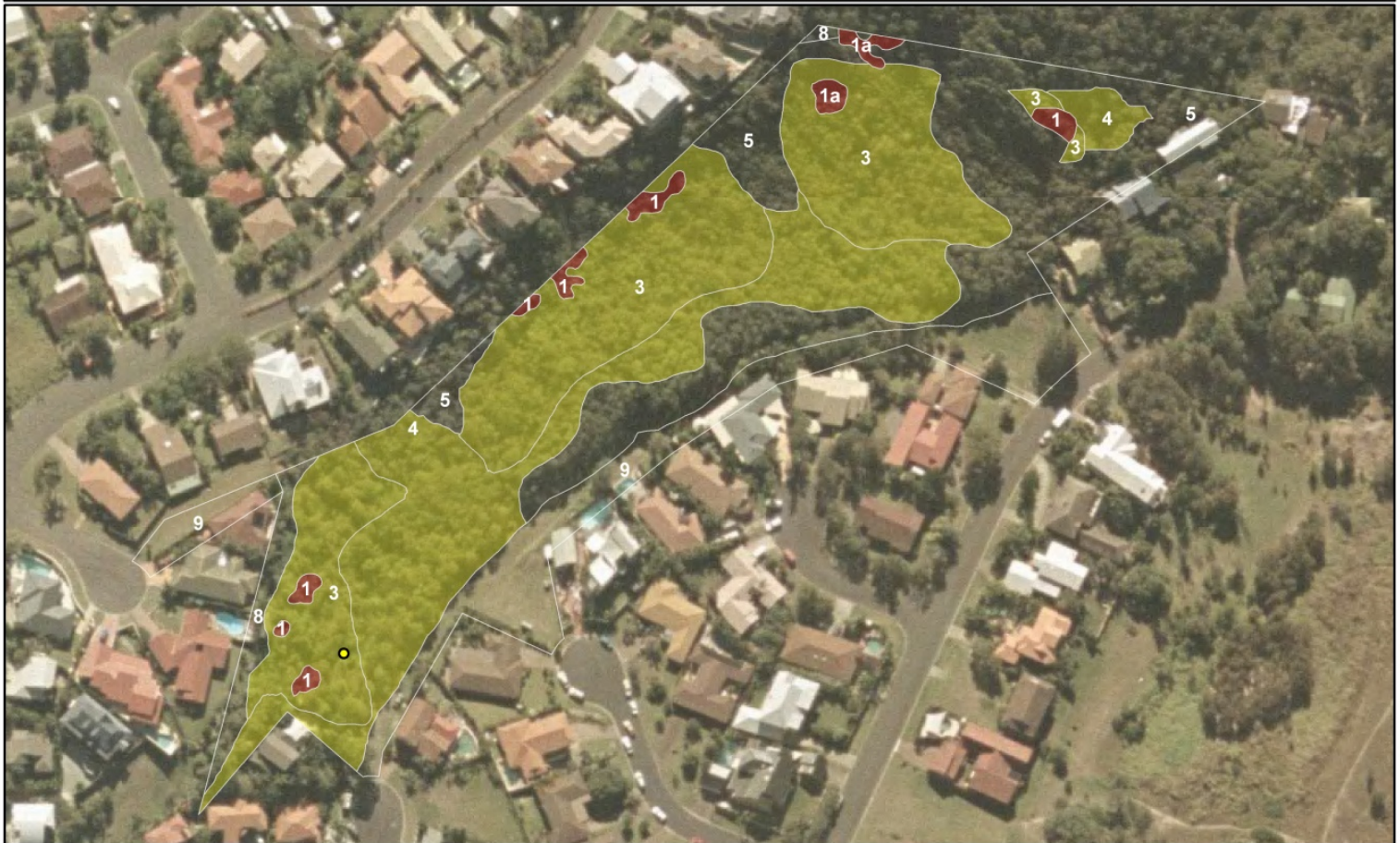
**TEC (NSW TSC)**  
Byron Clay Heath

-  Typical
-  Encroached
-  Vegetation (See Fig. 2)



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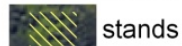
**SITE ACTION PLAN**

**Byron Clay Heath Sites  
Byron Bay**

Figure 3B  
**Threatened Flora and  
Ecological Communities**

**Threatened Flora**

*Allocasuarina defungens*



stands



individuals



*Cryptocarya foetida*



*Lindsaea ensifolia*

**TEC (NSW TSC)**

Byron Clay Heath



Typical



Encroached



Vegetation (See Fig. 2)



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**SITE ACTION PLAN**

**Byron Clay Heath Sites  
Byron Bay**

**Condition (Weed Cover)**

- 1, Very Good (<5%)
- 2, Good (5-20%)
- 3, Poor (20-50%)
- 4, Very Poor (>50%)

**Issues**

- Priority Weed
- Dumping / Encroachment
- Stormwater Pollution
- Erosion



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Figure 4A

**Condition and Issues**





**SITE ACTION PLAN**

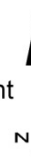
**Byron Clay Heath Sites  
Byron Bay**

**Condition (Weed Cover)**

- 1, Very Good (<5%)
- 2, Good (5-20%)
- 3, Poor (20-50%)
- 4, Very Poor (>50%)

**Issues**

- Priority Weed
- Dumping / Encroachment
- Stormwater Pollution
- Erosion

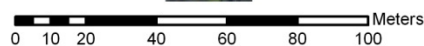


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Figure 4B  
**Condition and Issues**









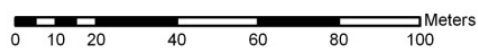
**SITE ACTION PLAN**

**Byron Clay Heath Sites  
Byron Bay**

Figure 5A  
**Fire Interval Status**

**Fire Interval Status**

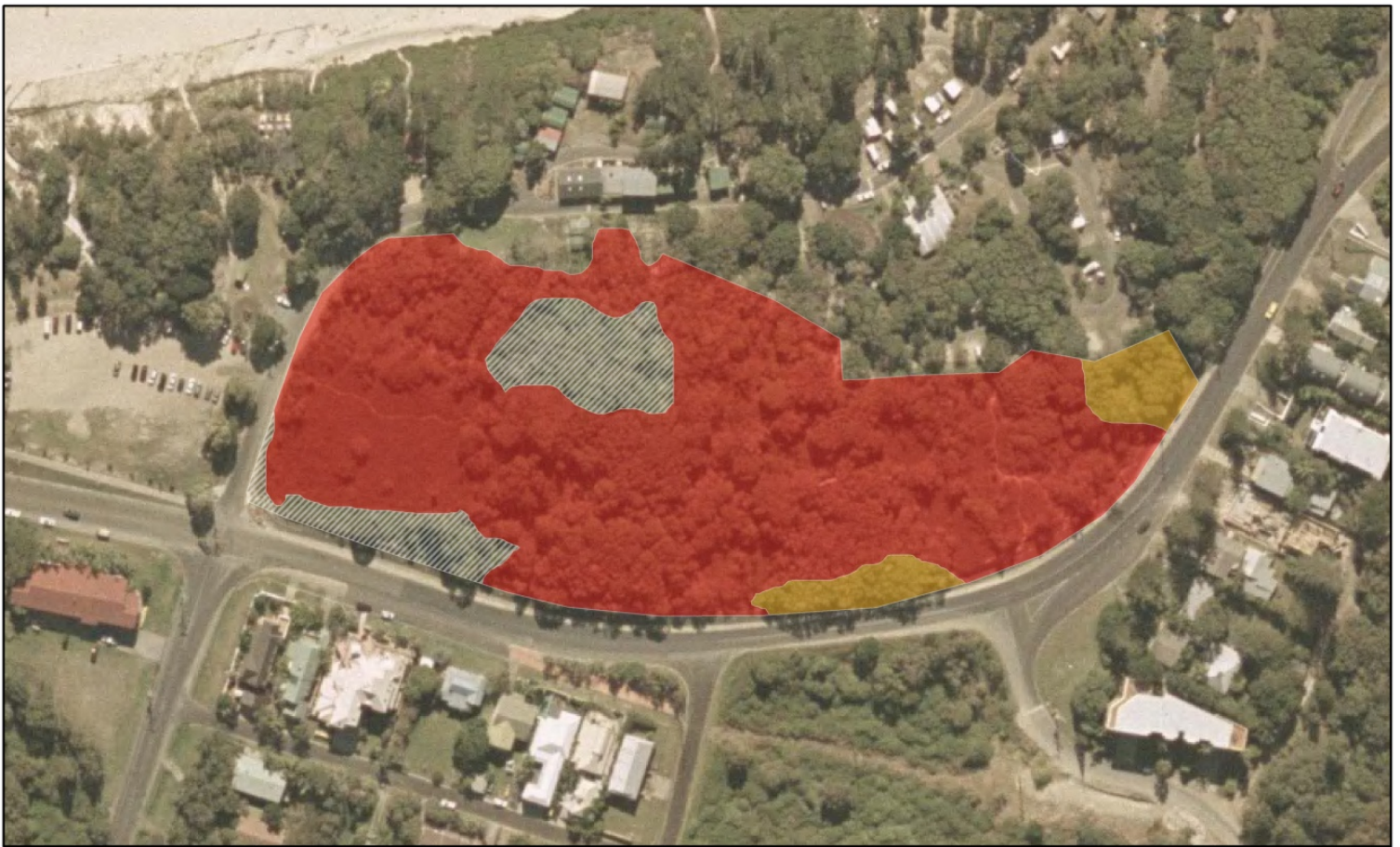
-  Already beyond recommended maximum
-  Beyond recommended maximum within 5 yrs
-  Within recommended threshold
-  Undetermined



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**SITE ACTION PLAN**

**Byron Clay Heath Sites  
Byron Bay**

Figure 5B  
**Fire Interval Status**

**Fire Interval Status**

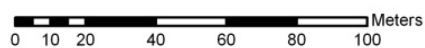
-  Already beyond recommended maximum
-  Beyond recommended maximum within 5 yrs
-  Within recommended threshold
-  Undetermined



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**SITE ACTION PLAN**

**Byron Clay Heath Sites  
Byron Bay**

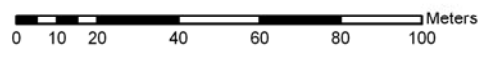
**Zone 2** Management Zone  
(See Plan)

- Clay Heath
- Woodland w/ Clay Heath
- Forest w/ Clay Heath
- Swamp Sclerophyll Forest w/ Mixed Understorey



Figure 6A

**Managment Zones &  
Restoration Extent**



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**SITE ACTION PLAN**

**Byron Clay Heath Sites  
Byron Bay**

Figure 6B

**Management Zones &  
Restoration Extent**

**Zone 2** Management Zone  
(See Plan)

**Proposed Restoration Extent**

-  Clay Heath
-  Woodland w/ Clay Heath
-  Forest w/ Clay Heath
-  Swamp Sclerophyll Forest w/ Mixed Understorey



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## PART C

# MANAGEMENT STRATEGIES

### 1. INTRODUCTION

The primary management aim of the project is to *'restore to the maximum extent possible the extent, structure, function, dynamics and integrity of the pre-European clay heath and associated woodlands and forests, and the habitats they support.'*

But how has the clay heath changed since European settlement? Analysis of aerial photographs and analysis of vegetation in the field indicate that clay heath was historically much more widely spread than it is today. Today, former areas of clay heath have been displaced by a range of different communities including: dense fernland; sclerophyll woodland or forest with some clay heath species persisting in the understorey; and relatively dense forests with a mesic understorey and a high proportion of environmental weeds. Also, localised areas of erosion, dense weed infestation and bare earth also occur in areas formerly occupied by clay heath.

All these changes to the clay heath vegetation can be linked to changes to the clay heath environment since European settlement. The local environment has been modified by the introduction of environmental weeds, permanent and concentrated stormwater overflows and concentrated pedestrian, vehicular and livestock traffic. But arguably the most significant environmental change has been the disruption of traditional Aboriginal fire management which undoubtedly played a primary role in determining the extent and composition of clay heath vegetation. The arrival of Europeans disrupted this fire management and wildfire is now suppressed to protect adjacent residential areas, with significant consequences for clay heath vegetation.

Accordingly, the restoration of the clay heath vegetation will involve the reinstatement, to the maximum extent possible, the pre-European environmental conditions of the sites. While the reinstatement of the pre-European fire and hydrological regimes will form a critical basis for the restoration of ecological functioning and dynamics within the clay heath vegetation, additional management intervention will be required to revert areas now dominated by introduced species or encroaching native trees.

In order to restore the clay heath vegetation, two broad management strategies will be required and include:

1. Reinstatement of the pre-European conditions on the sites (to the maximum extent possible), particularly:
  - a. fire regime
  - b. hydrological regime
2. Management of encroaching species which displace clay heath vegetation including:
  - a. environmental weeds; and
  - b. native trees, tall shrubs and ferns that have been disproportionately favoured by modern anthropogenic changes

## 2. MANAGEMENT STRATEGIES

In addressing these goals the management strategies outlined in Part B focus on 5 subject areas:

1. ENVIRONMENTAL WEEDS
2. FIRE
3. ENCROACHMENT OF CLAY HEATH BY FERNLAND, WOODLAND & FOREST
4. VISITOR IMPACTS
5. NEIGHBOUR ISSUES

Each subject heading is addressed in the following manner:

**BACKGROUND INFORMATION** - Information which needs to be known in order to comprehend the subject and which provides a context for the outcomes, guidelines and actions.

**DESIRED OUTCOMES** - The desired condition of one or more specific attributes of the subject to be achieved by or before 2015.

**EXISTING SITUATION** - The current condition of the attributes referred to in 'Desired Outcomes'.

**GUIDELINES AND POLICIES** - Guidelines and policies to guide the change from the existing situation to the desired outcome.

**ACTIONS** - Actions needed to bring about the proposed change from the existing situation to the desired outcome.

See **Table 14** for a complete table of all proposed actions and their relative priorities.

# 1. ENVIRONMENTAL WEEDS

*See also: Fire and Neighbour Issues.*

---

## BACKGROUND INFORMATION

### **General**

Environmental weeds (i.e. weeds that invade largely natural environments) are acknowledged as the second most significant cause of biodiversity decline, after habitat loss. (Coutts-Smith & Downey, 2006; WRI *et. al.* 1992).

Environmental weeds threaten the survival of many native plants because they:

- compete for available nutrients, water, space and sunlight;
- reduce natural diversity by smothering native plants or preventing them from growing back after clearing, fire or other disturbances; and
- modify the structure and function of natural habitats.

Most environmental weeds were initially introduced as garden and ornamental plants. In some cases, seeds spread into natural environments, via wind, people, vehicles, machinery, birds and other animals. In other cases weeds have spread vegetatively out of gardens, or spread into bushland areas from dumped garden waste.

Weeds rapidly invade disturbed sites. Human activities which encourage weed establishment include loss of plant cover, soil disturbance, soil compaction or altered burning patterns. However, many weeds can establish in undisturbed vegetation and ultimately modify the habitat.

Once established, weeds often grow faster and survive better than native plants as they may not be affected by the pests or diseases that would normally control them in their natural habitats.

NPWS (2003) list weed invasion, particularly from the invasive Wild Watsonia (*Watsonia meriana* cv. *Bulbillifera*) as one of the main threats to Clay Heath.

### **Environmental Weeds in the Study Area**

A total of 65 introduced species (Appendix 1) have been identified in the study area, of which 43 are recognised environmental weeds, 8 are listed as Noxious within Byron Shire and 24 are listed, or consistent with, Key Threatening Processes (KTPs) under the TSC Act.

Characteristic weeds within areas of typical clay heath include Watsonia, Singapore Daisy, Introduced Grasses such as Whiskey Grass and Vasey Grass. These species can form dense swards and displace areas of heathland locally. Treatment of introduced grasses is complicated within the heathland by difficulties in identifying and spraying introduced species among the diversity of native grasses present.

Well developed forests with mesic understorey tend to have a higher proportion of environmental weeds with common species including Ochna, Winter Senna, Indian Hawthorn, Fishbone Fern, Boston Fern and Umbrella Trees. In these areas Camphor Laurel and Umbrella Trees are becoming increasingly common in the canopy.

Woodlands and forests w/ clay heath understorey generally have low weed density and diversity.

Weed density for each site in the study area is given in **Figures 4a & 4b**.

### **Restoration Approach**

An assisted regeneration approach is the main strategy for weed control and regeneration of the clay heath vegetation, although reconstruction using supplementary plantings and/or seed may be necessary in some small and very degraded areas. Bush regeneration is the rehabilitation of bushland from a weed infested or otherwise degraded plant community to a healthy community composed of native species (Buchanan 1989; BSC 2004). Bush regeneration typically relies on promoting natural regeneration through the natural germination and resprouting of plants, and focuses on weed removal, management of disturbance and maintenance of natural processes.

The regeneration approach used will generally be consistent with accepted standards in the industry locally and must include the standard 'Primary Weed Control', 'Follow-up Weed Control' and 'Maintenance' treatment stages and generally follow the weed control methods outlined in **Appendix B**. The regeneration approach outlined in this plan intentionally avoids being overly prescriptive, allowing for adaptive management. Although critical and priority actions are identified in the plan, specific technique, timing, priority and follow-up treatment will be at the discretion of the bush regeneration contractor supervising the specific site.

### **Special Considerations**

Two areas requiring special consideration have been identified and include:

1. The timing of weed control works with prescribed ecological burns; and
2. Management of Asset protection Zones

#### 1) Timing of Weed Control Works with Ecological Burns

The disturbance resulting from fire creates ideal opportunities for the increased establishment and spread of weeds within the recently burnt area. Following fire a diversity of weeds may emerge throughout the burn site, including in previously 'clean' areas. These include species arising from soil-stored seed (e.g. Bitou Bush), wind-blown seed (e.g. *Ageratina* spp.) and seeds transported by animals/humans (e.g. Farmer's Friends and tobacco Bush).

Accordingly, it is necessary to specifically coordinate weed treatments with prescribed ecological burns including:

- Primary and Follow-up treatment of all weeds within burn area before an ecological burn;
- Treatment of all weeds with easily transportable seeds (e.g. Farmer's Friends, Asteraceae family) adjacent to the burn area (especially within Adjacent APZs) immediately before an ecological burn; and
- Regular follow-up treatment throughout entire burn area and adjacent APZ until recovery of native ground cover.

Additionally, mesic pioneer species (e.g. *Macaranga* and *Commersonia*) may also commonly emerge following an ecological burn. These species should also be removed to prevent them displacing clay heath and other sclerophyll species. Mesic regeneration is most common around standing dead trees following a fire, and the collapsing to ground level of these branches can minimise perching opportunities for birds potentially carrying seed onto the site.

#### 2) Asset Protection Zones

Asset Protection Zones present special problems for weed management and regeneration as follows:

- *APZ's often require special vegetation management, as periodic slashing, reduced canopy cover and proximity to residential gardens create conditions which favour weed establishment and persistence.*
- *Restoration of the original vegetation type within APZs is not consistent with fuel minimisation requirements in these areas. In order to remain effective as fire breaks, the extent and volume of vegetation within APZ's must be maintained below specifications.*

The regular disturbance within an APZ favours weeds that pose a constant risk of colonising adjacent areas if not properly managed. In the short term, it is recommended that these areas be slashed at a frequency which suppresses seed set of weeds, and weeds which spread vegetatively be controlled along APZs as a priority. In the long term any regeneration efforts should favour the establishment of vegetation cover consisting of either:

- native groundcovers; or
- relatively benign and easily managed introduced ground covers

## AIM

By or before 2015, to have environmental weeds within the sites reduced to a level requiring minor maintenance weeding only.

---

## EXISTING SITUATION

Environmental weeds seriously threaten the high conservation vegetation of the sites.

Dumping of garden waste is an ongoing problem along all residential boundaries, with more than 40 sites of dumping observed.

Significant sources of weed seed and other propagules occur on neighbouring lands and contribute to the weed problems on the sites.

Conditions within existing APZs favour environmental weeds and require special management.

---

## GUIDELINES & POLICIES

*All bush regeneration works are to:*

- *be undertaken by suitably qualified and experienced bush regenerators.*
- *be undertaken by contractors holding a s.132C licence (National Parks and Wildlife Act) to work in TECs and threatened species habitat.*
- *comply with the 'NPWS checklist for bush regeneration in threatened species habitat or an endangered ecological community' (**Appendix C**).*

*Bush regeneration is to be coordinated with prescribed burning activities (DEC et. al. 2004) as follows:*

- *within proposed burn area, primary and follow-up treatments are to be completed before prescribed burn.*
- *follow-up weed treatment within burn area and adjacent APZ will be prioritised for the first 18 months following a prescribed burn.*

*Weed control needs to be undertaken carefully due to the sensitivity and high conservation value of the area (NPWS 2003).*

*All weed removal and site access are to avoid exacerbating erosion and the development of informal walking tracks.*

*Any informal tracks resulting from regeneration work within Clay Heath areas are to be concealed when work in the area is completed by lifting trampled vegetation and/or the placement of cut material (i.e. unwanted emergent species) along track lines.*

*In the season following a prescribed ecological burn, bush regeneration is to be avoided in Clay Heath during July – October to avoid damage to potentially emerging *Diuris byronensis*.*

---

## ACTIONS

Actions specific to each management zone are outlined in **Table 14**.

## 2. FIRE

**See also:** *Environmental weeds; Encroachment of Clay Heath by Fernland, Woodland and Forest and Neighbour Issues.*

---

### BACKGROUND INFORMATION

#### **Exclusion of Fire**

Fire is a natural part of the study area environment and is essential to the survival of its plant communities (Baker 1998, DEC et. al. 2004, DEC 2004). Importantly however, fire has been excluded from most sites for several decades and is resulting in significant modification of the natural vegetation communities present.

Many plant species found in heathland and taller sclerophyll communities require fire to stimulate flowering, seed release and germination, and maintain suitable habitat. Species that require fire to complete their life cycle are increasingly at risk of becoming extinct within the study area, and their loss is likely to change the floristic and structural composition of associated vegetation.

Additionally, low frequency fires allow heathland to be colonised by taller woodland and forest species (Specht & Morgan, 1981; Burrell, 1981; Keith et al. 2002a; Keith et al. 2002b). In the continued absence of fire the taller encroaching species will develop a stratum above, and ultimately displace, the original community if it cannot persist under the new canopy. DEC et al.(2004) state that too infrequent fire is posing a very high risk to the biodiversity values of the Clay Heath.

Within forests, fire is essential for maintaining sclerophyll dominance of canopies and understorey strata, and low frequency fires allow existing sclerophyll forest to be colonised by rainforest species (Floyd 1989; Keith 2004). In the prolonged absence of fire, the sclerophyll forest of the study area are rapidly being colonised by mesophyllous species, which are progressively displacing sclerophyllous species in all strata.

Excessive fire interval may also exacerbate the effects of environmental weeds, stormwater pollution, and soil disturbance. In all cases the prolonged absence of fire allows the persistence of the encroaching species originally facilitated by these other process.

The displacement of clay heathland by taller communities is occurring very rapidly, and threatening its extinction in the study area. For example, during the period between 1994 and 2007, displacement within the Arakwal NP had reduced graminoid clay heath by approx. 35.4% (Baker 2009).

The fire regimes within the study area have been dramatically altered due to their location within the surrounding residential development and the active suppression of fire within both the study area and adjacent lands. The fire strategy of this Plan aims to reinstate the pre-European fire regime of the study area through the application of prescribed burning within limits imposed by the small size, isolation and modified physical condition of the sites.

#### **Appropriate Frequency**

Contemporary ecological research in fire prone ecosystems has established broad principles about the fire regimes needed to avoid the extinction of species and inappropriate habitat modification. Recommended fire interval guidelines are outlined in Table 11.



**Table 11. Fire Interval Guidelines (adapted from NPWS 2002).**

These thresholds define a domain of “acceptable” fire intervals consistent with the maintenance of existing plant species. If the fire history of a site is such that over 50 % of any one vegetation formation falls outside of the appropriate domain, serious conservation consequences are predicted.

Vegetation type	Minimum interval	Maximum interval	Notes
Rainforest	n/a	n/a	Fire should be avoided
Saline wetland	n/a	n/a	Fire should be avoided
Wet sclerophyll forest	25	60	Crown fires should be avoided in the lower end of the interval range
Swamp sclerophyll forest	7	35	-
Shrubby dry sclerophyll forest	7	30	-
Heathland	7	30	-
Grassland	2	10*	Some intervals greater than 7 years should be included in coastal areas. There was insufficient data to give a definite maximum interval; available evidence indicates maximum intervals should be approximately 10 years.
Freshwater wetland	6	35	-

\* intervals given are tentative due to insufficient data.

Fire is not believed to have affected the vast majority of the study area for at least 30 years and possibly considerably longer (Laurence McCoy, Rural Fire Service, 2006, pers. comm., February). Accordingly, Table 11 indicates that the upper fire frequency threshold is exceeded for all vegetation types in the study area.

Importantly, the relatively high proportion of graminoid species within Clay Heath indicates that pre-European fire intervals may have been shorter than other heathland generally.

### ***Appropriate Intensity***

DEC et al. (2004) state that all the heath (Clay Heath), woodland and sclerophyll forest communities of the Paterson Hill area require the application of relatively high intensity fire to maintain biodiversity values.

Many shrub species exhibit heat stimulated germination and temperatures in low intensity fires may not be high enough to stimulate germination of some species (Auld and O’Connell 1991). Additionally, a low-intensity fire may not greatly affect some tree species (Gill et. al. 1999)(Keith et. al. 2002a), with intact canopies still restricting light reaching the ground within forest communities, and invading woodland trees persisting within heathland communities.

In fire prone vegetation, a fast hot fire is more desirable than a slow smoldering burn, as prolonged heat can eventually penetrate the soil and damage underground organs (Cropper 1993).

RFS (2006) list several factors that increase fire intensity, including:

- Increasing fuel availability
- Decreasing moisture content
- Increasing wind speed
- Decreasing atmospheric humidity
- Increasing slope (in direction of fire spread)

Accordingly, prescribed burning should aim to be applied in environmental conditions that facilitate the intensity and rate of spread required to achieve the desired biodiversity objectives, while insuring the adequate protection of life and property.

### ***Appropriate Season***

Wildfires most commonly occur when vegetation is at its driest (Cropper 1993). The peak fire season in subtropical eastern Australia is spring – early summer (Keith *et. al.* 2002a) and corresponds with the end of the areas winter/spring dry season. Rainfall reduces probability of fire after midsummer in northern NSW (Keith *et. al.* 2002a).

Although heathland has the capacity to carry fire throughout much of the year (Keith *et. al.* 2002a), heathland within the locality forms part of a complex mosaic of vegetation formations most of which have a reduced ability to carry fire during the wet season. Although fires originating within the heathland may occasionally occur outside the peak fire period, the majority of large scale wildfires are still believed to be limited to spring-midsummer.

Importantly, this coincides with the flowering/fruitlet season for *Diuris byronensis*, and any prescribed burn should preferably occur after flowering, to allow for a pre-burn survey for the presence of this species.

### ***Extent***

Fire management should aim to provide a pattern of fires of varied intensity, frequency and extent to maintain natural diversity. While it is unrealistic to provide the full mosaic of fire regimes within each individual site, the timing of any prescribed burns should be considered in the context of all other occurrences of clay heath in the area.

Importantly, many of the sites are small and isolated from adjacent areas of vegetation by roads and residential development. Although the sites are considered too small to provide a mosaic of fire regimes, prescribed burns should not affect the entire site in one event, but must maintain unburnt refuge areas for fire sensitive species to facilitate recolonisation of burnt areas following the burn.

---

## AIM

By or before 2015, to have undertaken prescribed ecological burns in 50% of management zones in the study area.

---

## EXISTING SITUATION

The upper fire frequency threshold is exceeded for the majority of vegetation in the study area with serious consequences for biodiversity conservation predicted (NPWS 2002).

Species that require fire to complete their life cycle are increasingly at risk of becoming extinct within the study area.

The prolonged fire interval is allowing woodland and forest species to colonise the Clay Heath, and mesic and weed species to colonise sclerophyll forest, leading to the ultimate displacement of clay heath within the study area.

The small size of the sites and their surrounding network of management tracks and public roads provide good access for control of prescribed burning activities.

There are currently no APZs within Paterson St. Water Tower or Clarkes Beach Crown Land, although they may be required in future.

---

## GUIDELINES

*Prescribed burning interval should aim for a diversity of age classes across the study area and entire clay heath distribution, and will be guided by the biodiversity thresholds as specified in Table 11.*

*Prescribed burns should NEVER be applied to an entire site in one event, but must maintain unburnt refuge areas for fire sensitive organisms to facilitate recolonisation of burnt areas following the burn.*

*Within the entire study area, at least one prescribed ecological burn should be implemented every year during the life of this plan to prevent irreversible vegetation change from prolonged fire interval.*

*Within limits imposed by maintaining safety to life and property, prescribed burning will be applied between spring - midsummer and under environmental conditions that allow an intensity and rate of spread required to achieve planned biodiversity objectives.*

*A small proportion of fires outside the abovementioned period should be trialled and the vegetation response monitored.*

*The negative impacts of any fire management activities on the vegetation of the study area will be minimised as far as possible, including the following:*

- *Avoid heavy machinery for fire suppression activities.*
- *Avoid the use of wetting agents and fire retardant.*
- *Access to areas of Clay Heath during prescribed burning activities should be avoided as far as possible. Any access should be limited to recognised tracks, or if necessary, limited to the area proposed for immediate burning.*
- *All fire management staff should undergo a site induction to ensure awareness of biodiversity values of the site and of appropriate behaviour to minimise damage to these values.*
- *Prescribed burning activities will be coordinated with Bush regeneration and weed control works.*

*Follow-up weed treatment in recently burnt areas and adjacent APZs will be prioritised for the first 18 months following a prescribed burn.*

*Fire management activities are to be undertaken in consultation with Department of Environment & Climate Change and Water and the Rural Fire Service and must consider the safety of visitors and neighbours.*

*Native vegetation should be encouraged throughout all APZs to avoid providing a corridor for weed dispersal.*

*Records of fire occurrences will be entered into a geographical information system, with particular emphasis on mapping and recording the extent, frequency, seasonality and intensity of fire.*

*Adjacent APZs should be slashed/mown immediately before prescribed burning.*

*Slash/mow APZ every 2 months between December-May and every 3 months between June – November to avoid weed seed set and dispersal.*

*All works other than habitat restoration (e.g. bushfire hazard reduction) are to be subject to the appropriate environmental impact assessment and approval processes.*

*In order to remain effective as fire breaks, the extent and volume of vegetation within APZ's must be maintained below specifications, and the restoration of the original vegetation type within these areas is therefore impractical.*

*Workers are prohibited from accessing the sites when bushfires are known to be active in the locality.*

---

## ACTIONS

Actions specific to each management zone are outlined in **Table 14**.

### 3. ENCROACHMENT OF CLAY HEATH BY FERNLAND, WOODLAND AND FOREST

*See also: Fire and Neighbour Issues*

---

#### BACKGROUND INFORMATION

##### **Introduction**

While the clay heath vegetation is subject to a number of threatening processes including environmental weeds, altered fire regime, stormwater pollution, erosion and visitor impacts, it is the encroachment by fernland, woodland and forest that is the most widespread and arguably the most significant process threatening the clay heath and its flora. This section provides a brief overview of the mechanisms of encroachment and its relationship to other threatening processes such as altered fire and hydrological regimes and soil disturbance. The role of each threatening process in encroachment of clay heath is discussed in more detail in the relevant management strategies.

Importantly, areas of woodland with clay heath understorey are believed to have formed part of the pre-European vegetation of the area, however environmental changes since European settlement have facilitated widespread expansion of woodland, forest and fernland.

Analysis of aerial photographs (1947, 1966, 1994 & 2007) indicates significant areas of Clay Heath are being displaced by vegetation changes resulting from past and present anthropogenic disturbance (See **Figure 7** below). The displacement of clay heathland by taller communities is occurring very rapidly, and threatening its extinction in the study area. For example, during the period between 1994 and 2007, displacement within the Arakwal NP had reduced graminoid clay heath by approx. 35.4% (Baker 2009).

While it is recognised that succession of low communities to woodland and forest may occur within natural systems, the vast majority of displacement within the study area is readily attributable to one or more of the following modern anthropogenic changes:

- excessive fire interval
- soil disturbance
- stormwater overflow

##### **Excessive Fire Interval**

Reduced fire frequency allows heathland areas to be colonised by taller woodland and forest species (Specht & Morgan, 1981; Burrell, 1981; Keith et. al. 2002a; Keith et. al. 2002b), and this is believed to be the primary factor responsible for the succession of clay heathland into woodland and forest. In the continued absence of fire, the taller encroaching species will develop a stratum above, and ultimately displace the original community if it cannot persist under the new canopy. The process of encroachment is further reinforced with prolonged fire interval as seed availability of encroaching species increases and the vegetation becomes more fire retardant.

Where seedling establishment and encroachment may have originally been facilitated by soil disturbance or stormwater pollution, the prolonged absence of fire allows the persistence of these encroaching species.

DEC (2004) list the invasion by sclerophyll woodland and mesic plant species due to prolonged fire interval as one of the main threats to Clay Heath.

##### **Soil Disturbance**

In areas of clay heath subject to past soil disturbance (e.g. old tracks), regrowth is often dominated by mixed tree species including *Melaleuca quinquenervia*, *Casuarina glauca*, *Banksia integrifolia*, *Lophostemon suaveolens*, *Lophostemon confertus*, *Acacia sophorae*, *Rhodomyrtus psidioides* and *Pittosporum undulatum*. It is believed the soil disturbance within the heathland creates niches for the establishment of emergent tree and shrub seedlings that are otherwise excluded.

The process is believed to be exacerbated by the prolonged absence of fire, which allows the persistence of the encroaching species, and is likely further accelerated by increased availability of water and nutrients within stormwater plumes.

This mixed regrowth is common along old and existing track alignments, hilltops (e.g. Clarkes Beach Crown Land and Honeysuckle Hill) and also on fill batters (e.g. around the water tower).

### **Stormwater Overflow**

Stormwater is contributing to the displacement of many areas of heathland within the study area. Aerial photograph interpretation clearly reveals that a plume of encroached/modified clay heath closely corresponds to all significant stormwater outfall points within clay heath areas including stormwater outlets, overflow discharge from the Paterson Hill Water Tower and backyard pools. The most rapidly displacing species is Coral Fern (*Gleichenia dicarpa*), although Broadleaved Paperbark (*Melaleuca quinquenervia*) and Swamp Box (*Lophostemon suaveolens*) are common encroaching tree species.

It is believed the increased water availability favours the encroaching species, however elevated nutrient levels may also play a role. The prolonged absence of fire exacerbates the process by allowing the persistence and further spread of the encroaching species, which would otherwise be limited by wildfire.

### **Successional Pathway**

Analysis of historical aerial photography and vegetation in the field indicates a typical successional pathway where these processes operate.

Typically, in the absence of fire, tree/shrub saplings which establish within the heathland develop a discontinuous, although recognisable, upper stratum to form a woodland canopy above the heath ground layer. Over time the woodland will continue to develop a more continuous forest canopy, and species in the heathy understorey will gradually decline in the modified conditions and without the regenerating effects of fire. As the forest canopy continues to develop, mesic species gradually colonise and begin to dominate the understorey. By this stage no, or very few, clay heath species persist in the shady conditions of the understorey. Although not yet observed, it is likely that in the continued absence of fire, mesic understorey species will gradually displace the sclerophyll species in all strata and ultimately develop into a closed rainforest community.

The stages in the typical successional pathway sequence include:

1. Heath
2. Sclerophyll woodland w/ heath understorey/indicators
3. Sclerophyll forest w/ heath understorey/indicators
4. Sclerophyll forest /w mesic understorey
5. Rainforest (*not observed but assumed likely in the continued absence of fire*)

The following variations have been observed:

- Coral Fern may partially or totally displace the heathy understorey at any stage
- In stormwater plumes Coral Fern often displaces clay heath directly before being colonised by swamp sclerophyll trees.
- Regrowth following large scale soil disturbance often bypass stages 1-3, usually commencing at stage 4.

### **Encroaching Species**

A number of species have been identified which commonly establish within clay heath, become emergent and ultimately outcompete underlying heath species. These species include:

- +*Acacia sophorae*
- +*Banksia integrifolia*
- +*Callitris* sp.
- +*Casuarina glauca*
- +*Commersonia bartramia*
- +*Glochidion sumatranum*
- +*Leptospermum polygalifolium*
- +*Lophostemon confertus*
- +*Lophostemon suaveolens*
- +*Macaranga tanarius*

- *Corymbia intermedia*
- *Elaeocarpus reticulatus*
- +*Gleichenia dicarpa*
- +*Glochidion ferdinandi*
- *Melaleuca quinquenervia*
- +*Pittosporum undulatum*
- +*Rhodomyrtus psidioides*
- +*Synoum glandulosum*

(Note: species marked with a '+' are *priority encroaching species* are not believed to occur naturally in clay heath vegetation. Unmarked species are believed to occur naturally as emergents or woodland canopy over clay heath vegetation, however will gradually displace clay heath species in the prolonged absence of fire)

### Restoration Approach

The primary strategy for restoration of encroached clay heath is the reinstatement, to the maximum extent possible, of pre-European fire and hydrological regimes.

However, while this is critical for the restoration of the ecological functioning and dynamics within the clay heath vegetation, it will not remove many of the encroaching trees and additional management intervention will therefore be required to revert these areas to clay heath vegetation.

Following prescribed burns or wildfire larger emergent trees are likely to survive and regenerate from epicormic or lignotuberous regrowth, or if some of their crown is above the scorch height of the fire (Gill *et. al.* 1999; Keith *et. al.* 2002a). Also, while removal of concentrated stormwater inputs will likely stop further associated encroachment, established trees will persist on the site. Accordingly, in areas where clay heath vegetation is to be restored, these emergent trees will need to be removed/treated manually.

Treatment of emergent trees will be undertaken progressively over time to slowly expand areas of clay heath and gradually shift the zonation of adjacent woodland and forest using the following approach:

1. Removal of all encroaching species (see list above) in areas mapped as clay heath
2. Expansion of mapped clay heath by removal of all encroaching species in a band of adjacent woodland/forest
3. Progressive removal of all priority encroaching species (see list above) from adjacent woodland and forest
4. Progressive thinning of existing woodland and forest by removal of encroaching species, particularly
5. Control of mesic species in all strata to minimise competition with sclerophyll species and avoid the development of fire resistant vegetation

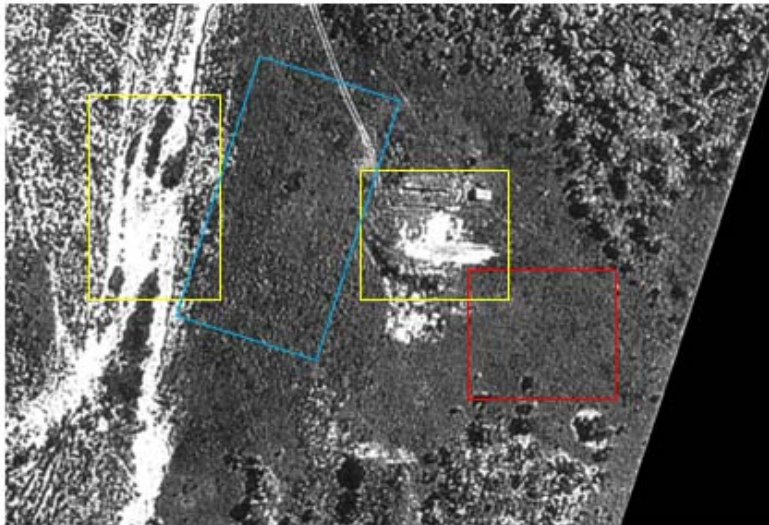
Importantly, the exact boundaries of the pre-European vegetation types are unclear, and were likely unfixed and migrated over time. Furthermore, the importance and relative abundance of related vegetation and ecotones (i.e. woodland/forest with clay heath understorey) is unknown. Accordingly, the restoration project will ensure that all known states of clay heath vegetation are represented in each contiguous block of vegetation occupied by a site.

Therefore, with regard to the relative extent of restored communities the project aims are as follows:

- to secure all existing areas of clay heath from further encroachment
- to reinstate a clay heath ground stratum to approx. 95% of the study area
- to expand clay heath to approx. 50% of the study area
- to retain woodland w/ clay heath understorey on approx. 30% of the study area
- to retain forest w/ clay heath understorey on approx. 15% of the study area
- to have clay heath on all sites adjoin ecotones of woodland w/ clay heath understorey

**Figure 6a & 6b** gives an indication of the desired extent of the different vegetation types within the sites.

**Figure 7. Mechanisms for Encroachment of Clay Heath by Fernland, Woodland and Forest**



**Northern slope of Honeysuckle Hill in 1966.**  
The 3 mechanisms of encroachment are highlighted by the rectangles: red (prolonged fire interval), blue (stormwater) and yellow (soil disturbance). Note areas of soil disturbance (white areas). The uniform grey texture is clay heath.



**Northern slope of Honeysuckle Hill in 1994.**  
Note: a) the regrowth of trees on areas of disturbed soil (yellow rectangles); b) the growth of trees and Coral Fern (bright green patches) in the stormwater plume (blue rectangle); c) trees emerging from undisturbed heathland in the prolonged absence of fire (red rectangle).



**Northern slope of Honeysuckle Hill in 2007.**  
Note: a) the continued develop of forest on areas of previously disturbed soil (yellow rectangles); b) the continued growth of trees and further rapid expansion Coral Fern (bright green patch) in the stormwater plume (blue rectangle); c) continued emergence and growth of trees in undisturbed heathland in the prolonged absence of fire (red rectangle).

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## AIMS

By or before 2015, to have:

- secured all existing areas of clay heath from further encroachment
- reverted some areas of woodland to clay heath in all sites
- reverted some areas of forest to woodland in all sites

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## EXISTING SITUATION

Encroachment by fernland, woodland and forest is rapidly displacing clay heath and is arguably the most significant process threatening the survival of clay heath.

Encroachment is facilitated by prolonged fire interval, soil disturbance and stormwater discharge.

The reinstatement of the pre-European fire and hydrological regimes is necessary to stop further encroachment of clay heath.

Many encroaching trees are too well established to be removed by reinstatement of pre-European fire and hydrological regimes alone and will need to be manually treated to reinstate the original clay heath.

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## GUIDELINES & POLICIES

*All Allocasuarina defungens are to be **RETAINED** during manual removed of emergent woodland/forest species.*

*Treatment of encroaching trees should be undertaken as follows:*

- *Before prescribed burns, targeted trees should be stem injected and left standing so as to avoid smothering underlying heath vegetation;*
- *After prescribed burns, targeted trees should be cut and paint to remove perching opportunities for birds dispersing seeds of mesic tree species and weeds.*

*The extent of restored vegetation structure will be guided by Figure 6.*

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## ACTIONS

Actions specific to each management zone are outlined in **Table 14**.



## 4. VISITOR IMPACTS

*See also:* -

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### BACKGROUND INFORMATION

Informal walking tracks were identified throughout areas of clay heathland including at Honeysuckle Hill, Paterson St/ Seaview St, Paterson Street South and Clarkes Beach Crown Land. These informal tracks cause erosion, introduce weeds and result in trampling of adjoining vegetation. Importantly, NPWS (2003) list erosion, fragmentation and disturbance caused by pedestrian tracks as one of the main threats to Clay Heath.

Any pedestrian traffic across the Clay Heath and adjacent woodlands, results in significant vegetation damage. Because the vegetation is dense and intertwined, visible tracks are left by the passage of only one person, and may persist for many months. These small tracks often attract more pedestrians, leading to yet further damage and informal track establishment.

It has been observed that pedestrians and cyclists will walk/cycle on low areas of vegetation adjacent to track to avoid bare earth in wet periods, with a resultant loss of vegetation and further widening of the track.

Morand (1994a) states that the clay soils of the study area are highly erodible and hence are extremely susceptible to disturbance. Minor to severe gullying is frequently observed on unpaved tracks around Paterson Hill.

While vegetation adjacent to many informal tracks continue to deteriorate with increasing usage, several old tracks have fallen into disuse and are now actively regenerating.

To address these issues walking tracks must be closed or formalised. Along closed tracks natural regeneration alone may be sufficient to achieve good vegetation cover. However, many areas have little or no remaining topsoil and are severely compacted, with limited natural regeneration occurring. In these areas, assisted regeneration techniques including deliberate soil disturbance, use of brush matting, direct seeding and transplanting may be necessary in difficult areas.

Squatting and illegal camping commonly occurs adjacent to Clarkes Beach Caravan Park. Although this issue affects relatively small areas, it is recognised to impact on threatened flora and the recovery of endangered ecological communities. Young plants are often removed at the time of campsite establishment and throughout the period of use. However, many squatters camps are abandoned, and the remaining tents and tarpaulins ultimately collapse to the ground, where they may suppress regeneration for many years.

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### AIMS

By or before 2015 to have:

- all major walking tracks in Paterson Street South and Honeysuckle Hill formalised and associated erosion and vegetation damage controlled;
- all other informal tracks closed and their revegetation commenced; all areas of gully erosion within the study area stable and safe from further erosion and their revegetation commenced; and
- squatting and illegal camping no longer occurring in any sites.

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### EXISTING SITUATION

The informal track network throughout the study area results in significant vegetation damage through increasingly severe erosion and trampling of vegetation.

Squatting and illegal camping commonly occurs adjacent to Clarkes Beach Caravan Park, damaging understorey vegetation and suppressing regeneration.

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### GUIDELINES

*Any erosion rehabilitation work will be in a manner which when carried out will not threaten vegetation values of the sites.*

*To the greatest extent possible, any earthworks undertaken to mitigate erosion will utilise local, lithologically similar materials and will be designed and undertaken in a manner which minimises soil erosion and incorporates soil conservation principles.*

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#### ACTIONS

Actions specific to each management zone are outlined in **Table 14**.

## 5. NEIGHBOUR ISSUES

*See also: Environmental Weeds and Fire*

### BACKGROUND INFORMATION

#### **General**

Building, maintaining and enhancing constructive relationships with neighbours based on mutual respect and trust is critical if the BSC is to achieve its conservation objectives. Neighbours who share a common boundary with the sites include private landholders, the Department of Environment Climate Change and Water, the North Coast Holiday Parks Trust (Clarkes Beach Caravan Park) and Rous Water.

Issues arising from adjacent lands include: environmental weeds; landscaping, mowing and inappropriate planting encroachments along residential boundaries; private informal walking tracks; clearing for views; and stormwater runoff.

#### **Stormwater**

Stormwater is facilitating the displacement of many areas of clay heath within the study area. Aerial photograph interpretation clearly reveals the displacement of heathland by Coral Fern (*Gleichenia dicarpa*) and Broadleaved Paperbark (*Melaleuca quinquenervia*) within stormwater outfall plumes around Paterson and Honeysuckle Hills. It is believed the increased water availability favours the encroaching species, however elevated nutrient levels may also play a role. The prolonged absence of fire exacerbates the process by allowing the persistence and further spread of the encroaching species, which would otherwise be controlled by wildfire.

Stormwater pollution sources within the study area are outlined in **Table 12**.

**Table 12. Stormwater pollution sources and affected sites.**

Source	Sites Affected
<b>Runoff from Roads</b>	Paterson St/Seaview St Paterson Hill South West of Paterson Street
<b>Pools</b>	Honeysuckle Hill Paterson St/Seaview St
<b>Paterson Hill Water Tower</b>	West of Paterson Hill Paterson Hill Water Tower

Additional issues with stormwater includes exacerbation of gully and sheet erosion and the transport of weed propagules.

#### **Environmental Weed Sources**

Neighbouring lands contribute a significant source of weeds in the study area through direct dumping of garden wastes or dispersal from mature parent plants occurring adjacent to the sites.

The dumping of garden waste is a serious issue threatening the vegetation of the study area. A high incidence of dumping was observed on all site boundaries. The number and distribution of dumping sites correlates closely with neighbouring properties and suggests the majority of neighbours are involved in dumping.

Many environmental weeds on the sites are actively dispersing onto the sites from neighbouring properties. Birds appear to be the main dispersal agent bringing new material onto the sites, with weeds including (*Cinnamomum camphora*), Mickey Mouse Plant (*Ochna serrulata*), Brazilian Pepper Tree (*Schinus terebinthifolius*), Winter Senna (*Senna pendula* var. *glabra*) and Coralberry (*Ardisia crenata*).

### **Boundary Encroachment**

The position of land parcel boundaries with residential properties is poorly defined and encroachments exist in most sites. These encroachments displace native vegetation, hinder the establishment and management of APZs and may result in the application of inappropriate vegetation management (e.g. lawn establishment, planting of ornamentals, fertiliser use, excessive watering) by neighbours within site boundaries.

### **Dumping (other than garden waste)**

The dumping of construction fill and other waste materials is also relatively common along site boundaries. Dumped fill threatens vegetation through direct damage to existing plants, smothering of the soil seed bank, elevated nutrients and may contain seed and other propagules of environmental weeds. The dumping of construction materials was commonly observed adjacent to Clarkes Beach Caravan Park. This results in direct damage to existing plants, smothering of the soil seed bank, and reduces accessibility for bush regeneration works.

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### AIMS

By or before 2015, to have:

- Removed or resolved all encroachments on the sites;
- Identified and addressed all significant sources stormwater discharge into the sites;
- The level of dumping reduced to a manageable level; and
- A majority of site neighbours understand and act sympathetically toward vegetation management on the sites.

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### EXISTING SITUATION

Garden dumping is widespread, currently active, and appears to involve a significant proportion of neighbouring residents.

The dumping of construction fill and waste building materials is occurring in many sites.

The largest source of environmental weeds is from dumped garden waste and bird-dispersed seed originating from neighbouring properties.

Stormwater discharge from neighbouring properties is causing erosion and facilitating the spread of weeds, and facilitating the encroachment/displacement of Clay heath by Coral Fern.

Inappropriate vegetation management by neighbours within site boundaries is displacing native vegetation on many sites.

Tree lopping for view enhancement is occurring along Paterson Street.

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### GUIDELINES

*The following activities are prohibited on the sites:*

- *Dumping of any rubbish or other material;*
- *Unauthorised damage or removal of any vegetation; and*
- *Planting of ornamental plants.*

*Planting on the sites:*

- *is to be coordinated by the BSC;*
- *shall be limited to areas mapped as 'highly modified' vegetation only (see **Figures 2a & 2b**) and, within these areas, only where natural regeneration is found to be significantly limited by past disturbances including topsoil loss and soil compaction; and*

- *must only use propagules derived from immediately local populations of native species and sourced from clay heath related vegetation.*

*Resolution of neighbour issues will favour approaches that promote understanding and encourage respect for the site's values over strict regulation and enforcement.*

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## ACTIONS

Actions specific to each management zone are outlined in **Table 14**.

### 3. CONSIDERATION OF ALTERNATIVES

Available management options and the likely vegetation response to these are compared in **Table 13**.

**Table 13. Assessment of various management options and predicted vegetation response (preferred option is highlighted).**

Management Option	Likely Vegetation Response	Predicted Long Term Vegetation Composition
<b>Do nothing</b>	<p>If no management actions are undertaken, the process of encroachment and mesic shift will continue.</p> <p>The displacement of clay heath will continue and the resulting forest will rapidly shift to a mesic forest and ultimately closed rainforest.</p> <p>This shift is likely to result in the localised extinction of clay heath and its associated flora and fauna, including extinction of <i>Diuris byronensis</i> and <i>Allocasuarina defungens</i>. Environmental weeds will continue to increase in abundance and diversity and are likely to displace many native species in all strata.</p>	All sites are likely to be dominated by degraded mixed species closed forest with a high proportion of environmental weeds.
<b>Treat Environmental Weeds Only</b>	<p>While the removal of environmental weeds will remove this competitive pressure for native species, in the absence of fire, the displacement of clay heath by native trees and tall shrubs will continue and the resulting forest will gradually shift to closed forest. This shift will likely result in the localised extinction of clay heath and its associated flora and fauna, including extinction of <i>Diuris byronensis</i> and <i>Allocasuarina defungens</i>.</p> <p>Importantly, closed forest (including littoral rainforest) is already well represented in the adjacent Arakwal National Park and Cape Byron State Recreation Area and elsewhere in the region, whereas these sites contain approx. 37% of all known Byron Clay Heath vegetation.</p>	All sites are likely to be dominated by high quality, but fragmented, closed forest, although at the expense of the localised extinction of clay heath and associated species.
<b>Reinstate Fire Regime Only</b>	<p>While this option may stabilise the encroachment process and maintain the existing distribution of clay heath and associated woodland and forest vegetation, the post fire environment encourages weed establishment and spread. It is likely that weeds including Singapore Daisy, <i>Watsonia</i>, <i>Ochna</i> and Bitou Bush (as soil stored seed) would likely survive fire events and increase in distribution and abundance throughout the sites and may progressively displace the clay heath ground stratum. Additionally, weed and mesic native tree species such as Camphor Laurel,</p>	The clay heath understorey is likely to be degraded and potentially displaced by severe weed infestation. Persistence of mesic and weed tree species after fire will lead to mesic closed forest with a high proportion of environmental weeds.

Management Option	Likely Vegetation Response	Predicted Long Term Vegetation Composition
	<p>Macaranga, Commersonia area also likely to displace clay heath understorey in between fire events, especially when fire interval is as high as 15 years. Although unclear, some mesic species and Camphor Laurel may be able to survive fire after a fire interval of 15 years (especially given the difficulty of achieving hot fires in the urban context) and ultimately dominate the site and displace the clay heath values.</p>	
<p><b>Manual Treatment of Encroaching Species Only</b></p>	<p>While this option is likely to increase the distribution of clay heath and clay heath woodland, the floristic composition of the clay heath is likely to change over time as a significant number of clay heath species require fire for critical life cycle stages including one or more of flower initiation, seed release, germination and/or seedling establishment. While the ultimate floristic composition is unknown, it is likely that many clay heath species would become locally extinct on the sites.</p>	<p>Increased area of clay heath and associated woodland, but with reduced floristic diversity and localised extinction of component clay heath flora species.</p>
<p><b>Treat Environmental Weeds &amp; Reinstate Fire Regime &amp; Manual Treatment of Encroaching Species</b> <i>(preferred option)</i></p>	<p>This option is likely to remove the competitive pressures from environmental weeds and thereby allow the persistence of all clay heath species. Reinstatement of the pre-European fire regime will facilitate the continued recruitment and regeneration of all clay heath species, and suppress persistence of encroaching woodland and forest species. Manual treatment of encroaching species will increase the extent of clay heath and associated woodlands, and also suitable habitat for associated species including <i>Diuris byronensis</i> and <i>Allocasuarina defungens</i>.</p>	<p>High quality mosaic of clay heath and associated woodland/forest throughout all sites.</p>

## 4. IMPLEMENTATION SCHEDULE

### 4.1 Introduction

To facilitate the implementation of this plan, the sites have been divided into management zones (**Figures 6a & 6b**).

Relative priorities for identified activities are set out in the table below. These priorities are subject to the availability of resources.

The environmental impact of proposed activities will be assessed at all stages in accordance with established environmental assessment procedures. Where the potential impacts of a proposed activity are found to be unacceptable, the activity may be modified or rejected.

This plan of management will stay in force until amended or replaced. Implementation of the plan will be monitored and its success in achieving the identified objectives will be annually assessed.

As a guide to the orderly implementation of this plan, actions identified in this plan are prioritised within the following categories:

- |                     |  |
|---------------------|--|
| <b>VH</b> Very High | Urgent actions required to address immediate threats to the biodiversity values of the site  |
| <b>H</b> (high)     | Actions that are imperative to achievement of the objectives of this plan. They must be undertaken in the near future to avoid significant deterioration in vegetation values. |
| <b>M</b> (medium)   | Actions that are necessary to achieve the objectives of this plan but are less urgent.   |



**Table 14. Implementation Schedule**

(Abbreviations: Bush Regeneration Contractor (BRC), Byron Shire Council Department (BSCD), Bush Futures Project Officer (BFPO), Rural fire Service (RFS), North Coast Holiday Parks (NCHP), Paterson Street Hilltop Reserve Trust (PSHRT).

Action Number	Zone	Action	Priority	Resp.
<b>GENERAL</b>				
GEN01	<b>All zones</b>	Prepare educational material for residents outlining values and threatening processes associated with Clay Heath sites. Management issues addressed should include the following as a minimum: weed invasion, fire management, stormwater pollution, informal tracks, APZ management	H	BFPO
GEN02	<b>All zones</b>	Investigate rezoning all land parcels for 'Environmental Protection' to reflect high conservation value vegetation on the sites.	H	BSCD
GEN03	<b>All zones</b>	Remove or resolve all encroachments	H	BFPO
<b>HONEYSUCKLE HILL</b>				
HS01	<b>Zone 1</b>	Treat all weeds (e.g. annuals, Inkweed, Tobacco Bush, Winter Senna and Bitou Bush) and mesic native species (e.g. Commersonia, Macaranga, Synoum) throughout recently burnt areas.	VH	BRC
HS02	<b>Zone 1</b>	Treat all weeds (e.g. Mist Flower, Crofton Weed, perennial grasses) immediately below houses at top of slope	VH	BRC
HS03	<b>All zones</b>	Secure all areas of mapped clay heath by stem injecting all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> )	VH	BRC
HS04	<b>Zone 2 &amp; 3</b>	Spray all Coral Fern in areas currently mapped as woodland or heath within zones	VH	BRC
HS05	<b>Zone 1</b>	Identify all sources of pool discharge and excessive stormwater pollution onto site and take steps to address	VH	BFPO
HS06	<b>All zones</b>	Expand areas of mapped clay heath by stem injecting all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ) from adjacent woodland in a band c.10 wide from existing clay heath boundary, favouring removal of the largest individuals where possible	H	BRC
HS07	<b>All zones</b>	Thin existing woodland areas by stem injecting c. 50% of all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ), prioritising the largest individuals where appropriate	H	BRC
HS08	<b>All Zones</b>	Treat all mesic tree species occurring in the understorey of vegetation types 1-4 including the following: <i>Macaranga tanarius</i> , <i>Commersonia bartramia</i> , <i>Synoum glandulosum</i> , <i>Cupaniopsis anacardioides</i> , <i>Cryptocarya triplinervis</i> , <i>Pittosporum undulatum</i> , <i>Acronychia imperforata</i> , <i>Archontophoenix cunninghamia</i> .	H	BRC

Action Number	Zone	Action	Priority	Resp.
HS09	<b>Zone 1</b>	Undertake maintenance works on walking track between zone 1 and 2 to prevent further erosion (e.g. installation of water bars)	H	BRC
HS10	<b>Zone 2</b>	Investigate options for realigning walking track (currently between zone 2 and 3) to minimise erosion	H	BFPO
HS11	<b>Zone 2</b>	Treat Madeira Vine, Singapore Daisy and other weeds along western boundary	H	BRC
HS12	<b>All Zones</b>	Treat all Boston Fern, Fishbone Fern, Furcraea, Camphor Laurel, Umbrella Trees and other weeds along lowermost edge.	M	BRC
HS13	<b>All Zones</b>	Continue to progressively shift vegetation toward desired state in Figures 6a & 6b by process of expanding clay heath thinning adjacent woodland and forest	M	BRC
HS14	<b>All zones</b>	Resolve/remove encroachments through negotiation with neighbours, including Shed and landscaping in Zone 3 and landscaping in Zone 2	M	BSCD
HS15	<b>Zone 2 &amp; 3</b>	Undertake prescribed ecological burn in zones 2 & 3. Ensure burn coordinated with overall mosaic approach for all clay heath areas.	M	RFS
HS16	<b>All zones</b>	Remove all dumped rubbish, garden waste and building materials from site. Any dumped inert organic matter or local rock/soil may be respread thinly so as not to suppress natural regeneration.	M	BRC
<b>Paterson Hill South</b>				
PHS01	<b>Zone 1</b>	Secure all areas of mapped clay heath by stem injecting all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> )	VH	BRC
PHS02	<b>Zone 1</b>	Spray all Coral Fern	VH	BRC
PHS03	<b>Zone 3</b>	Remove all non-indigenous/inappropriate planted native trees and shrubs from southern end of APZ, including <i>Corymbia maculata</i> and <i>E. robusta</i>	VH	BRC
PHS04	<b>Zone 3</b>	Resolve/remove encroachments through negotiation with neighbours, including plantings, garden furniture and mowing of APZ.	VH	BSCD
PHS05	<b>Zone 3</b>	Treat Singapore Daisy, Watsonia, Fishbone Fern and Whiskey Grass within and adjacent to APZ	VH	BRC
PHS06	<b>All Zones</b>	Treat all mesic tree species occurring in the understorey of vegetation types 1-4 including the following: <i>Macaranga tanarius</i> , <i>Commersonia bartramia</i> , <i>Synoum glandulosum</i> , <i>Cupaniopsis anacardioides</i> , <i>Cryptocarya triplinervis</i> , <i>Pittosporum undulatum</i> , <i>Acronychia imperforata</i> , <i>Archontophoenix cunninghamia</i> .	H	BRC
PHS07	<b>Zone 3</b>	Treat perennial grasses, annuals and Lantana along road verge with Paterson Street	H	BRC
PHS08	<b>All Zones</b>	Undertake prescribed ecological burn in all areas to west of main walking track between Paterson Street and Pacific Vista Drive. Ensure burn coordinated with overall mosaic approach for all clay heath	H	RFS

Action Number	Zone	Action	Priority	Resp.
		areas.		
PHS09	<b>Zone 1 &amp; 2</b>	Expand areas of mapped clay heath by stem injecting all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ) from adjacent woodland in a band c.3 wide from existing clay heath boundary, favouring removal of the largest individuals where possible	H	BRC
PHS10	<b>Zone 2</b>	Thin existing woodland areas by stem injecting c. 50% of all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ), favouring removal of the largest individuals where possible	H	BRC
PHS11	<b>All Zones</b>	Continue to progressively shift vegetation toward desired state in Figures 6a & 6b by process of expanding clay heath thinning adjacent woodland and forest	M	BRC
PHS12	<b>Zone 3</b>	Progressively remove mesic overstorey species (Native Guava) in area of mixed regrowth adjacent to Paterson Street in order to encourage establishment of more sclerophyll species. Some supplementary planting may be necessary achieve appropriate vegetation cover.	M	BRC
PHS13	<b>All Zones</b>	Remove all dumped rubbish, garden waste and building materials from site. Any dumped inert organic matter or local rock/soil may be respread thinly so as not to suppress natural regeneration.	L	BRC
<b>Clarkes Beach Crown Land</b>				
CB01	<b>Zone 2 &amp; 3</b>	Install fence along boundary of caravan park in Zones 2 & 3 to prevent informal pedestrian traffic through clay heath areas	VH	NCHP
CB02	<b>All zones</b>	Secure all areas of mapped clay heath by stem injecting all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> )	VH	BRC
CB03	<b>Zone 1 &amp; 2</b>	Spray all Coral Fern	VH	BRC
CB04	<b>Zone 1 &amp; 3</b>	Expand areas of mapped clay heath by stem injecting all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ) from adjacent woodland in a band c.5 wide from existing clay heath boundary, favouring removal of the largest individuals where possible	VH	BRC
CB05	<b>Zone 1 &amp; 3</b>	Thin existing woodland areas by stem injecting c. 70% of all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ), prioritising the largest individuals where appropriate	VH	BRC
CB06	<b>Zone 2</b>	Expand areas of mapped clay heath by stem injecting all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ) in areas mapped as woodland throughout zone	VH	BRC
CB07	<b>All zones</b>	Treat all environmental weeds on site boundary for all zones	VH	BRC
CB08	<b>All Zones</b>	Treat all mesic tree species occurring in the understorey of vegetation types 1-4 including the following: <i>Macaranga tanarius</i> , <i>Commersonia bartramia</i> , <i>Synoum glandulosum</i> , <i>Cupaniopsis anacardioides</i> , <i>Cryptocarya triplinervis</i> , <i>Pittosporum undulatum</i> , <i>Acronychia imperforata</i> , <i>Archontophoenix cunninghamia</i> .	H	BRC

Action Number	Zone	Action	Priority	Resp.
CB09	<b>Zone 2 &amp; 3</b>	Undertake prescribed ecological burn in zone 2 and 3. Ensure significant proportion of <i>Lindsaea ensifolia</i> is protected from fire and monitor impact of fire on effected plants. Ensure burn coordinated with overall mosaic approach for all clay heath areas.	VH	RFS
CB10	<b>Zone 1 &amp; 4</b>	Undertake prescribed ecological burn in zone 1 & 4. Ensure burn coordinated with overall mosaic approach for all clay heath areas including waiting at least 2 years after burning zones 2 & 3.	M	RFS
CB11	<b>All Zones</b>	Undertake annual density mapping of <i>Lindsaea ensifolia</i> subsp. <i>ensifolia</i> to determine rate of spread and competitiveness	M	BRC
CB12	<b>All Zones</b>	Continue to progressively shift vegetation toward desired state in Figures 6a & 6b by process of expanding clay heath thinning adjacent woodland and forest	M	BRC
CB13	<b>All Zones</b>	Remove all dumped rubbish, garden waste and building materials from site. Any dumped inert organic matter or local rock/soil may be respread thinly so as not to suppress natural regeneration.	L	BRC
<b>Paterson Hill Watertower</b>				
PSW01	<b>Zone 1</b>	Treat <i>Watsonia</i> , Slash Pine and other weeds along eastern edge	VH	BRC
PSW02	<b>Zone 1</b>	Secure all areas of mapped clay heath by stem injecting all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> )	VH	BRC
PSW03	<b>Zone 2</b>	Treat all <i>Watsonia</i> adjacent to Paterson Street road verge	VH	BRC
PSW04	<b>Zone 1</b>	Expand areas of mapped clay heath by stem injecting all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ) from the area of adjacent woodland between Paterson Street and a roughly north-south line projected from the centre of the water tower, favouring removal of the largest individuals where possible	VH	BRC
PSW05	<b>Zone 4</b>	Block opening adjacent to south-eastern edge of zone (created by removal of car body) with cut branches of Swamp Oak or other suitable trees	VH	BRC
PSW06	<b>Zone 1</b>	Spray all Coral Fern in areas currently mapped as woodland or heath within zone	VH	BRC
PSW07	<b>Zone 2</b>	Treat <i>Ochna</i> , Winter Senna, Camphor Laurel, Umbrella Trees and other weeds along eastern edge	H	BRC
PSW08	<b>Zone 3</b>	Remove all trees including Planted Eucalyptus species, <i>Westringia</i> , Coast Banksia, Swamp Oak, Umbrella Trees, Camphor Laurel from around Water Tank	H	BRC
PSW09	<b>Zone 4</b>	Treat Singapore Daisy and <i>Watsonia</i> throughout zone	H	BRC
PSW10	<b>Zone 1</b>	Thin existing woodland areas by stem injecting c. 50% of all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ), favouring removal of the largest individuals where possible	H	BRC
PSW11	<b>Zone 1 &amp; 2</b>	Undertake prescribed ecological burn. Ensure burn coordinated with overall mosaic approach for all	H	RFS

Action Number	Zone	Action	Priority	Resp.
		clay heath areas. Ensure infrastructure associated with water tower considered in fire planning.		
PSW12	<b>All Zones</b>	Treat all mesic tree species occurring in the understorey of vegetation types 1-4 including the following: <i>Macaranga tanarius</i> , <i>Commersonia bartramia</i> , <i>Synoum glandulosum</i> , <i>Cupaniopsis anacardioides</i> , <i>Cryptocarya triplinervis</i> , <i>Pittosporum undulatum</i> , <i>Acronychia imperforata</i> , <i>Archontophoenix cunninghamia</i> .	H	BRC
PSW13	<b>Zone 1</b>	Thin existing forest areas immediately north west of water tower by stem injecting c. 70% of all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ), favouring removal of the largest individuals where possible.	H	BRC
PSW14	<b>Zone 4</b>	Treat Swamp Oak, Cadaghi, Ochna, Winter Senna, Camphor Laurel, Umbrella Trees and other weeds along eastern edge	M	BRC
PSW15	<b>All Zones</b>	Continue to progressively shift vegetation toward desired state in Figures 6a & 6b by process of expanding clay heath thinning adjacent woodland and forest	M	BRC
PSW16		Remove all dumped rubbish, garden waste and building materials from site. Any dumped inert organic matter or local rock/soil may be respread thinly so as not to suppress natural regeneration.	L	BRC
<b>Paterson Street East</b>				
PSE01	<b>Zone 1</b>	Treat all Whiskey Grass, Kikuyu, annuals and planted Lomandra etc. within zone	VH	BRC
PSE02	<b>All Zones</b>	Spray all Coral Fern	VH	BRC
PSE03	<b>All Zones</b>	Expand areas of mapped clay heath by stem injecting all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ) throughout zone	VH	BRC
PSE04	<b>Zone 2</b>	Treat all weeds within zone 2	VH	BRC
PSE05	<b>All Zones</b>	Undertake prescribed ecological burn. Ensure burn coordinated with overall mosaic approach for all clay heath areas.	H	RFS
PSE06	<b>All zones</b>	Place markers to limit extent of mowing adjacent to APZ	H	BRC
<b>West Paterson Hill</b>				
WPH01	<b>Zone 1</b>	Treat Singapore Daisy, Watsonia and Nephrolepis throughout zone	VH	BRC
WPH02	<b>Zone 1</b>	Spray all Coral Fern in areas currently mapped as woodland.	VH	BRC
WPH03	<b>Zone 2</b>	Commence regular maintenance slashing/brushcutting of APZ understorey	VH	BSCD
WPH04	<b>Zone 1</b>	Thin existing woodland areas by stem injecting c. 30% of all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ), favouring removal of the largest individuals where possible	H	BRC

Action Number	Zone	Action	Priority	Resp.
WPH05	<b>Zone 2</b>	Treat Singapore Daisy, Watsonia and Nephrolepis throughout zone	H	BRC
WPH06	<b>Zone 2</b>	Treat all weeds within zone including S&P Ochna, C&P Winter Senna, Lantana, Rhaphiolepis etc, Stem inject all Camphor and Umbrella Trees.	H	BRC
WPH07	<b>All Zones</b>	Undertake prescribed ecological burn. Ensure burn coordinated with overall mosaic approach for all clay heath areas.	H	RFS
WPH08	<b>All Zones</b>	Treat all mesic tree species occurring in the understorey of vegetation types 1-4 including the following: <i>Macaranga tanarius</i> , <i>Commersonia bartramia</i> , <i>Synoum glandulosum</i> , <i>Cupaniopsis anacardioides</i> , <i>Cryptocarya triplinervis</i> , <i>Pittosporum undulatum</i> , <i>Acronychia imperforata</i> , <i>Archontophoenix cunninghamia</i> .	H	BRC
WPH09	<b>Zone 1</b>	Create small patch of clay heath c. 20m in south-western corner of zone by stem injecting all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ) from existing woodland. Maintain at least 5m buffer from existing weedy areas or road fill batters.	M	BRC
WPH10	<b>Zone 1</b>	Thin existing forest within zone by stem injecting c. 30% of all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ), favouring removal of the largest individuals where possible.	M	BRC
WPH11	<b>All Zones</b>	Continue to progressively shift vegetation toward desired state in Figures 6a & 6b by process of expanding clay heath thinning adjacent woodland and forest	M	BRC
WPH12	<b>All Zones</b>	Remove all dumped rubbish, garden waste and building materials from site. Any dumped inert organic matter or local rock/soil may be respread thinly so as not to suppress natural regeneration.	L	BRC
<b>Paterson Street/Seaview Street</b>				
PSS01	<b>Zone 2</b>	Treat Watsonia, Senna, Ochna, Camphor and other weeds in Zone 2	VH	BRC
PSS02	<b>Zone 2</b>	Secure and expand on existing clay heath by C&P of all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ) upslope of the Browning Street entrance to the Browning Street - APZ walking track.	VH	BRC
PSS03	<b>Zone 2</b>	Spray all Coral Fern in Zone 2	VH	BRC
PSS04	<b>Zone 1 &amp; 2</b>	Close informal track between zone 1 & 2, undertake erosion management works and track rehabilitation	VH	PSHRT
PSS05	<b>Zone 2</b>	Undertake prescribed ecological burn in zone 2. Ensure burn coordinated with overall mosaic approach for all clay heath areas.	VH	RFS
PSS06	<b>Zone 1</b>	Undertake prescribed ecological burn in southern half of zone 1. Ensure burn coordinated with overall mosaic approach for all clay heath areas.	VH	RFS
PSS07	<b>All Zones</b>	Treat all mesic tree species occurring in the understorey of vegetation types 1-4 including the following: <i>Macaranga tanarius</i> , <i>Commersonia bartramia</i> , <i>Synoum glandulosum</i> , <i>Cupaniopsis anacardioides</i> ,	VH	BRC

Action Number	Zone	Action	Priority	Resp.
		<i>Cryptocarya triplinervis</i> , <i>Pittosporum undulatum</i> , <i>Acronychia imperforata</i> , <i>Archontophoenix cunninghamia</i> .		
PSS08	<b>Zone 2</b>	Thin existing woodland and forest areas downslope of the Browning Street entrance to the Browning Street - APZ walking track by C&P of c. 50% of all encroaching trees and tall woody shrubs (except <i>Allocasuarina defungens</i> ), prioritising the largest individuals where appropriate	VH	BRC
PSS09	<b>Zone 1</b>	Identify all sources of pool discharge and excessive stormwater pollution onto site and take steps to address	H	BFPO
PSS10	<b>Zone 1</b>	Thin existing woodland areas by C&P of c. 50% of all emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ), prioritising the largest individuals where appropriate	H	BRC
PSS11	<b>Zone 2</b>	The formalising of the walking track linking Browning and Seaview Streets will be investigated and implemented with the assistance of Byron Shire Council.	H	BFPO
PSS12	<b>Zone 1</b>	Expand existing woodland by C&P of 50% emergent trees and woody shrubs (except <i>Allocasuarina defungens</i> ) from adjacent forest in a band c.10 wide from existing woodland / clay heath boundary, favouring removal of the largest individuals where possible	M	BRC
PSS13	<b>All Zones</b>	Continue to progressively shift vegetation toward desired state in Figures 6a & 6b by process of expanding clay heath thinning adjacent woodland and forest	M	BRC
PSS14	<b>All Zones</b>	Remove all dumped rubbish, garden waste and building materials from site. Any dumped inert organic matter or local rock/soil may be respread thinly so as not to suppress natural regeneration.	L	BRC

## 4.2 Resources for Implementation

The estimated person days required to complete on-ground tasks within each site are outlined in **Table 15**.

**Table 15. Estimated person days required to complete on-ground tasks within each site.**

Site Name	Primary Work	Secondary Work	Total
Honeysuckle Hill	40	17	57
West of Paterson Hill	35	9	44
Paterson Street Watertower	22	14	36
Paterson St/Seaview St	20	12	32
Paterson Hill South	12	18	30
Clarkes Beach Crown Land	7	11	18
Paterson Street East	3	4	7
	139	85	224

## 4.3 Monitoring and Reporting

### Overview

Monitoring for the Bush Futures Project will be based on the bushland health rating system developed as part of the initial auditing process. A rapid assessment of site attributes (e.g. structural composition, habitat features, weed density, weed severity and threats) is to be conducted using a scoring system. Scores for each attribute are combined to give an overall rating on bushland health. Monitoring over time will indicate if management activities are having a positive impact on bushland health resulting in a higher score for a site.

Reporting on the progress of the RMP is required to demonstrate that the restoration project is achieving its aims and objectives.

Monitoring and reporting is to be undertaken by a suitably qualified person.

### Monitoring and Evaluation Proforma

Monitoring for each site will require completion of a Monitoring and Evaluation Proforma (see **Appendix F**) for **each management zone** within a site. A guide to completing the data sheet is provided as **Appendix G**.

### Photo points

In addition to completion of a monitoring and evaluation proforma, photo points must be established in **each management zone** of a site.

Photos must be undertaken as follows:

- For each photo point contractors must record relevant photo point number(s) and unique site identification, photo direction- facing information and GPS co-ordinates (easting and northing) on the monitoring and evaluation proforma.
- Photo point locations must be marked using a star-picket with flagging tape tied to the top
- The star-picket must be located in a similar location for each photo to provide a reference point.



- Photos should be taken at the same time of the day each time
- The camera lens, angle and height should be the same for each photo.

### **Frequency**

Monitoring is to be undertaken as follows:

- Initial baseline monitoring before work commences
- Annual monitoring for progress reporting
- At the completion of work contract as part of final report.

## **4.4 Reporting**

Progress reports are to be submitted to Byron Shire Council annually and are to include:

- A summary of works completed by management zone (including all information recorded on Daily Record sheets);
- Progress of the Implementation Schedule;
- Monitoring results;
- Any adaptive management approaches used or proposed and resulting changes in the Implementation Schedule;
- Progress of ongoing site management issues;
- Any records of threatened flora and fauna species; and
- Recommendations regarding the ongoing management of the site.
- Rapid Assessment data sheets;
- Photo-point photos;
- Photo documentation of work activities; and
- Resources used including labour.

## **4.5 Plan Duration & Adaptive Management**

### **Plan duration**

Management actions outlined in the RMP shall be maintained for a minimum period of five years (i.e. until 2015) to maximise the success of the restoration project. If restoration outcomes have not been achieved at the end of the five year period, Council may instruct that the duration of the RMP be extended.

### **Adaptive management & contingency planning**

The aims, guidelines, recommended actions and restoration methods outlined in the plan will be reviewed in light of annual progress reports to determine whether they remain appropriate.

The proposed management strategies may be modified in response to changes in site conditions, to unanticipated circumstances (e.g. fire, drought, floods, planting failure and insect pests), technical advances and/or regular monitoring. Procedures for variation to an approved RMP are discussed in below.

### **Variation of an approved RMP**

Variation of the existing RMP will be undertaken by submission of an amended RMP to Council for a new approval. Once approved, the new RMP replaces the old one.

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### **Aerial Photography**

- 1947** SVY 122 TWEED HEADS RUN 3, 1:15000, 27-5-1947. Source Unknown.
- 1966** SH56-3 TWEED HEADS RUN 5, 1:25 000, 14-11-1966. Source Unknown.
- 1994** TWEED HEADS-SANDON POINT-BYRON BAY, NSW 4199 1:10000, 12-05-1994. NSW Department of Conservation and Land Management
- 2006** MILLS, W. R., 2006, BRUNSWICK HEADS TO BOKEN HEAD FILE/NEG: 2497/6, 12-4-2006, NSW Department of Environment and Conservation.

## 6. APPENDICES

### Appendix A. Flora species recorded within Area of survey

- \* denotes introduced species
- † denotes native species considered to be locally introduced

### Foliage Cover Class (FCC)

1	<5% & uncommon
2	<5% & common
3	6-20%
4	21-50%
5	51-75%
6	76-100%

Scientific Name	Common Name	Vegetation Type / FCC							
		1	2	3	4	5	6	7	8

### FILICOPSIDA - FERNS

#### Aspleniaceae

*Asplenium australasicum forma australasicum*

Bird's Nest Fern

						1		1	
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#### Blechnaceae

*Doodia aspera*

Prickly Rasp Fern

								3	
--	--	--	--	--	--	--	--	---	--

#### Davalliaceae

*Arthropteris tenella*  
*Nephrolepis cordifolia*  
 \**Nephrolepis exaltata*

Climbing Fishbone Fern  
 Fishbone Fern  
 Boston Fern

								1	
		1							2
	1								1

#### Dennstaedtiaceae

†*Hypolepis muelleri*  
*Pteridium esculentum*

Harsh Ground Fern  
 Bracken Fern

		1							
		2		1					

#### Dicksoniaceae

*Calochlaena dubia*

False Bracken

				5					
--	--	--	--	---	--	--	--	--	--

#### Dryopteridaceae

*Lastreopsis decomposita*

Trim Shield Fern

								1	
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#### Gleicheniaceae

*Gleichenia dicarpa*

Pouched Coral Fern

1	6	4	3	1					
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#### Lindsaeaceae

*Lindsaea linearis*  
*Lindsaea ensifolia subsp. ensifolia*

Screw Fern

3	1	2							
1	1	1	1						

#### Thelypteridaceae

*Christella dentata*  
*Cyclosorus interruptus*

Binung  
 Shield-Fern

									1

### CYCADOPSIDA - FERNS

**Zamiaceae**

<i>Lepidozamia peroffskyana</i>	Sessile Burrawang								2
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**MAGNOLIOPSIDA FLOWERING PLANTS****Liliidae - monocotyledons****Anthericaceae**

<i>Caesia parviflora</i> var. <i>parviflora</i>	Pale Grass-lily	1							1
<i>Sowerbaea juncea</i>	Vanilla Plant	1							
<i>Thysanotus tuberosus</i>	Common Fringe-lily	1							

**Arecaceae**

<i>Archontophoenix cunninghamiana</i>	Bangalow Palm			1	2				
<i>Livistona australis</i>	Cabbage Palm				2				
* <i>Syagrus romanzoffiana</i>	Cocos palm			1				2	

**Asparagaceae**

* <i>Asparagus aethiopicus</i>	Asparagus Fern				1				1
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**Asteliaceae**

<i>Cordyline congesta</i>	Coast Palm Lily								
<i>Cordyline petiolaris</i>	Narrow-Leaved Palm Lily							1	

**Blandfordiaceae**

<i>Blandfordia grandiflora</i>	Christmas Bells	1							3
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**Commelinaceae**

* <i>Commelina benghalensis</i>	Hairy Wandering Jew								1
<i>Commelina cyanea</i>	Blue Wandering Dew								2

**Cyperaceae**

<i>Caustis recurvata</i> var. <i>recurvata</i>		2				1	2		
<i>Cyperus polystachyos</i>		1							
<i>Gahnia aspera</i>	Short Saw Sedge								2
<i>Gahnia sieberiana</i>	Red-Fruit Saw Sedge				1	1			
<i>Lepidosperma laterale</i>	Broad Sword Sedge	2	1	2		1			
<i>Schoenus apogon</i>	Fluke Bogrush	2		2		1			
<i>Schoenus brevifolius</i>	Zig Zag Bog-Rush	3	2	3	4				

**Dioscoreaceae**

<i>Dioscorea transversa</i>	Native Yam					1			1
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**Flagellariaceae**

<i>Flagellaria indica</i>	Whip Vine							2	
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**Iridaceae**

<i>Patersonia fragilis</i>	Swamp Iris	2		2					2
<i>Patersonia sericea</i>	Silky Purple Flag	2		1					
* <i>Watsonia meriana</i> cv. <i>Bulbillifera</i>	Bugle Lily								

**Lomandraceae**

<i>Lomandra elongata</i>	A Mat-rush	2				2	1
<i>Lomandra laxa</i>	Sprawling Mat-Rush	1					
<i>Lomandra longifolia</i>	Spiny-Headed Mat-Rush	2	2	1	2	2	2
<i>Lomandra multiflora subsp. multiflora</i>	Many-Flowered Mat-Rush	3	2	2	2		

**Luzuriagaceae**

<i>Eustrephus latifolius</i>	Wombat Berry		1	1	2		
<i>Geitonoplesium cymosum</i>	Scrambling Lily		2	2	2		2

**Orchidaceae**

<i>Cryptostylis subulata</i>	Large Tongue Orchid	1	1	2	2		1
* <i>Epidendrum ibaguense</i>	Crucifix Orchid						

**Phormiaceae**

<i>Dianella caerulea</i>	Rough Flax Lily	2		1			1
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**Poaceae**

* <i>Andropogon virginicus</i>	Whisky Grass						
<i>Aristida warburgii</i>	A Wiregrass	2				2	3
* <i>Axonopus compressus</i>	Broad-leaved Carpet Grass						
* <i>Chloris gayana</i>	Rhodes Grass						3
<i>Cynodon dactylon</i>	Couch						3
* <i>Digitaria ciliaris</i>	A Summer Grass						6
* <i>Digitaria sanguinalis</i>	Summer Grass						3
<i>Entolasia stricta</i>	Wiry Panic	2	2	1			2
<i>Eragrostis spp.</i>	A Lovegrass		1	1			
<i>Imperata cylindrica var. major</i>	Bladey Grass		1			2	2
* <i>Melinis minutiflora</i>	Molasses Grass					2	3
* <i>Melinis repens</i>	Red Natal Grass					1	3
<i>Oplismenus aemulus</i>	A Beard Grass					1	2
<i>Panicum simile</i>	Two Colour Panic	2					1
* <i>Paspalum conjugatum</i>	Sour Grass						
* <i>Paspalum urvillei</i>	Vasey Grass						
* <i>Paspalum wettsteinii</i>	Broad-Leaved Paspalum					1	3
* <i>Pennisetum clandestinum</i>	Kikuyu Grass						2
* <i>Setaria gracilis</i>	Slender Pigeon Grass						2
* <i>Setaria sphacelata</i>	South African Pigeon Grass						
<i>Sporobolus spp.</i>	-						1
* <i>Stenotaphrum secundatum</i>	Buffalo Grass						2
<i>Themeda australis</i>	Kangaroo Grass	2	1	2	1		3

**Smilacaceae**

<i>Smilax australis</i>	Austral Sarsaparilla			1		2	2
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**Xanthorrhoeaceae***Xanthorrhoea fulva*

A Grass Tree

		1		3		2	
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**Magnoliidae - dicotyledons****Acanthaceae***Pseuderanthemum variabile*

Pastel Flower

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**Anacardiaceae***Euroschinus falcata* var. *falcata*Ribbonwood, Blush  
Cudgerie

						2	
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\**Schinus terebinthifolius*

Broadleaved Pepper Tree

				2	2	2	2
--	--	--	--	---	---	---	---

**Apiaceae***Centella asiatica*

Pennywort

				1			
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\**Cyclospermum leptophyllum*

Slender Celery

							1
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*Hydrocotyle* spp.

							1
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*Trachymene incisa*

A Native Parsnip

1				1			
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**Apocynaceae***Alyxia ruscifolia*

Prickly Alyxia

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\**Nerium oleander*

Oleander

						1	
--	--	--	--	--	--	---	--

*Parsonsia straminea*

Common Silkpod

	1	2	2		1		
--	---	---	---	--	---	--	--

**Araliaceae**†*Schefflera actinophylla*

Umbrella Tree

			1	2	2		2
--	--	--	---	---	---	--	---

\**Schefflera arboricola*

Dwarf Umbrella Plant

				2	2		1
--	--	--	--	---	---	--	---

**Asclepiadaceae**\**Gomphocarpus fruticosus*Narrow-leaved Cotton  
Bush

				1			
--	--	--	--	---	--	--	--

*Tylophora benthamii*

Coast Tylophora

							1
--	--	--	--	--	--	--	---

**Asteraceae**\**Ageratina adenophora*

Crofton Weed

						1	
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\**Ageratina riparia*

Mistflower

					2		2
--	--	--	--	--	---	--	---

\**Ageratum houstonianum*

Blue Billygoat Weed

							3
--	--	--	--	--	--	--	---

\**Ambrosia artemisiifolia*

Annual Ragweed

							2
--	--	--	--	--	--	--	---

\**Baccharis halimifolia*

Groundsel Bush

							1
--	--	--	--	--	--	--	---

\**Bidens pilosa*Farmer's  
Friends/Cobbler's Pegs

							1
--	--	--	--	--	--	--	---

\**Chrysanthemoides monilifera* subsp.  
*rotundata*

Bitou Bush

		1	1		2		3
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\**Conyza bonariensis*

Fleabane

				2	2		2
--	--	--	--	---	---	--	---

\**Conyza sumatrensis*

Tall Fleabane

							2
--	--	--	--	--	--	--	---

\**Galinsoga parviflora*

Potato Weed

							2
--	--	--	--	--	--	--	---

\**Hypochaeris radicata*

Catsear/Flatweed

							2
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\**Onopordum acanthium* subsp.  
*acanthium*

Cotton Thistle

							2
--	--	--	--	--	--	--	---



<i>*Sonchus oleraceus</i>	Common Sow Thistle								2
<i>*Wedelia trilobata</i>	Singapore Daisy								3
<b>Balsaminaceae</b>									
<i>*Impatiens walleriana</i>	Busy Lizzy								3
<b>Baueraceae</b>									
<i>Bauera capitata</i>	-	1							1
<b>Bignoniaceae</b>									
<i>Pandorea pandorana</i>	Wonga Vine			1					
<b>Capparaceae</b>									
<i>Capparis arborea</i>	Brush Caper Berry					2			
<b>Caryophyllaceae</b>									
<i>Drymaria cordata subsp. cordata</i>	Tropical Chickweed								1
<b>Casuarinaceae</b>									
<i>Allocasuarina defungens</i>	Dwarf Heath Casuarina	2	1	2	4	1			1
<b>Celastraceae</b>									
<i>Cassine australis var. australis</i>	Red Olive Plum								
<b>Convolvulaceae</b>									
<i>Dichondra repens</i>	A Kidney Weed								1
<i>*Ipomoea cairica</i>	Coastal-Leaf Morning Glory								3
<i>*Ipomoea indica</i>	Blue Morning Glory							2	
<b>Dilleniaceae</b>									
<i>Hibbertia aspera</i>	Rough Guinea Flower			2	2				1
<i>Hibbertia obtusifolia</i>	Hoary guinea flower	1				2			
<i>Hibbertia scandens</i>	Twining Guinea Flower				1				
<i>Hibbertia vestita</i>	Hairy Guinea Flower	3		2		1			
<b>Ebenaceae</b>									
<i>Diospyros fasciculosa</i>	Grey Ebony					2			1
<b>Elaeocarpaceae</b>									
<i>Elaeocarpus reticulatus</i>	Blueberry Ash		1			1	2		1
<b>Epacridaceae</b>									
<i>Acrotriche aggregata</i>	Red Cluster Heath			1		3			
<i>Epacris obtusifolia</i>	Blunt-Leaf Heath	1				2			
<i>Epacris pulchella</i>	Wallum Heath	2		1					
<i>Leucopogon ericoides</i>	Pink Beard-Heath			1					
<i>Monotoca scoparia</i>	Prickly Broom-Heath	1							
<i>Sprengelia sprengelioides</i>	-	1							

**Euphorbiaceae**

<i>Drypetes deplanchei</i>	Yellow Tulipwood							
<i>Glochidion ferdinandi</i>	Cheese Tree			1			2	
<i>Glochidion sumatranum</i>	Umbrella Cheese Tree		2		2	2		
<i>Macaranga tanarius</i>	Macaranga				2			
<i>Mallotus discolor</i>	White Kamala							1
* <i>Phyllanthus tenellus</i>	Hen and Chicken						2	

**Eupomatiaceae**

<i>Eupomatia laurina</i>	Bolwarra							1
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**Fabaceae (Caesalpinioideae)**

* <i>Senna pendula</i> var. <i>glabrata</i>	Winter Senna, Easter Cassia			1	1			2
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**Fabaceae (Faboideae)**

* <i>Crotalaria incana</i>	Woolly Rattlepod				1	2	1	2
* <i>Crotalaria lanceolata</i> subsp. <i>lanceolata</i>	-							1
* <i>Desmodium uncinatum</i>	Silver-leaved Desmodium							1
<i>Gompholobium pinnatum</i>	Pinnate Wedge Pea	2						2
<i>Hovea acutifolia</i>	Pointed-Leaf Hovea		2	1				
* <i>Macroptilium atropurpureum</i>	Siratro				2			
<i>Mirbelia rubiifolia</i>	Heathy Mirbelia	3						2
<i>Mucuna gigantea</i>	Burny Bean							
<i>Pultenaea villosa</i>	Hairy Bush-pea	2	1	1				3

**Fabaceae (Mimosoideae)**

<i>Acacia longifolia</i> subsp. <i>sophorae</i>	Coastal Wattle	1	1	1				
<i>Acacia melanoxyton</i>	Blackwood, Sally Wattle			1		3		2
<i>Acacia suaveolens</i>	Sweet Wattle	1			1			

**Geraniaceae**

<i>Geranium homeanum</i>	-							
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**Goodeniaceae**

<i>Dampiera sylvestris</i>	Blue Fan Flower	2		2	1			2
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**Haloragaceae**

<i>Gonocarpus tetragynus</i>	A Raspwort	2		2				
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**Lauraceae**

<i>Cassytha glabella</i>	Tangled Devil's Twine	2		2				
* <i>Cinnamomum camphora</i>	Camphor Laurel			1		2	2	2
<i>Cryptocarya microneura</i>	Murrogun					1		
						1		
<i>Cryptocarya triplinervis</i>	Three-Veined Laurel					1		
<i>Neolitsea australiensis</i>	Green Bolly Gum							4

**Lobeliaceae**

*Pratia purpurascens*

Whiteroot

								3	
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**Malaceae**

\**Rhaphiolepis indica*

Indian Hawthorn

		1		2					
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**Malvaceae**

*Hibiscus tiliaceus*

Native Cottonwood

					2				
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\**Sida rhombifolia*

Paddy's' Lucerne

								3	
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**Melastomataceae**

*Melastoma affine*

Melastoma

		1							2
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**Meliaceae**

*Dysoxylum mollissimum subsp. molle*

Red Bean

					1				
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*Synoum glandulosum subsp. glandulosum*

Scentless Rosewood

		1	1	2				2	
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**Menispermaceae**

*Stephania japonica var. discolor*

Snake Vine

					2				
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**Monimiaceae**

*Wilkiea huegeliana*

Veiny Wilkiea

					2		1		
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**Moraceae**

*Ficus coronata*

Creek Sandpaper Fig

								4	
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**Myrsinaceae**

\**Ardisia crenata*

Coral Berry

					1		2		
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\**Ardisia elliptica*

Shoebuttan Ardisia

					2				
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*Rapanea subsessilis*

Red Muttonwood

					2				
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**Myrtaceae**

*Acmena smithii*

Lilly Pilly

								1	
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*Austromyrtus dulcis*

Midgen Berry

2	2	2	2	3	2	1	1		
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*Callistemon spp.*

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*Calytrix tetragona*

Common Fringe-myrtle

1								1	
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*Corymbia intermedia*

Pink Bloodwood

1	2	4	3	3	1				
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*Leptospermum polygalifolium subsp. cismontanum*

Yellow Teatree

1	1	2	2	1					
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*Lophostemon confertus*

Brush Box

					1				
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*Lophostemon suaveolens*

Swamp Turpentine

1		2	4	4	1				
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*Melaleuca nodosa*

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*Melaleuca quinquenervia*

Paperbark

	2	2	2	4	2		1		
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*Psidium cattleianum var. cattleianum*

Porpay, Red or Strawberry Guava, Cherry Guava

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*Rhodomyrtus psidioides*

Native Guava

					2		2		
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*Syzygium oleosum*

Blue Lilly Pilly

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					2				
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<i>Xanthostemon chrysanthus</i>	Golden Penda					1		2	
<b>Ochnaceae</b>									
<i>*Ochna serrulata</i>	Mickey Mouse Plant			2		2	1		2
<b>Oleaceae</b>									
<i>Notelaea longifolia</i>	Large Mock Olive					3			
<b>Passifloraceae</b>									
<i>*Passiflora edulis</i>	Common Passionfruit					1			
<i>*Passiflora suberosa</i>	Cork Passionflower					1			
<b>Pittosporaceae</b>									
<i>Auranticarpa rhombifolia</i>	Hollywood								2
<i>Pittosporum undulatum</i>	Sweet Pittosporum	1		1	1	2	3		2
<b>Proteaceae</b>									
<i>Banksia integrifolia subsp. integrifolia</i>	Coast Banksia					3			
<i>Banksia oblongifolia</i>	Dwarf Banksia	4	2	3	3	1	3		
<i>Grevillea spp.</i>	A Grevillea					2			
<i>Lomatia silaifolia</i>	Crinkle Bush	1	1	1	2				1
<i>Persoonia adenantha</i>	Round-Leaved Geebung					1			
<i>Persoonia spp.</i>	A Geebung	1				1			
<i>Strangea linearis</i>	Strangea	1							
<b>Ranunculaceae</b>									
<i>Clematis glycinoides</i>	Headache Vine								
<b>Rhamnaceae</b>									
<i>Alphitonia excelsa</i>	Red Ash							1	
<b>Rubiaceae</b>									
<i>Canthium coprosmoides</i>	Coast Canthium					1			
<b>Rutaceae</b>									
<i>Acronychia imperforata</i>	Beach Acronychia							1	
<i>*Citrus x taitensis</i>	Lemon Tree					3			
<i>Melicope elleryana</i>	Pink-Flowered Doughwood			1	1				
<i>Sarcomelicope simplicifolia subsp. simplicifolia</i>	Bauerella					1			
<b>Sapindaceae</b>									
<i>Alectryon coriaceous</i>	Beach Alectryon							1	
<i>Arytera divaricata</i>	Rose Tamarind					1			
<i>Cupaniopsis anacardioides</i>	Tuckeroo			2				3	
<i>Dodonaea triquetra</i>	Large-Leaf Hop-Bush	2		2	2	1	1	4	
<b>Solanaceae</b>									
<i>*Solanum mauritianum</i>	Wild Tobacco					2			

<i>*Solanum nigrum</i>	Blackberry Nightshade	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td>2</td></tr></table>							1	2
						1	2			
<b>Stackhousiaceae</b>										
<i>Stackhousia nuda</i>	-	<table border="1"><tr><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td></tr></table>	2							1
2							1			
<b>Sterculiaceae</b>										
<i>Commersonia bartramia</i>	Brown Kurrajong	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>								
<b>Thymelaeaceae</b>										
<i>Pimelea linifolia</i>	Slender Rice Flower	<table border="1"><tr><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td></tr></table>	1							1
1							1			
<i>Wikstroemia indica</i>	Red-Fruited Rice-Flower	<table border="1"><tr><td></td><td></td><td>1</td><td></td><td></td><td></td><td></td><td></td></tr></table>			1					
		1								
<b>Ulmaceae</b>										
<i>Celtis paniculata</i>	Native Celtis	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>								
<b>Urticaceae</b>										
<i>Dendrocnide photinophylla</i>	Shiny-Leaved Stinging Tree	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td></tr></table>								1
							1			
<b>Verbenaceae</b>										
<i>*Lantana camara</i>	Lantana	<table border="1"><tr><td></td><td></td><td>2</td><td></td><td>1</td><td>2</td><td>1</td><td>2</td></tr></table>			2		1	2	1	2
		2		1	2	1	2			
<i>*Verbena bonariensis</i>	Purple Top	<table border="1"><tr><td></td><td></td><td></td><td></td><td>1</td><td></td><td></td><td>2</td></tr></table>					1			2
				1			2			
<b>Violaceae</b>										
<i>Viola banksii</i>	Native Violet	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td></tr></table>								1
							1			
<b>Vitaceae</b>										
<i>Cissus antarctica</i>	Water Vine	<table border="1"><tr><td></td><td></td><td></td><td></td><td>2</td><td></td><td></td><td></td></tr></table>					2			
				2						
<i>Cissus hypoglauca</i>	Five-Leaf Water Vine	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td></td></tr></table>							1	
						1				

## APPENDIX B: Weed Control Methods

Current best practice methods for weed control are described below.

Please note: (1) It is the responsibility of the herbicide user to hold an off-label permit (obtained from the National Registration Authority for Agricultural and Veterinary Chemicals) for herbicide use that is not consistent with conditions specified on the label; and (2) The methods and herbicide use rates provided below are current best practice methods. It is the responsibility of the operator to ensure methods used are current best practice and are suitable for the site and any environmental constraints experienced at the site.

### Cut-scrape-paint

This weed control method applies to all woody shrubs, trees and some vines.

- Cut plant low to the ground at an angle.
- Apply Glyphosate immediately at the rate of 1 part Glyphosate to 1.5 parts water, with a paintbrush approximately 1.5 centimetres wide.
- Scrape sides lightly to reveal green tissue and apply the herbicide to the scraped area.
- Take care that the brush is not contaminated with soil.
- Note - all seed that has high viability and longevity, e.g. *Senna spp.* and other members of the Fabaceae family, or plants with a high invasive potential, such as Umbrella Tree *Schefflera actinophylla*, must be removed from the parent and either composted on site or removed from the site.

### Gouge-paint

This weed control method applies to those plant species that have a fleshy root system, such as rhizomes or large bulbs. It is particularly appropriate for the treatment of *Asparagus spp.*

- Gouge out sections of the fleshy base with a knife (if using on *Asparagus*, first cut the stems at shoulder height and also at the base).
- Apply 1 part Glyphosate to 1.5 parts water immediately, with a paint brush approximately 1.5 centimetres wide.

### Stem Injection

This weed control method applies to all woody trees and shrubs with a diameter of about six to ten centimetres or greater.

- With a tomahawk, make a cut the width of the blade, at a slight angle, into the trunk. Note - it is important not to make cuts too deep.
- Apply herbicide immediately into the cut using a tree-injecting device (if using Glyphosate, apply at the rate of 1 part Glyphosate to 1.5 parts water).
- Repeat this procedure in a brickwork pattern around the circumference of the tree, as close to the ground as possible. Where the presence of a crotch angle makes this difficult, make a cut above it. Note - two rows of cuts will be sufficient for trees with trunks of six to ten centimetres; larger trunk diameters will need correspondingly more.
- Treat all visible lateral roots as per dot point 1.

### Scrape-ditch-paint

This weed control method is applicable to many species of vines where it is desirable to treat the vines intact, particularly those with aerial tubers such as Madeira Vine *Anredera cordifolia* or those which will propagate from segments, e.g. Cape Ivy *Delairia odorata*.

- Scrape the stem tissue on one side of the stem only for at least 20-30 centimetres if possible. Note - on Madeira Vine, it is necessary to scrape heavily. Scrape as many sections of the stem as possible.
- Apply undiluted Glyphosate with a paintbrush.
- On stems that are thicker or horizontal, make a ditch into the stem with a knife and apply herbicide. Tubers and side roots should be treated the same way. Note - care must be taken not to sever the stem.

## Spraying

This weed control method is carried out using a 15 litre backpack spray unit with a modified spray nozzle that gives a solid spray pattern. Glyphosate is the main herbicide used with the addition of a marker dye. For plants that show some resistance (e.g. Madeira Vine) or where growing conditions are not optimal, an acidifying agent, LI700®, is added. Metsulfuron methyl can also be used for resistant species and grasses. It should be used with a surfactant, such as Agral®.

Where both Glyphosate and Metsulfuron methyl are recommended for a species, it may be possible to use a commercially available compound of these two herbicides. This approach is currently under trial and is not suitable for operators unskilled in precision spraying.

Dilution rates for Glyphosate and Metsulfuron methyl are in accordance with the manufacturer's recommendations and any variation requires a permit from the National Registration Authority.

Dilution rates for Glyphosate to water for treatment of some weed species are provided below:

- Plants with more or less succulent leaves, e.g. Wandering Jew *Tradescantia fluminensis*, Madeira Vine *Anredera cordifolia* (autumn to winter is the suggested time for spraying these plants), Spider/Ribbon Plants *Chlorophytum spp.* etc - 1 part Glyphosate to 50 parts water + LI700® 0.5%
- Lantana *Lantana camara* - 1 part Glyphosate to 100 parts water
- Other soft-leaved plants, annuals and grasses - 1 part Glyphosate to 100 parts water
- Bitou Bush *Chrysanthemoides monilifera subsp. rotundata* - 1 part Glyphosate to 150 parts water to 1 part Glyphosate to 400 parts water

Typical dilution rates for Metsulfuron methyl to water are - 1.5g Metsulfuron methyl to 10 litres water + 20 millilitres Agral® to 10 litres water.

## Overspray

This weed control method is applicable to large, dense infestations of such plants as *Lantana camara*, where it is desirable to leave the dead plants intact to prevent erosion and over-exposure of large areas, protect native seedlings from predators such as wallabies, and avoid trampling by humans.

- Spray over the top of the infestation, using a weak solution of Glyphosate.
- Any native plants that may be under the weed will be protected by the foliage cover of the weed.
- Leave the sprayed plants intact so that native seedlings can establish under the shelter provided.
- The rate for overspraying of Lantana is 1 part Glyphosate to 100 parts water.

Alternatively, weeds can be cut and flattened with bush-hooks or loppers and the subsequent regrowth sprayed with Glyphosate. In many cases it is preferable to overspray wherever practicable as this will cause less erosion and trampling of suppressed native plants, such as ferns and seedlings. However, handwork will be necessary to cut-scrape-paint any unsprayed Bitou Bush or Lantana that surrounds native plants.

## Crowning

This weed control method is applicable to weeds which have their growing points below the surface of the ground (corms, bulbs, rhizomes, clumped or fibrous root systems, etc. e.g. *Asparagus spp.*, *Chlorophytum comosum* and grasses).

- Grasp the leaves or stems and hold them tightly so that the base of the plant is visible. Plants with sharp leaves or stems should be cut back first.
- Insert the knife close to the base of the plant at a slight angle, with the tip well under the root system.
- Cut through the roots close to the base. Depending on the size of the plant, two or more cuts may be needed to sever all the roots.
- Remove the plant. Make sure that the base of the plant where the roots begin is completely removed.

Adapted from Joseph (2001)



# Checklist For Bush Regeneration Activities In The Habitat Of Threatened Species, Endangered Populations And Endangered Ecological Communities

## Background

Threatened species, endangered populations and endangered ecological communities are protected in NSW under the *Threatened Species Conservation Act 1995* (TSC Act).

It is an offence to “harm” or “pick” threatened species, populations or ecological communities, or cause “damage” to critical habitat or the habitat of threatened species, populations or ecological communities<sup>1</sup>.

“Harm” refers to native fauna, and is defined as to:

hunt, shoot, poison, net, snare, spear, pursue, capture, trap, injure, or kill.

“Pick” refers to native flora, and is defined as to: gather, pluck, cut, pull up, destroy, poison, take, dig up, remove or injure the plant or any part of the plant.

“Damage” is not defined but the common dictionary definition would apply.

It is a defence to a prosecution if the action was:

- authorised in accordance with a Section 120 licence or a Section 132C licence under the *National Parks and Wildlife Act* or a licence granted under Section 91 of the TSC Act (flora and ecological communities);
- authorised in accordance with a development consent under the *Environmental Planning & Assessment Act 1979*; or
- authorised by or under the Rural Fires Act 1997, or the State Emergency and Rescue Management Act 1989.

## Bush regeneration activities

Areas where bush regeneration is undertaken are often the habitat of threatened species or

may be an endangered ecological community (e.g. Lowland Rainforest on Floodplain). It is understood that the intention of bush regeneration activities is to have a positive impact, however, there is a chance that these activities may adversely impact on threatened species, populations or ecological communities. This may occur where:

- a species (flora or fauna) is not known to exist on the site (e.g. cryptic species such as orchids);
- a species may be accidentally harmed or picked (e.g. by spray drift or accidental cutting).
- a species may be misidentified and is thought to be either an exotic or common native species and therefore may be removed or damaged;
- the requirements of the species, including habitat structure and components, may be temporarily adversely impacted (e.g. maintaining microclimatic conditions, connecting or sheltering habitat for fauna);

## Licensing

Those undertaking bush regeneration activities may consider applying for a Section 132C licence under the NPW Act.

A Section 132C licence is issued where the NPWS considers that the proposed work is for conservation purposes.

## Licence Conditions

Generally, licences are issued on an annual basis; however, shorter or longer term licences are also issued where appropriate.

The NPWS may prohibit, condition, or restrict bush regeneration works in some areas which may affect research plots. Other

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WILDLIFE  
SERVICE



conditions may be applied after consideration of population estimates, age structure, viability and health of the population or individuals.

### **The Bush Regeneration Checklist**

The intention of the checklist is to ensure that bush regeneration activities will **not** have a significant impact on threatened species, populations or ecological communities and their habitats. Applicants should consider attaching this standard checklist to any Section 132C licence application to assist the NPWS in assessing the significance of the proposed activity. The NPWS will assume the applicant is prepared to adhere to the guidelines in the checklist where they form part of the licence application. Detail of any proposed work additional or contrary to that described in the checklist must be provided. The NPWS then assesses the likely significance of the impact of the proposal<sup>2</sup> using the information provided in the licence application.

For the purposes of the checklist, bush regeneration is considered as all types of habitat restoration and may include such activities as manual weed removal, herbicide use, temporary damage to, or removal of native plants, planting, track work or maintenance and habitat removal or modification.

1. Threatened Species are listed under two schedules on the *Threatened Species Conservation Act*: Schedule 1 includes Endangered Species, Endangered Populations and Endangered Ecological Communities and Schedule 2 includes Vulnerable species. The *Threatened Species Conservation Act* Schedules are maintained by the NSW Scientific Committee. The most recent versions of these schedules may be obtained on the NPWS Web Site: [www.nationalparks.nsw.gov.au](http://www.nationalparks.nsw.gov.au).
2. A Species Impact Statement must be prepared where a proposed activity is assessed as likely to have a significant impact on threatened species, populations or ecological communities.
3. The Wildlife Atlas is the NPWS statewide flora and fauna database.

# NPWS Checklist For Bush Regeneration Activities:

**Please Note:**

- 1) The checklist is provided to facilitate licence applications and to draw attention to NPWS issues of concern.
- 2) There is no requirement to use the checklist when applying for a licence. You may alternatively choose to provide details of your project and an explanation of how you will ensure there will not be a significant impact on threatened species, their habitat or on endangered ecological communities.
- 3) If you provide a negative answer using the checklist this does not necessarily mean your application will be unsuccessful. You will however need to provide a satisfactory explanation as to why you do not wish to comply with the guideline and how you will ensure there is unlikely to be a significant impact on threatened species, their habitat or on endangered ecological communities.
- 4) You may wish your licence application to cover the collection of Voucher Herbarium Specimens and Plant Material for Identification. Guidelines to cover those activities are also attached.

<b>Management Planning:</b>	<b>yes</b>	<b>no</b>	<b>more info attached</b>
The proposed activities will be in accordance with a management plan or site plan (map). <i>Please attach the plan or relevant sections of the plan or strategy to the licence application.</i>			
The project has been discussed with the relevant Landcare coordinator. <i>If not, provide details of any other professional advice you have sought, e.g. from a qualified bush regenerator.</i>			
A NPWS Wildlife Atlas database search of a 5km radius of the site has been undertaken to identify threatened flora/fauna species known or likely to occur on the site. <i>The Wildlife Atlas is accessible on the NPWS Web Site <a href="http://www.nationalparks.nsw.gov.au">www.nationalparks.nsw.gov.au</a>.</i>			
Prior to commencing any works on site, a permit or permission will be obtained from the relevant landowner(s) or land manager(s).			
<b>Training and supervision:</b>			
All workers carrying out bush regeneration and associated works will be supervised by a trained and experienced co-ordinator who has completed a recognised bush regeneration course (e.g. the Certificate of Bushland Regeneration) or a minimum of 2 years bush regeneration experience. <i>If 'yes', please provide below the name and qualifications of the co-ordinator.</i> Name: ..... Qualifications/experience:.....			
Other members of the group that have bush regeneration training or experience. Name: ..... Qualifications/experience: ..... Name: ..... Qualifications/experience:..... Name: ..... Qualifications/experience:..... Name: ..... Qualifications/experience:..... Name: ..... Qualifications/experience:.....			
All activities by workers will be regularly checked and approved by the co-ordinator.			
All workers will be informed of any threatened species or endangered ecological communities in the area or which may occur in the area and the potential impacts of activities on these species/communities. <i>e.g. vines on the edge of a littoral rainforest remnant may protect the remnant from salt-bearing winds.</i>			
	<b>yes</b>	<b>no</b>	<b>more</b>

			<b>info attached</b>
All workers have adequate weed and native plant identification skills. <i>i.e. all workers can identify and differentiate between weeds and native plants that occur on the site.</i>			
Workers will be familiar with the identifying features of threatened flora that are known or likely to occur in the project area. Where threatened species known from the area are similar to weed species, the distinguishing features between these will be understood prior to commencing the work.			
<b>Access to sites</b>			
All vehicular access to sites will be restricted to formed roads.			
Unnecessary damage to sites will be avoided. <i>e.g. avoid working in wet weather to lessen soil compaction.</i>			
<b>Impacts on flora:</b>			
Prior to any works being undertaken, the presence or absence of threatened flora will be determined by a thorough walking search of the area.			
All threatened flora will be tagged with highly visible flagging tape before work commences. If a number of individuals occur in a clump, that area should be marked out with flagging tape.			
Cutting or damaging of threatened flora will be avoided.			
All plants will be positively identified before they are removed (pulled, cut, poisoned etc).			
Weed removal within 2m of a threatened species will be undertaken by hand.			
To reduce the possibility of introducing plant diseases and weeds the following measures will be applied: 1. Secateurs will be sharp and cleaned with methylated spirits. 2. Footwear will be cleaned of loose soil and preferably treated with bleach between sites.			
<b>Impacts on fauna:</b>			
All workers will be aware of any threatened fauna that are known or likely to occur on site, and the potential impacts of the proposed activities on those species.			
The habitat and refuge potential of weeds and rubbish will be considered prior to removal. <i>e.g. Lantana can provide cover for threatened fauna such as the Bush-hen. Dead Lantana and poisoned Camphor Laurels should, where possible, be left in situ.</i>			
Weeds will be removed gradually in areas where an infestation is extensive. <i>Ideally, 50% of weeds that may provide habitat should be left until native plant species have re-established and provide alternative refuge.</i>			
Disturbance to, and removal of rocks, logs and other potential refuge sites will be avoided.			
A herbicide registered for use near waterways will be used within 5m of waterways.			
Herbicide spraying will be prohibited within 5 metres from watercourses where threatened frogs are known or likely to occur and within a 10m radius of records of threatened frogs.			
A buffer of 1m along other watercourses will be maintained in which no herbicide will be sprayed.			
Care will be taken to minimise disturbance to shy or cryptic species. <i>e.g. the Marbled Frogmouth roosts in vine 'curtains'.</i>			
Care will be taken to minimise disturbance to the leaf litter layer.			
<b>Reconstruction through revegetation:</b> <i>This section does <b>not</b> address propagation or planting of threatened species – this activity would need to be separately addressed.</i>			
Seed collection or cuttings will be from species, populations or ecological communities other than those listed as threatened (unless licensed by NPWS).			
Prior to collecting any seed or cuttings permission will be obtained from the relevant landholder or manager of the site. <i>e.g. a licence is required to collect native plants on National Parks estate.</i>			
	<b>yes</b>	<b>no</b>	<b>more info attached</b>

Seed collection from any one species will be limited to less than 10% of the available crop at that site.			
Seed collection from any individual plant will be limited to less than 10% of the available crop.			
If your seed source is used by other seed collectors, has consideration been given to minimising any cumulative impacts to the source plants? <i>Some individual plants are known as a reliable seed source and their seed is collected extensively. This may result in – (i) a reduction in genetic diversity; (ii) an impediment to the individual's natural ability to regenerate.</i>			
When collecting propagation material from a wild population, collection will be random from as many individuals as possible across the population to ensure a representative range of genetic material is collected. Collectors will avoid selection of propagation material on the basis of physical attributes. <i>e.g. tallest, most attractive, greatest amount of seed or flowers.</i>			
Plantings will be sourced from stock of local provenance.*			
Propagated plants will be used only at the subject site. <i>i.e. excess material will only be used at other sites if it meets the provenance criteria.</i>			
A buffer of 5 metres will be maintained around all threatened plant specimens. Planting will only be undertaken outside this buffer. <i>This requirement is intended to protect the roots of the threatened plant from damage, introduction of disease or impacts of herbicide.</i>			
Care will be taken to ensure that mulch does not introduce weeds or impede natural regeneration at the site.			
Care will be taken to ensure that weeds and/or phytophthora are not introduced to a site from any plantings.			
Consideration will be given to the possible impacts of plantings on the ecological requirements of threatened species at the site <i>e.g. reduced light, competition, etc.</i>			
Species will be planted within their natural habitat and range. Plantings will be guided by the plants' local habitat preferences. <i>e.g. the species used for plantings along watercourses should be those that naturally occur in that habitat in your local area.</i>			
<b>Herbicide use:</b> <i>A permit from the National Registration Authority for Agricultural and Veterinary Chemicals PO Box E240, Kingston ACT 2604 may be required for herbicide use that is not consistent with conditions specified on the label.</i>			
A buffer of 2m will be maintained around all threatened plant specimens. Herbicide use will only be undertaken outside this buffer.			
Herbicide use will cease where there are any signs of threatened species being affected by herbicide. <i>e.g. browning off, wilting, deformed growth.</i>			
All herbicide spray operators will be capable of undertaking precise and effective weed control.			
Spray will be directed away from threatened flora.			
Herbicide will only be sprayed in suitable weather conditions when the impact of spray drift (windy) or run-off (wet) on threatened flora is minimised.			
Marker dyes e.g. 'white field marker' will be mixed with herbicide before use. <i>Marker dye enables the worker to see where the spray is landing.</i>			
<b>Reporting and data records:</b>			
Any new records of threatened species will be provided within three months to NPWS. These records will be in a format appropriate for entry into the Wildlife Atlas, once identification of a threatened species is confirmed by a recognised authority. <i>Wildlife Atlas cards available on request.</i>			

\*Local provenance species should be regarded as those species propagated from material that has been collected from a natural wild population as close as possible to a site. For example, within the local catchment – which may be based on a local creek.

# APPENDIX D: Sample Daily Record Sheet

Site Name / Location: \_\_\_\_\_

Date: \_\_\_\_\_ Time: \_\_\_\_\_ to \_\_\_\_\_

Team / Staff: \_\_\_\_\_

Growing conditions	Temperature / Humidity		Weather conditions			Wind direction / Speed		
Zone(s) / Work locations	Hours	Weeds treated				Method	New T.S. encountered / location	
Chemicals used / Rates / Totals						Notes and comments		
Equipment used	Glyphosate	Met-methyl	Herbicide	Additive	Other	Water	Number mixed	*include batch number and brand
Daily Chemical Totals								

## APPENDIX E: Sample Project Risk Assessment Form and Matrix

### Sample Risk Assessment Form

HAZARD IDENTIFIED	RISK RATING	CONTROL MEASURE RISK ASSESSMENT
<b>Traffic Hazard</b> Working in close proximity to roads		Use traffic controller Use of safety signs Use of woggles hats or temporary barrier High visibility clothing
<b>Sun Exposure</b> Hot conditions		Reduce exposure time – rest breaks Provide ample water Protective clothing and sunscreen
<b>Working With Chemicals</b>		Current MSDS held Adequate washing facilities Hazardous substances stored and labelled correctly Use of personal protective clothing Rotate tasks to avoid prolonged exposure
<b>Biological Hazard</b> Needle stick injury		Inspect site before work commences Provide appropriate waste disposal container Personal protective equipment
<b>Manual Handling</b> Handling heavy objects		Use correct lifting and carrying techniques Use lifting aids Use wheelbarrow etc wherever possible Ensure clear area before lifting Share the load Rotate activities or rest breaks Appropriate personal protective clothing
<b>Crush Impact</b> Cut, crush and impact		Knowledge and correct use of tools Appropriate personal protective clothing Correct tool for job
<b>Slips, Trips and Falls</b>		Avoid carrying awkward or heavy objects on uneven ground Remove all potential hazards if possible or mark with coloured tape Do not leave tools lying in pathways Do not run Ensure boots are firmly laced
<b>Hazardous Plants</b> Plants that may cause allergic reaction		Identify plants which may cause allergic reactions Mark area with coloured tape
<b>Bites and Stings</b>		Create disturbance on site before beginning work Apply insect repellent Wear appropriate personal protective equipment

## Sample Risk Assessment Matrix

How severely could it hurt someone  Or How ill could it make someone	Very likely - could happen anytime	Likely - could happen sometime	Unlikely - could happen, but very rarely	Very unlikely - could happen, but probably never will
☠ kill or cause permanent disability or ill health	1	1	2	3
Long term illness or serious injury	1	2	3	4
Medical attention and several days off work	2	3	4	5
! First aid needed	3	4	5	6

# Appendix F



## Monitoring and Evaluation proforma

A guide to completing this form is included in the appendices of the SAP guidelines. This form should be completed for each management **zone** within a work site. Assessment should be made of the zone as a whole.

Date		Observer	
Site name		Site location	
Zone		Area	

### Dominant Vegetation Community

Dominant Species Canopy			
Dominant Species Mid			
Dominant Species Ground			

### Notes and Comments (including Threatened Species observations, presence of EEC, variations in veg types and location)

### Structural and Compositional Integrity

Stratum	Height Range(m)	%Cover			Disturbance Type / Stratum	Score (1-4)
		Natives	Exotics	Total		
Emergent					Native Vegetation Cover	
Canopy					Age Class Diversity	
Mid					Native Species Composition	
Ground					Overstorey Regeneration	
					Growth Stage	
Notes and Comments:						<b>Overall Score (average)</b>

### Habitat Features (Score 0-3)

Hollows(>5cm)		Glossy Black Cockatoo FT	
Fallen Logs		Koala FT	
Native Grass/Reed/Sedge		Blossom bat FT	
Riparian/Wetland		Flying Fox Camp	
Gullies		Other Feature	
Rock/Boulders			
Cave/Overhangs		<b>Raw Score</b>	
Low Cover/Thickets		<b>Habitat Assessment Score</b>	



### Dominant Weed Assessment

% cover

Species	Upper	Mid	Lower

**Weed Total Score = (2-10)**

**Weed Density Score =**

5\_Few or no weeds observed (No or Light Infestation).  
 4\_Weeds mainly edges /very scattered (Light to Mod)  
 3\_Weeds common, but patchy or scattered (including canopy)  
 2\_Weeds throughout excluding canopy (Heavy infestation)  
 1\_Weeds throughout including the canopy (Heavy infestation)

**Weed Severity Score =**

5\_No problem weeds present  
 4\_Infestation is mostly Cat 3 weeds  
 3\_Infestation a mix of Cat 2 & 3 weeds  
 2\_Infestation mostly Cat 2 or a Cat 1 weed present  
 1\_2 or more major weeds present

### Other weeds


### Threats:

Other Threats	Score
Erosion	
Grazing	
Dumping	
IFR	
Vehicles	
Clearing	
Underscrubbing	
Other	
<b>Raw Score</b>	
<b>Scaled Score</b>	

### Management notes:

Erosion Control	
Structural Works	
Rubbish removal	
Contamination	
Pest Control	
Fire Management	
Other	

### Fencing

Fence Type	Length	Cost

Fencing Notes:

### Photo points

Photo point No.	Description	Direction (N,S,E,W)	GPS co-ordinates	
			Easting	Northing

## APPENDIX G-

### Guide to completing Bush Futures Site Attribute and Habitat Assessment Data Sheet.

- A data sheet should be completed for **each management zone** as defined by the Site Action Plan. Therefore more than one data sheet should be completed for each work site.
- The scoring methodology was developed to create a score of overall health of the area which can be assessed over time to determine if management actions are having a positive impact on the site resulting in a increase score of the site over time.
- Data sheets should be complete prior to on-ground works and then by each progress report period as defined by council.
- Data sheet information will be entered into council database to monitor and report on project outcomes.

1. Record date, site name, location, observers, and approximate area of management unit.

### Dominant Vegetation Community

2. Record a brief Vegetation Description for the management Unit noting dominant floristics and structure
3. Record the three dominant species in each strata (canopy, mid and ground).
4. Note variation in vegetation communities recording presence of minor vegetation communities and relevant notes of significance regarding threatened species occurring on the site.

### Structural and Compositional Integrity Assessment

5. Record which strata are present in the area and the height range of each strata.
6. Record the percentage canopy cover (natives, exotic and total vegetation) for the canopy and emergent strata (% of sample site within the vertical projection of the periphery of the crowns)
7. Record the percentage cover of the other strata (natives, exotics and total vegetation) (% of sample site occupied by the vertical projection of the foliage and woody branches.)
8. **Native Vegetation Cover Score:** Use vegetation benchmarks (provided below) and professional judgement and **score (1-4)** for native vegetation cover %:

4- All strata OK – within benchmarks for all strata (woody or non –woody communities),

3 - Only overstorey OK – within over-storey benchmarks for woody communities,

2 – Only lower strata OK – within lower strata benchmarks only

1 - Other – other observation.

9. **Age Class Diversity Score:** score (1-4) for forests and woodlands only (not shrublands or non woody communities)

4 – All Strata OK – range of age classes within all strata (or within normal limits),

3 – Only overstorey OK – range of age classes (or within normal limits) within overstorey only;

2 – Only lower strata OK- range of age classes (or within normal limits) within lower strata only.

1 – Other. Other (woody or non-woody vegetation communities)

10. **Native Species Composition:** Score (1-4) for native species composition. Assess both woody and non woody communities. Native species composition (NSC) includes both species richness and relative abundances (use professional judgement for normal limits). Do not assess weeds.

4- All Strata OK –NSC within normal limits and weed cover < 10 % in all relevant strata (woody /non woody),

3 – Only overstorey OK - NSC within normal limits and weed cover < 10 % within the overstorey (woody communities only),

2 – Only lower strata OK – NSC within normal limits and weed cover < 10% in lower strata only (woody communities only),

1 – Other – Other (woody or non woody vegetation communities)

**11. Overstorey Regeneration:** Score (1-4) overstorey regeneration. Assess regeneration (young canopy species - overstorey species up to 5 cm diameter at breast height (dbh).

4 – Common – native regeneration common throughout,

3 – Patchy – native regeneration common but patchy,

2 – Minimal – native regeneration observed but minimal,

1 – None, No native regeneration observed.

**12. Growth Stage:** Score (1-4) for growth stage of vegetation. Assess successional stage of vegetation unit as an indication of disturbance history.

4 Old growth – Mature forest or other vegetation with common age related features (fallen logs, senescent trees, stags, tree hollows, epiphytes, buttresses, large trees, emergents etc).

3- Mature vegetation – well developed vegetation; e.g. > 5 yrs old for non woody vegetation; >8yrs for shrublands; >40 yrs for forests.

2 - Advanced regrowth – intermediate successional development e.g. 1 – 5 yrs old for non woody vegetation; 3 – 8 yrs for shrublands; 10 – 40 yrs for forests.

1 – Early successional development e.g. < 1 yr old for non-woody vegetation; < 3 yrs for shrublands; < 10 yrs for forests.

13. Note the overall (average) site score for steps 9 – 16.

14. Note any relevant disturbances observed and the relevant stratum

15. Can note any relevant comments / observations

### Habitat Feature Assessment

16. Abundance of habitat features within the management unit where for each habitat feature:

0= Absent,

1 = Few observed,

2 = common,

3 = abundant.

**Raw score** = sum of all scores

**Scaled score:** will be converted into an index or %.

### Weeds and other Threat Assessment

17. Rank the 5 dominant weed species (in order of abundance) across the site noting species and the % cover for relevant strata.

**Dominant weed:** weed which is recorded = or > 5% cover of any stratum.

Record all other weeds present on the site in *Other Weeds* box.

18. **Weed Density Score** within the management unit:

1 – Weeds throughout the canopy (Heavy infestation),

2- Weeds throughout excluding canopy (Heavy infestation),

3 - Weeds common, but patchy or scattered (including canopy),

4 – Weeds mainly around edges or very scattered (Light to Mod),

5 – Few or no weeds observed (No or Light infestation)

**19. Weed Severity Score.** Assess dominant weeds only. See table below for weed categories. If no dominant weeds present but some are problem weeds the use category 4.

- 1 –2 or more category 1 weeds are present,
- 2- Infestation mostly category 1 &/or 2 weeds present,
- 3 –Infestation a mix of category 2 & 3 weeds,
- 4 – Infestation is mostly category 3 weeds,
- 5 –No problem weeds present:

**20. Total Weed Score** is the sum of the Weed Density and Weed Severity scores (2 – 10)

**21. Other Threats:** Score the presence of other threats (Use habitat feature score categories 1-3)

**22.** Scaled score will be converted

**23.** Site score will be calculated on all field assessed values

**24.** Site ranking will be calculated in relation to all other sites entered in database.

### **Fencing and Management notes**

**25.** For **fencing** note type (Standard, Electric), length, cost and any relevant notes/ issues.

**26.** Brief comments on any other potential or recommended management actions can be noted next to the relevant action.

### **Photo Points**

**A minimum of 1 photo point must be established in each management zone. For larger more complex zones additional photo points should be established.**

Photo points should be established at the start of the project before on-ground work begins and included in the site action plan if possible.

Record relevant photo point number, site identifier or description of shots, direction facing and GPS co-ordinates (easting and northing).

- Photo point location must be marked using a star-picket with flagging tape tied to the top.
- Photos should be taken at the same time of the day each time.
- The camera lens and angle of the photo should be the same for each photo.
- The star-picket must be located in a similar location in each photo to provide a reference point.

## WEEDS SEVERITY CATEGORIES

ComName	ScName	Category	Form
Asparagus Fern(s)	<i>Asparagus spp.</i>	1	Groundcover/Vine
Balloon Vine	<i>Cardiospermum grandifolium</i>	1	Vine
Cats Claw Climber	<i>Macfadyena unguis-cati</i>	1	Vine
Glory Lily	<i>Gloriosa superba</i>	1	Groundcover
Madeira Vine	<i>Anredera cordifolia</i>	1	Vine
Morning Glory	<i>Ipomoea spp.</i>	1	Vine
Moth Vine	<i>Araujia sericifolia</i>	1	Vine
Privet(s)	<i>Ligustrum spp.</i>	1	Tree
Salvinia	<i>Salvinia molesta</i>	1	water weed
Camphor Laurel	<i>Cinnamomum camphora</i>	2	Tree
Broad Leaf Pepper Tree	<i>Schinus terebinthifolia</i>	2	Tree
Cape Ivy	<i>Delairea odorata</i>	2	Vine
Chinese Celtis	<i>Celtis sinensis</i>	2	Tree
Dutchman's Pipe	<i>Aristolochia elegans</i>	2	Vine
Firethorn	<i>Pyracantha spp</i>	2	Shrub / Tree
Fishbone Fern	<i>Nephrolepis spp.</i>	2	Groundcover
Green-leaved desmodium	<i>Desmodium intortum</i>	2	Vine
Hairy Commelina	<i>Commelina benghalensis</i>	2	Groundcover
Hawthorn	<i>Crataegus monogyna</i>	2	Shrub
Honeysuckle	<i>Lonicera japonica</i>	2	Vine
Monbretia	<i>Crocosmia X crocosmiiflora?</i>	2	Groundcover
Mother of Millions	<i>Bryophyllum spp.</i>	2	Groundcover
Ochna	<i>Ochna serrulata</i>	2	Shrub
Silver-leaf Desmodium	<i>Desmodium uncinatum</i>	2	Vine
Siratiro	<i>Macroptilium atropurpureum</i>	2	Vine
Smooth Senna	<i>Senna X floribunda</i>	2	Shrub
Thorny Poinciana	<i>Caesalpinia decapetala</i>	2	Vine
Turkey Rhubarb	<i>Acetosa sagittata</i>	2	Vine
Umbrella Tree	<i>Schefflera actinophylla</i>	2	Tree
Watsonia	<i>Watsonia meriana cv.</i> <i>Bulbillifera</i>	2	Groundcover
Ardisia	<i>Ardisia crenulata</i>	2	Shrub
Winter Senna	<i>Senna pendula var glabrata</i>	2	Shrub
Brazilian Cherry	<i>Eugenia uniflora</i>	2	Shrub / Tree
Coffee	<i>Coffea arabica</i>	2	Shrub
Coral Tree	<i>Erythrina spp</i>	2	Shrub / Tree
Freckle Plant	<i>Hypoestes phyllostachya</i>	2	Groundcover
Ginger Lily	<i>Hedychium gardnerianum</i>	2	Shrub
Guavas	<i>Psidium spp</i>	2	Shrub / Tree
Mother-in-law's Tongue	<i>Sansevieria trifasciata</i>	2	Groundcover
Passionfruit	<i>Passiflora spp.</i>	2	Vine
Singapore Daisy	<i>Wedelia trilobata</i>	2	Groundcover
Tradescantia (Wandering Dew)	<i>Tradescantia fluminensis</i>	2	Groundcover
White Butterfly	<i>Syngonium podophyllum</i>	2	Vine
White Trumpet Flower, Monkey's Comb	<i>Pithecoctenium crucigerum</i>	2	Vine
Green Cestrum	<i>Cestrum parqui</i>	2	shrub
Creeping Inch Plant	<i>Callisia repens</i>	2	ground cover
Orange Trumpet Vine	<i>Pyrostegia venusta</i>	2	vine
Yucca	<i>Yucca elephantides</i>	2	shrub

Fucreae	<i>Fucreae sp</i>	2	shrub
Bana Grass	<i>Pennisetum purpurea</i>	2	grass
Para grass	<i>Brachiaria mutica</i>	2	grass
Bitou Bush	<i>Chrysanthemoides monilifera</i>	3	Shrub
Aerial Yam	<i>Dioscorea bulbifera</i>	3	Vine
African Olive	<i>Olea europaea ssp. africana</i>	3	Tree
Black-eyed Susan	<i>Thunbergia alata</i>	3	Vine
Blackberry	<i>Rubus fruticosus agg. Spp</i>	3	Vine
Blue Skyflower	<i>Thunbergia grandiflora</i>	3	Vine
Bush Lemon	<i>Citrus lemonia</i>	3	Shrub / Tree
Busy Lizzie	<i>Impatiens walleriana</i>	3	Groundcover
Butterfly Bush	<i>Buddleja madagascariensis</i>	3	Vine
Cadagi	<i>Eucalyptus torelliana</i>	3	Tree
Callisia	<i>Callisia fragrans</i>	3	Groundcover
Canna Lily	<i>Canna indica</i>	3	Shrub
Cape Honeysuckle	<i>Tecoma capensis</i>	3	Vine
Caster Oil Tree	<i>Ricinus communis</i>	3	Shrub / Tree
Century plant	<i>Agave spp.</i>	3	Shrub
Coast TeaTree	<i>Leptospermum laevigatum</i>	3	Shrub / Tree
Cocos Palm	<i>Syagrus romanzoffianum</i>	3	Tree
Coral Berry	<i>Rivina humilis</i>	3	Shrub
Duranta	<i>Duranta repens</i>	3	Shrub
Evening Primrose	<i>Oenothera spp</i>	3	Groundcover
Golden Rain Tree	<i>Koelreuteria paniculata</i>	3	Tree
Jacaranda	<i>Jacaranda mimosifolia</i>	3	Tree
Japanese Daisy	<i>Tithonia diversifolia</i>	3	Shrub
Lantana	<i>Lantana camara</i>	3	Shrub
Large-leaf Abutilon	<i>Abutilon grandiflorum</i>	3	Shrub
Loquat	<i>Eriobotrya japonica</i>	3	Tree
Mistflower	<i>Ageratina riparia</i>	3	Groundcover
Mulberry	<i>Morus sp</i>	3	Tree
Nightshades	<i>Solanum spp</i>	3	Shrub
Orange Jessamine	<i>Murraya paniculata</i>	3	Shrub
Pellaea viridis	<i>Pellaea viridis</i>	3	Groundcover
Periwinkle	<i>Vinca major</i>	3	Groundcover
Prickly Pear	<i>Opuntia spp</i>	3	Shrub
Tecoma	<i>Tecoma stans</i>	3	Shrub / Tree
Variegated Ribbon Grass	<i>Chlorophytum comosum cv. Variegatum</i>	3	Groundcover
Devil's Fig	<i>Solanum chrysotrichum</i>	3	Tree
Broad-leaved Paspalum	<i>Paspalum wettsteinii</i>	3	Grass
Pigeon Grass	<i>Setaria spp.</i>	3	Grass
Callisia	<i>Callisia repens</i>	3	Groundcover
Whisky Grass	<i>Andropogon virginicus</i>	3	grass
Trumpet Flower	<i>Campsis radicans</i>	3	shrub
Introduced grasses (other than those on list)	<i>Introduced grasses</i>	3	
Slash Pine	<i>Pinus elliottii</i>	3	Tree
Tabebuia	<i>Tabebuia chrysotricha</i>	3	tree
Icecream Bean	<i>Inga</i>	3	tree