



# Lake Ainsworth Vegetation Management Plan



*This vegetation management plan supersedes all previous vegetation management plans written for this area*

**Produced by  
Environmental Training and Employment Inc.  
(EnvITE NSW) & WetlandCare Australia  
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Environmental Training and Employment Inc. (EnviTE NSW)  
First Floor, 56 Carrington Street  
Lismore  
PO Box 1124  
Lismore NSW 2480  
Ph. 02 6621 9588  
FAX 02 6622 2518

Email [lismore@envite.org.au](mailto:lismore@envite.org.au)  
Web site [www.envite.org.au](http://www.envite.org.au)

WetlandCare Australia (WCA)  
PO Box 114  
Ballina NSW 2478  
Ph. 02 6681 6169  
FAX. 02 6686 6866  
Email [ballina@wetlandcare.com.au](mailto:ballina@wetlandcare.com.au)  
Web site [www.wetlandcare.com.au](http://www.wetlandcare.com.au)

**Map and Report Preparation** (Terrestrial)  
(Aquatic)  
**Technical and General Editing**

Andy Erskine  
Cassie Burns (WCA)  
Julie Reid and Emma Wagner

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*All photographs in this report, unless otherwise credited, were taken by Andy Erskine.*

## **EXECUTIVE SUMMARY**

*This plan provides practical guidelines for Ballina Shire Council and others on how to maintain the current diversity of endemic vegetation that is found within the lake and the catchment area of Lake Ainsworth in Lennox Head. A specialist component of this plan addresses aquatic vegetation both native and exotic.*

*Lake Ainsworth is located at the northern extreme of the village of Lennox Head in Ballina Shire (northern New South Wales). The area addressed in this plan is defined by a fire-trail amongst extensive heathland to the west, a picnic area and dune vegetation to the east, the northern end of the Sport and Recreation Camp to the north, and the Caravan Park to the south.*

*A number of management problems and recommended solutions are included in this plan. The western side of Lake Ainsworth is in very good order and unaffected by many of the serious environmental weeds affecting other coastal areas in the Shire. A minimum of restoration activity is required to ensure the long term conservation and enhancement of the area. Other areas around the lake have been heavily modified and subject to ongoing extensive recreational usage; appropriate vegetation management regimes are recommended.*

*The management of the aquatic vegetation within and on the foreshores of the lake is a more difficult issue. Knowledge of the aquatic flora of the lake is limited. Control of aquatic weeds and their role in the nutrient cycling within the lake is not well understood. Aquatic plants need to be managed with consideration to their impact on the lakes nutrient balance and the role this plays in the control of blue-green algae (cyanobacteria) outbreaks. The impact of aquatic plants including native species like Water Primrose on recreational amenity is another consideration. The works program for a management regime needs to consider the time frame required for such activities as propagating replacement plants from local source.*

*There are many advantageous reasons for carrying out this work including conservation of individual species and forest type, improved habitat for wildlife, and general public amenity. Environmental restoration can be very satisfying and the community/ team interaction is renowned for forming long, trusting associations between individuals.*

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## **1. INTRODUCTION**

As part of Ballina Shire Council's commitment to improving the health of Lake Ainsworth a number of studies of which this is one have been commissioned to investigate the physical nature of the lake and its immediate catchment.

This plan focuses on both terrestrial and aquatic vegetation and provides an inventory of species as well as practical guidelines for council and others on how to maintain the current diversity of endemic vegetation that is found at Lake Ainsworth.

Separate management plans have been prepared for the caravan park and for infrastructure upgrades on the the land around the lake. Each of the plans is being administered by separate departments with Ballina Shire Council.

### **1.1 Aims and Objectives of the Plan**

#### *1.1.1 Aim*

The aim of this plan is to provide practical guidelines to enable groups and individuals engaged in rehabilitating Lake Ainsworth's surrounds, to carry out works that will:

- maintain the resilience and regenerative capacity of the current native vegetation;
- reduce the potential for exotic plants, which can displace endemic species, to become established;
- provide a suitable habitat for local and migratory native fauna; and
- improve the general amenity of the area for local residents and visitors (aesthetic, recreational and educational).

#### *1.1.2 Objectives*

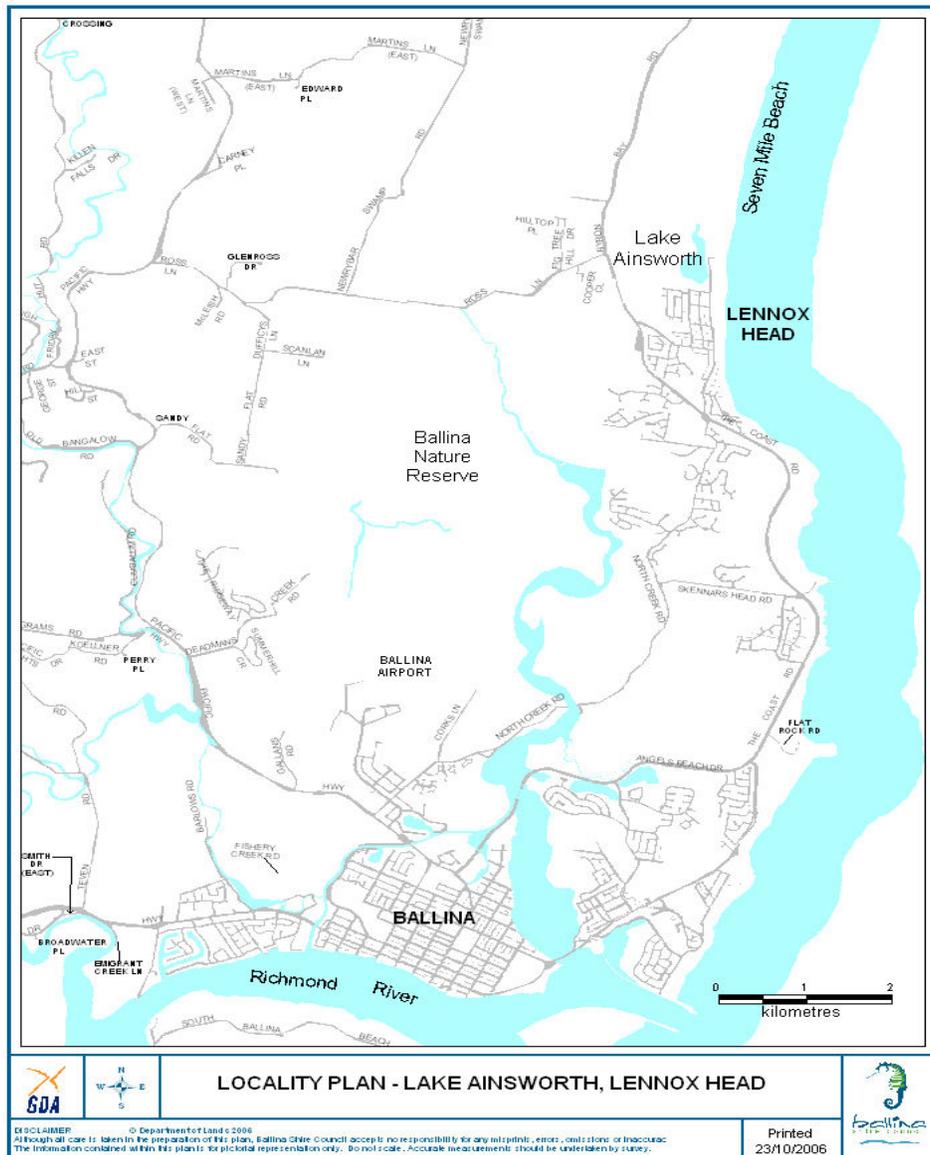
The objectives of this vegetation management plan and its recommended works are to:

- assess the condition and regeneration potential of native vegetation;
- provide information on weed species, weed control and restoration techniques;
- identify and assess threats that are contributing to the degradation of vegetation communities;
- make recommendations for the restoration of the vegetation communities;
- suggest best practice methods to undertake vegetation restoration in a manner that minimises adversely on the lake's nutrient balance and the frequency and intensity of algal blooms;
- recommend strategies to consolidate the existing vegetation through the planting of local native species in areas where natural regeneration is least likely to occur (i.e. sites that are highly disturbed and/or physically compacted);
- increase public awareness of the importance of coastal vegetation and encourage local stewardship for the area; and
- act as a supporting document for further funding.

## 2. BACKGROUND

### 2.1 Location

Lake Ainsworth is located at the outskirts of the township of Lennox Head in Ballina Shire, northern NSW (**Figure 1**). The area addressed in this plan is defined by a fire-trail amongst extensive heathland to the west, a picnic area, dune vegetation then the Coral Sea to the east, the northern end of the Sport and Recreation Camp to the north, and the caravan park to the south. The study area covers approximately 70 hectares.

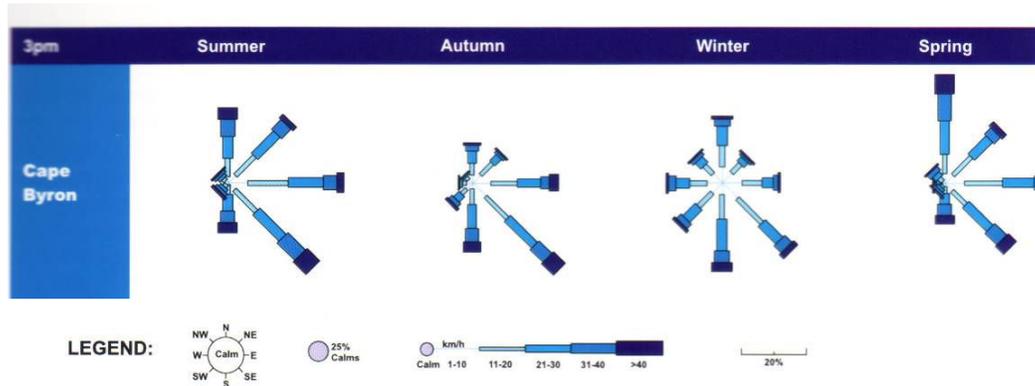


**Figure 1: A map of Lennox Head showing proximity to other landmarks and the area covered in this plan**

## 2.2 Climate

The region has a warm temperate climate with a pronounced summer/autumn “wet” season and “dry” mild winters. Rainfall is strongly seasonal with approximately 60 per cent of the annual average rainfall (of 1860.9mm) falling in the months of January to May. March is traditionally the wettest month with 283.7mm and September the driest with 52.4mm. (BSC web site, 2006).

Frosts are generally absent in the immediate coastal strip. Strong winds are experienced in summer and are predominately from the south-east. These winds are influenced by the Pacific Subtropical air mass. Winds from the north are influenced by the Tropical Maritime air mass. Refer to **Figure 2** for seasonal wind patterns in Byron Bay (20 km north of Lake Ainsworth).



**Figure 2: Seasonal wind roses showing wind direction recorded at Cape Byron headland located 20 kilometres to the north of Lake Ainsworth (Kidd, 2001)**

### 2.3 Land tenure and management requirements

Lake Ainsworth is Crown Land that is managed in trust by Ballina Shire Council and is zoned 7(f) (Environmental Protection – Coastal Lands) on Ballina Shire Council’s Local Environmental Plan. Hinddune areas to the north of the Sport and Recreation Centre are zoned 7(l) (Environmental Protection – Habitat), (see **Table 1**).

**Table 1: Land tenure for those parcels of land included in the plan**

Lot	DP	Ownership	LEP Zoning
62	8373	Crown, Lake Ainsworth Caravan Park	7f Environmental Protection
140	51873	Crown, NSW Sport & Recreation	
142	104	Crown, Camp Drew	
7001	17685	Crown	
7002	17686	Crown, Ballina Shire Council	
7003	17897	Crown	
7006	17897	Crown	
7009	17899	Crown	
7012	17877	Crown	
7014	1000372	Crown	
7015	1000371	Crown	
7653	146	Jali Aboriginal Land Council	

All land included in this report is Crown Land, part of the Ballina Coastal Reserve and Ballina Shire Council community owned land. This vegetation management plan for the coastal strip falls under the statutory Ballina Coastal Reserve Plan of Management (June 2003) created under the *Crown Lands Act 1989* for the purpose of public recreation and coastal environmental protection. The plan is also consistent with the goals of the NSW Coastal Policy 1997 in achieving a sustainable future for the NSW coastline. This vegetation management plan is also consistent with the Draft Priorities for Northern Rivers CMA Catchment Action Plan (May 2005).

The Ballina Coastal Reserve is managed by the Ballina Coastal Reserve Trust, notified 13 August 2004 and Ballina Shire Council is appointed the corporate manager of the Reserve Trust.

The Ballina Coastal Reserve Plan of Management (2003) is the overarching document rationalising all vacant Crown Lands and existing Crown Reserves into the single Ballina Coastal Reserve and guiding the management of the Reserve. Primary objectives of this zone are to protect environmentally sensitive coastal land and prevent development which would adversely affect or be adversely affected, in both short and long term, by the coastal processes. The secondary objective according to Ballina Shire Council (2003) is to enable the development of public works and recreation amenities where such development does not have significant detrimental effect on the habitat, landscape or scenic quality of the locality.

Land to the north of the study site is administered by the Jali Aboriginal Land Council. To the south are privately owned residential blocks in Ross Street, Barrett Drive, Gibbon Street, Stewart Street, Ian Avenue and Pacific Parade.

## 2.4 Geomorphology

Lake Ainsworth is a perched lake consisting of aquifer fed waters trapped above a layer of impervious coffee rock (indurated sand) (AWACS, 1996). The study area lies on an extensive coastal heath interrupted by ancient Pleistocene dunes and Melaleuca wetlands (Morand, 1994). This Pleistocene barrier is presumed to be of the last Interglacial Age (C120, 000 years old) (AWACS, 1996) and is made up of sands and clays deposited by marine and estuarine sedimentation. Groundwater immediately to the west of Lake Ainsworth flows away from the lake towards the Newrybar Swamp. It has been concluded that the groundwater divide around the lake coincides approximately with the boundary of the surface water catchment (AWACS, 1996).

Seven Mile Beach to the east of Lake Ainsworth is formed upon Quaternary (Holocene) beach and dune sand. The beach itself consists predominantly of coarse grained quartz sand with some shell fragments deposited by wave action. Dunes consist of fine to coarse grained aeolian quartz sands (Morand, 1994).

Mineral sandmining carried out from the 1930s to the 1970s (Morley, 1981) has modified the structure of the dunes (**Plate 1**), which are now likely to be less complex with fewer microenvironments than previously existed.



**Plate 1: Sand mining on Seven Mile Beach in 1935 (Source: Morley, 1981)**

## 2.5 Site History

### 2.5.1 Aboriginal Habitation

Prior to European settlement, members of the Bundjalung nation occupied several areas around the Richmond River. A well preserved Bora Ring is located in Gibbon Street in Lennox Head. This ceremonial site for the Nyangabal people and the adjacent well established workshop areas, campsites and middens bear witness to long occupation and was declared an Aboriginal Place under the management of the National Parks and Wildlife Service (NPWS) in 1973 (RRHS, 1997). A survey carried out by Collins (1992) for a subdivision south of the lake revealed four open campsites containing stone artefacts.

Midden sites have also been recorded to the north and south of Seven Mile Beach on old remnant dunes behind the beach (Campbell, 1982) and small deposits of *Turbinidae* sp. shells have been uncovered near the old four-wheel-drive beach access track by Dunecare workers.

Jolander Nayutah from the Gungil Jindabah Centre at Southern Cross University (Lismore) has advised that Lake Ainsworth is the subject of a dreaming story relating to three Bundjalung brothers, which has been documented by NPWS officers (AWACS, 1996). The lake was also known to contain large eels and turtles in the past that would have supplemented other food resources such as the Pipi (*Plebidonax deltoides*) and seasonal mass gatherings of spawning mullet, tailor and salmon. If a midden or archaeological deposits are uncovered during restoration works, the location should be immediately reported to the NPWS before continuing further disturbance.

This management plan acknowledges the living culture of local Aboriginal people and that these places are part of country and are of cultural, social and recreational importance. Consultation with the local Aboriginal community should occur to ensure the protection of cultural and heritage values of these areas.

A number of plants in the area are culturally significant to the Nyangabal people of the Ballina region. While these have not as yet been specifically documented NSW NPWS have published a booklet, *Place of Plenty – Culturally Useful Plants around Byron Bay* (Vidler, 2003). This book includes plants remembered today by elders living in neighbouring Byron Bay, and plants used elsewhere within Bundjalung country.

### **2.5.2 European Discovery**

The coast in the vicinity of Ballina was first mapped and described by Captain Cook on May 15, 1770. Cook spent only one day in the area and did not land but named Cape Byron and Mount Warning while sailing past. Cook failed to notice the entrance to the Richmond River but noted the presence of about 20 people on what is now Seven Mile Beach, just to the south of Broken Head. Sir Joseph Banks also noted these people and remarked that they completely ignored the presence of the Endeavour. This would seem to indicate that the Endeavour was not the first ship that they had seen (Richmond River Historical Society {RRHS}, 1997).

On August 20, 1828 Captain Henry Rous in the HMS Rainbow dropped anchor at Byron Bay. His mission was to discover a navigable river and safe anchorage site. On August 26, 1828 Rous discovered the entrance to the Richmond River and explored several miles upstream (RRHS, 1997).

### **2.5.3 Recent Environmental History**

Lake Ainsworth is named after James Ainsworth who selected land nearby in 1867 to grow sugarcane (RRHS, 1997). The lake and surrounding lands were proclaimed a Crown Reserve in 1893 (RRHS, 1997). Lennox Head was isolated and surrounded by swamps and thick scrub until 1906, when a bridge was built across North Creek linking it to Ballina (RRHS, 1997). Besides a few pioneering farmers and fishermen, Lennox Head had few permanent inhabitants until 1922 when the first subdivision and consequent land sales boosted the population (RRHS, 1997). The lake was always

popular (as now) for picnics and camping, and most of the eastern and southern portions of the lake were cleared of nearly all riparian and littoral vegetation to provide areas for recreation (including water skiing) in the 1960s.

The topography of Seven Mile Beach, and in particular the foredunes, is subject to continual changes in response to wave energy and tidal dynamics. The beach is prone to severe wave attack during high seas and wind erosion can create blowouts, particularly in beach access areas.

Old barbed wire that is sometimes encountered amongst the dunes is believed to be the legacy of an army encampment established beside Lake Ainsworth during World War II (Apps, D., 2002, pers. com). Seven Mile Beach is now mainly used for recreation, particularly swimming, surfing and fishing, with high visitation on weekends and holiday periods. Four-wheel-drive vehicles, dogs and horses are currently permitted on the beach north of Lake Ainsworth.

There history of the environmental history of the aquatic vegetation within the lake is patchy. The foreshore vegetation has been cleared on a number of occasions. to cater for recreational activities.

## **2.6 Site Values and Use**

Lake Ainsworth is treasured by locals and visitors alike for its scenic beauty and safe, tranquil character. Both the Department of Sport and Recreation Camp and Camp Drew have been established nearby to allow visiting youth the opportunity to share its pleasures.

A well patronised Council caravan park is located very close to the southern shore where a number of electric BBQ's and picnic tables are also found. Markets are conducted on the road between this caravan park and the lake once or twice a month.

A narrow sealed road currently separates the eastern bank from the hind dunes of Seven Mile Beach and allows vehicular access to the Sport and Recreation Camp. A current proposal closes this road for service and emergency vehicle access only, which will allow the remediation of considerable foreshore currently used for informal car parking. An alternative access road to the Sport and Recreation Camp exists to the west of the lake.

With the exception of this unsealed road and a number of fire-trails, vegetation on the western side of the lake consists of intact heath.

A survey conducted during March and April 1996 (AWACS, 1996) estimated that on one Sunday 3100 people visited the lake, with up to 1600 being present at any one time.

Despite habitat loss, fragmentation and weed incursion throughout the study site sections continue to be of high ecological value. This management plan has been formulated to ensure consistent restoration methodology to maintain the viability of this coastal ecosystem.

## **2.7 Community Landcare Groups**

The lake environment is fortunate to have a number of “care” groups maintaining its surrounds including the Lennox Head Residents Association and Lennox Head Landcare. Maintenance of these works has been supplemented by EnviTE contractors, Green Corps and Work for the Dole teams. Ballina Shire Council assists groups with provision of resources, rubbish removal, track maintenance, mowing of public areas and training in herbicide use and the management of potentially dangerous trees.

### 3. SITE ASSESSMENT

#### 3.1 Methods

##### Terrestrial

The authors of this plan have conducted a number of vegetation surveys for Lake Ainsworth's surrounds since 2001; *West Lake Ainsworth, Lennox Head Vegetation Management Plan (Envite 2002)* and *Seven Mile Beach Vegetation Management Plan (Envite 2003)*. The most recent of these were conducted during August/ September 2006. Native and weed plant species were identified (**Appendices 1 and 2**). The location, extent and condition of native vegetation were assessed and management recommendations developed for each area.

Full listing and profiles of all weed species are included in **Appendices 2 and 3**. The dominant native vegetation is also identified. Native species are listed and sites where they have been recorded have been included in the vegetation table. The condition and adequacy of fences, access paths and other facilities was also assessed.

The site has been divided into 11 terrestrial work zones (see **Figure 4**) and tasks to be undertaken at each site can be seen in the terrestrial recommendation table, **Table 2 (Section 4)**.

##### Aquatic

###### *Aquatic Vegetation History*

There is little information available on the history of the lake's aquatic vegetation. In light of this, WetlandCare Australia conducted an 'Oral History Morning Tea' at the Lake on the 8<sup>th</sup> September 2006. This morning allowed members of the public that have lived by and observed the lake for many years to convey their knowledge to WetlandCare Australia. That knowledge has been used as a basis for the recommendations in this plan (notes and attendance see **Appendix 9**).

###### *Current Aquatic Vegetation*

An extensive survey of Lake Ainsworth's current vegetation was conducted on 14<sup>th</sup> September 2006. The beginning of spring is an excellent time to assess wetland vegetation as many of the difficult to identify rushes and grasses have seed-heads or flowers, allowing accurate identification.

The sampling method used was based on the vegetation assessment of freshwater wetlands from the "Wetland Assessment Technique, Version 3.2" published by WetlandCare Australia. A canoe was used to get a clearer view of the vegetation and its extent and to gauge vegetation changes and where assessments were carried out.

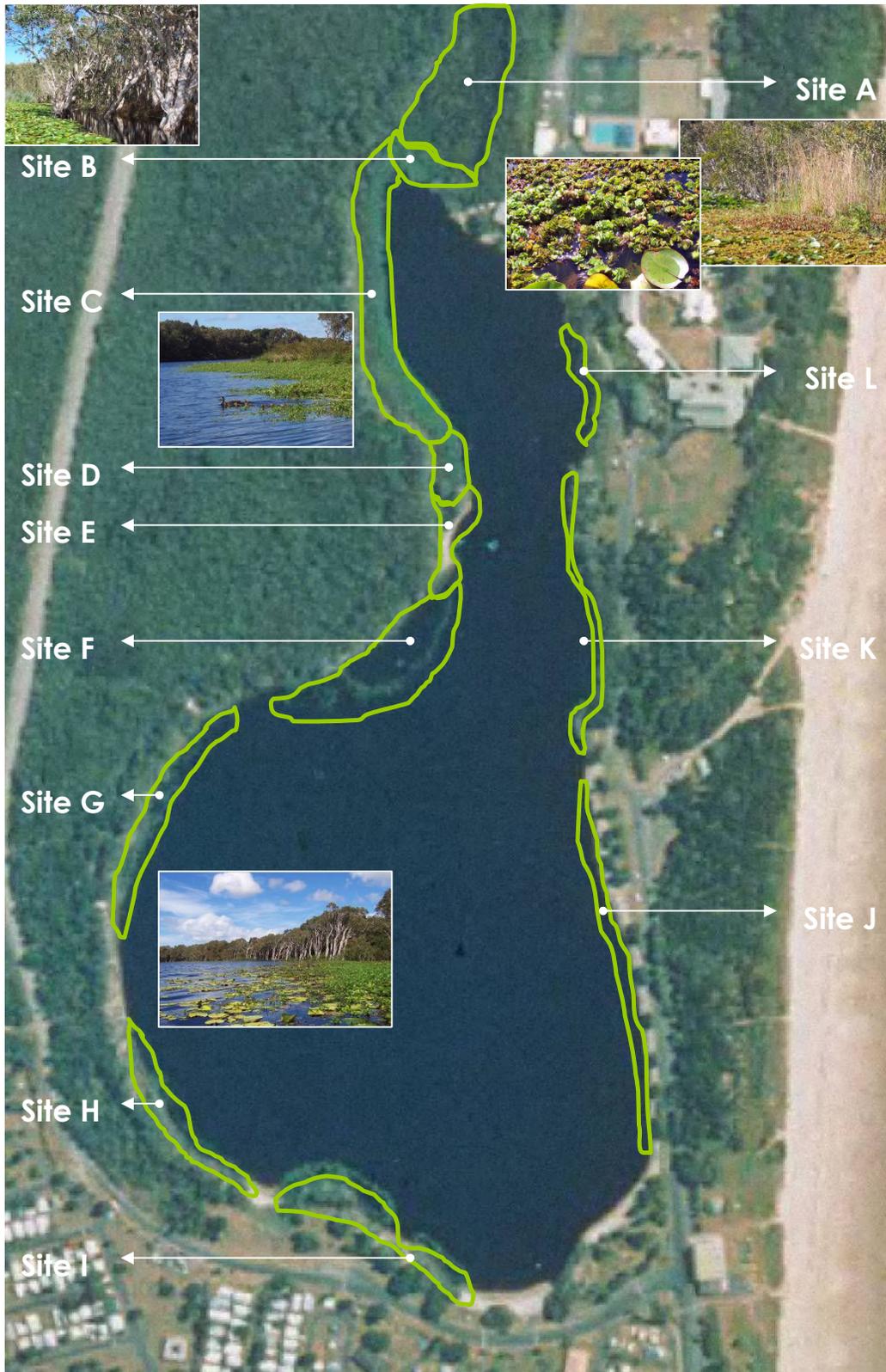
The assessment method included:

1. The lake was assessed from the water, beginning with the northern tip;
2. The vegetation community in that area was assessed, recording each species and the community structure using the DAFOR scale. The DAFOR scale allows each species in the community to be recorded as Dominant, Abundant,

- Frequent, Occasional or Rare. Depths of vegetation growth were also measured;
3. The lake was assessed as a series of aquatic plant communities, wherever there was a vegetation change, in either species or community structure, a new assessment site was recorded. Plant communities assessed are shown in **Figure 3**;
  4. All observations were recorded on field sheets (available from WetlandCare Australia on request); and
  5. Samples were taken of unknown species and identified in the office with field guides and in-house wetland plant experts, on the same day of collection. To ensure accuracy two staff members were involved in identifying plants and where necessary a third staff member was also consulted.



**Figure 3: Aerial view of Lake Ainsworth terrestrial work zones (red), contours (2m) (yellow) (Ballina Shire Council, 2003)**



**Figure 4: Aquatic vegetation assessment sites (Burns, C., 2006)**

## 3.2 Vegetation Description

### 3.2.1 Terrestrial

The study area displays a variety of ecological communities according mainly to differing heights above water level, exposure to salt laden winds, frequency of inundation, and fire sensitivity. The vegetation can generally be described as coastal sclerophyll (heath), dominated by *Banksia* spp. with low-lying areas inhabited by Melaleuca wetland. Vegetation is quite healthy, although there is a lack of seedlings and juvenile specimens in some areas, and weeds are beginning to encroach on the site. The major weeds identified near Lake Ainsworth are described in **Appendix 2**.

Remnant vegetation at Seven Mile Beach has been highly disturbed by mining, clearing, erosion control works, and weed infestation, but indicator species remain from which a model for restoration can be derived. Additionally vegetation is fragmented and exists in three distinct zones separated by other areas of recreational use. These zones are further delineated in this plan into seven areas depending on the vegetation type, location and access.

Areas further north support a frontal dune of sclerophyll vegetation dominated by a *Banksia integrifolia*, *Acacia sophorae* association. The *Acacia sophorae* and *Casuarina equisetifolia* in these areas have in most cases been planted by Lennox Head Dunecare. The hinddune consists of a narrow strip of vegetation separated from Lake Ainsworth by a road and is dominated by mature *Melaleuca quinquenervia* and the occasional rainforest species. See **Plate 2** below for dunal areas.



**Plate 2: Aerial view of Lake Ainsworth dunal areas**

Zone 3 shows some variation from other areas and the highest level of diversity, with rainforest and heath species prevalent and an encouraging number of endemic seedlings in the understorey. Troublesome environmental weeds occur throughout the entire area, despite substantial and long term efforts made by the Dunecare group to eradicate them. Seed is still entering the site via wind, birds and rubbish dumping, which if left unchecked will severely impact on current biodiversity. A description of the major weeds at Seven Mile Beach is included as **Appendix 2**.



**Plate 3: An area of frequent inundation on the western side of Lake Ainsworth**



**Plate 4: *Banksia aemula* community**



**Plate 5: *Melaleuca quinquenervia*, *Blechnum indicum* association**



**Plate 6: Looking south-east towards the lake from above the Lake Ainsworth Sport and Recreation Centre**



**Plate 7: Diverse heath in Zone 3 changes to *Melaleuca* wetland in the west as soil moisture increases**



**Plate 8: *Melaleuca quinquenervia* with floating fern *Azolla* beneath, Zone 4**

### 3.2.2 Aquatic

The aquatic vegetation of the lake seems to have undergone changes over the years in accordance with nature and due to the varying human use of the lake (ie. swimming, skiing). It seems that the recreational uses of the lake over the years have thus far dictated the management of the aquatic vegetation. This plan aims for a compromise between recreational uses and the best possible natural state for the lake.

Aquatic vegetation in the lake is important for nutrient cycling, especially uptake of nutrients, habitat and food for tortoises, fish and reptiles such as the water dragon. The vegetation is also important for bank stabilisation and filtering of run-off into the Lake. Similarly, the water quality of the lake is important to the health of the aquatic vegetation.

An extensive assessment of the aquatic vegetation of the lake was undertaken as outlined in the methods above. The following species compositions were found at each of the sites outlined in **Figure 3** above.

#### **Site A: Northern Reaches**

The northern reaches of the lake are dominated by small paperbarks, a variety of emergent water plants, interspersed with the floating native species Azolla and Duckweed. There is little open water, with the exception where the paperbarks provide shade.

(Photo: Burns, C. 2006)



#### **Site B: Mexican Waterlily and Salvinia Dominated Northern Section**

Between the open water of the lake and the closed sections of the northern reaches, Site B is a zone where the Mexican Waterlily seems to be making its way further north into Site A (where there is currently none). This lily and Salvinia dominate this area, taking over areas where native emergent and floating water plants would otherwise occur. These two exotic species seem to be choking the entrance to the northern section (Site A) and reducing water movement between the northern section and the open water. Shading from the paperbarks on the western bank seems to be preventing Salvinia and Mexican Waterlily growth on the western edge of this site.

(Photos: Burns, C. 2006)



**Site C: North-western Organic Island**

On the north-western side of the lake a long island of organic matter has formed. Behind it, where the paperbarks shade only water plants there is a 4 – 5 m wide strip of open water still remaining. On the open-water side Mexican Waterlilies, Snowflake Lilies and floating water plants extend approximately 5 m from the ‘island’. The organic matter island has more terrestrial species of plants growing on it, such as Swamp Hibiscus. There are also stands of juvenile paperbarks and Whiskey Grass (exotic). (Photos: Burns, C. 2006)

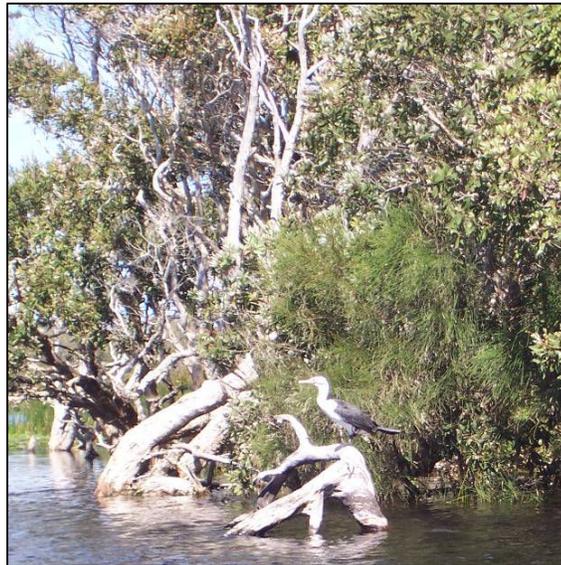


**Site D: Western Zone (1)**

This area is similar to that of Site C but is characterised by a thick stand of Water Primrose. Behind the area of primrose, the ‘island’ is becoming colonised with more terrestrial species and begins to become more connected with the lake’s edge, forming a swampy area where the open water occurs between the terrestrial and aquatic areas in Site C.

**Site E: Western Zone (2)**

Site E is again similar to Sites C and D, forming a headland in the lake where the terrestrial species grow up to the waters ‘true edge’ in this case, Blechum and paperbarks are dominant on the edge. The dominant aquatic plant at this site is the Mexican Waterlily, although much of the water surface at this site is clear of water plants. (Photo: Burns, C. 2006)



**Site F: Western Zone (3)**

Site F is again dominated by the Mexican Waterlily and also Water Primrose. The Jointed-twig Rush occurs for the first time at this site in a large stand in approximately 1 – 1.5 m of water. (Photo: Burns, C. 2006)



**Site G: Western Zone (4)**

The western-most side of the Lake has further stands of Jointed-twig Rush, Typha and lilies. This is the first site where Typha occurs. The native Snowflake Lily is more dominant at this site than the Mexican Waterlily, although it is still present. There is a large amount of Salvinia within the stands of Jointed-twig Rush. There are also some stands of juvenile paperbarks at this site. (Photo: Burns, C. 2006)

**Site H: Western Zone (5)**

The south-western corner of the lake is similar to Site G but is dominated by a thick stand of Water Primrose. Amongst the primrose are both species of lily, Typha and floating plants such as Azolla, Duckweed and Salvinia. (Photo: Burns, C. 2006)



**Site I: Southern section**

The southern section of the lake is used most by people for recreation where many areas are bare of water plants. There are two main stands of water plant at this site dominated by Water Primrose, Azolla, Salvinia and both species of water lily. (Photo: Burns, C. 2006)



***Site J: East Section***

The eastern side of the lake has been highly modified. It now contains evenly spaced, small stands of paperbarks. There are also stands of Phragmites that are thought to have been planted in the lake as there is no record of these species in the lake historically. Amongst the Phragmites, the native Snowflake Lily is present, but interestingly, not the Mexican Waterlily (this could be a result of water depth >1.5 m). Salvinia and Azolla are also frequent at this site. (Photo: Burns, C. 2006)



***Site K: North-east Section***

The north-eastern side of the lake, near the car park and the approaches to the sport and recreation ground there are a number of stands of Typha and paperbarks growing on the lake edge. There are also patches dominated by Mexican Waterlily accompanied by the Snowflake Lily, Water Primrose, Salvinia, Azolla and Duckweed. (Photo: Burns, C. 2006)



***Site L: Sports and Recreation Centre***

The north-eastern section of the lake in front of the Sport and Recreation Camp has a lot of areas devoid of aquatic vegetation. There is one main stand of vegetation dominated by Water Primrose and accompanied by both species of waterlily, Salvinia, Azolla and Duckweed.

## 4. MANAGEMENT RECOMMENDATIONS FOR LAKE AINSWORTH STUDY SITE

### 4.1 Terrestrial

#### KEY: Condition rating:

- 1 = weed dominated, native trees absent or dead.
- 2 = weed dominated with a few emergent native trees and shrubs.
- 3 = has structure of forest or original vegetation type with heavy weed infestation leading to rapid decline.
- 4 = has structure of forest or original vegetation type with heavy weed but some natural regeneration.
- 5 = has structure of original vegetation type with a number of stratus, healthy but threatened by encroaching weeds.
- 6 = vegetation in good order, sporadic weeds.
- 7 = forest or system self sustaining, needs no assistance.

**Table 2: Recommendations for terrestrial vegetation management**

Zone number and vegetation description (see Figure 3)	Condition rating (1-7)	Recommendations	Priority	Work to be performed by
<p><b>Zone 1. Southern end of lake incorporating BBQ areas.</b>                      This area is popular for day-use with mown lawns, shady trees and access to the lake for swimmers. Trees appear singly or in clumps and consist mainly of Paperbark (<i>Melaleuca quinquenervia</i>), <i>Banksia integrifolia</i> and Tuckeroo (<i>Cupaniopsis anacardioides</i>). Infrastructure consists of picnic tables, electric BBQ's, post and rail and shadecloth fencing which protect vegetation while directing swimmers to appropriate access points.</p>	N/A (Landscape)	<ul style="list-style-type: none"> <li>• Review informal car parking - vehicles should be kept away from immediate lake shore to reduce vehicle related pollutants.</li> <li>• Continue weed control in natural areas (see <b>Appendices 3 and 5</b> for weed profiles and treatment methods).</li> <li>• Evaluate condition and need for existing shadecloth fences. Remove if considered superfluous, repair if still needed.</li> </ul>	High  Medium Medium	Ballina Shire Council (BSC)  BSC or contractors  Lennox Landcare and Lennox Residents Association

Zone number and vegetation description	Condition rating (1-7)	Recommendations	Priority	Work to be performed by
<p><b>Zone 2. Narrow section of vegetation in south-west extending northward to the ‘waist’ of the lake.</b> Dry sclerophyll vegetation <i>Banksia integrifolia</i> and <i>B.aemula</i>, <i>Elaeocarpus reticulatus</i> and an understory made up of <i>Xanthorrhoea macronema</i>, Lomandra and Dianella. A single clump of the ROTAP species <i>Cordyline congesta</i> occurs in this zone. Weeds are sporadic following 5 years of control by volunteers (Approx. 20,000 Umbrella Tree seedlings, juveniles and adults were removed in 2001).</p>	<p>6</p>	<ul style="list-style-type: none"> <li>Regularly sweep through the zone controlling Umbrella Tree, Ground Asparagus, Lantana, Bitou Bush and any other weeds that may have established.</li> <li>Maintain existing fences, repair if needed, remove if considered superfluous.</li> </ul>	<p>Medium  Low</p>	<p>Lennox Landcare  Lennox Landcare</p>
<p><b>Zone 3. Broad section of vegetation on western shore contained to the west by Camp Drew access road.</b> This zone dominated by <i>M. quinquenervia</i> has only sporadic weeds with the exception of some well established Lantana on the edges of the road. A number of old drainage culverts run from the road towards the lake, the role of these drains will need to be re-evaluated should this western access road be sealed in the future.</p>	<p>6-7</p>	<ul style="list-style-type: none"> <li>Regularly sweep through the zone controlling Umbrella Tree, Ground Asparagus, Lantana, Bitou Bush and any other weeds that may have established.</li> <li>Control Lantana and Bitou Bush on edges of western access road and in drains.</li> <li>Maintain existing fences, repair if needed, remove if considered superfluous.</li> <li>Control weeds such as Whisky Grass that are present on the developing island.</li> </ul>	<p>Medium Medium Low Medium</p>	<p>Contractors assisted by Labour Market team and volunteers  BSC and contractors Volunteers  BSC and contractors Volunteers</p>

Zone number and vegetation description	Condition rating (1-7)	Recommendations	Priority	Work to be performed by
<p><b>Zone 4. A lineal strip of wetland at northern end of Lake confined to the east by the Sport and Recreation Camp.</b> Swamp area dominated by <i>M. quinquenervia</i> with an understory of <i>Azolla</i> (see <b>Plate 8</b>) and mixed <i>Cyperaceae</i>. The area is generally in good shape with only minor weed incursion.</p>	<p><b>6</b></p>	<ul style="list-style-type: none"> <li>Bush regenerators to methodically treat weeds such as Ground Asparagus and Bitou Bush as encountered (see <b>Appendix 2</b> for weed species present).</li> <li>Sport and Recreation Camp grounds maintenance staff to accompany bush regenerators on initial treatment to learn appropriate techniques.</li> <li>Revisit at 6 month intervals to treat any new or missed weeds.</li> </ul>	<p>Medium</p> <p>Medium</p> <p>Low</p>	<p>BSC or contract bush regenerators</p> <p>Sport and Rec</p> <p>BSC or contract bush regenerators or Sport and Rec staff</p>
<p><b>Zone 5. North-eastern section bounding Sport and Recreation Camp.</b> This area is regularly maintained containing a walking track and bush BBQ area. Weeds on the hind dune are relatively minor consisting of <i>Leptospermum laevigatum</i>, <i>Senna pendula</i> and Umbrella Trees.</p>	<p><b>6 but lacks diversity</b></p>	<ul style="list-style-type: none"> <li>Sport and Recreation Camp grounds maintenance staff to continue successful program of weed control they have been implementing.</li> <li>Revisit at 3 month intervals to treat any new or missed weeds.</li> </ul>	<p>Low</p> <p>Low</p>	
<p><b>Zone 6. Dunal area to the east of the Sport and Recreation Camp.</b> Bitou Bush and <i>L. laevigatum</i> persist on the foredune.</p>	<p><b>5</b></p>	<ul style="list-style-type: none"> <li>Include foredune in the larger strategy for Bitou Bush control on Seven Mile Beach.</li> </ul>	<p>Low</p>	

Zone number and vegetation description	Condition rating (1-7)	Recommendations	Priority	Work to be performed by
<p><b>Zone 7. Clump of diverse dunal vegetation at eastern entrance to Sport and Rec Camp ‘Hillarys’ Hill’.</b>                      Contains organically enriched sands possibly indicating area spared from sand mining. Rarely visited by the public and consequently has no tracks and little disturbance</p>	<p>6</p>	<ul style="list-style-type: none"> <li>Although weed infestations are light, this area requires regular minor weed control to maintain opportunity for natural regeneration. Weeds encountered will be Lantana, Bitou Bush and Umbrella Tree.</li> </ul>	<p>Low</p>	
<p><b>Zone 8. Dunal area east of southern Lake Ainsworth.</b> This area has an extensive history of maintenance initially by Lennox Head Dunecare and now from Lennox Head Landcare. Frontal dune vegetation has for the most part been planted following Bitou Bush control. Hind dune features some littoral rainforest species. Southern hind dune area dominated by “Durban Grass” (<i>Dactyloctenium australe</i>), this grass is exotic but proves to be a useful stabiliser in low light that should be retained until replacement is imminent.</p>	<p>4                      few weeds but lacks diversity and slow to naturally regenerate</p>	<ul style="list-style-type: none"> <li>Monitor for new weed germination, particularly Turkey Rhubarb and Glory Lily.</li> <li>Control Durban Grass on hind dune prior to planting activity.</li> <li>Plant hind dune in stages over a number of years with littoral rainforest species including groundcovers such as Dianella and Lomandra.</li> </ul>		
<p><b>Zone 9. Heathland to the west and north of caravan park up to fire-trail.</b></p>	<p>6</p>	<ul style="list-style-type: none"> <li>Control weeds growing in northern end of camping ground.</li> <li>Remove potential environmental weeds e.g. Cocos Palms and Umbrella Trees from landscaping.</li> </ul>		<p>BSC and contractors                      Volunteers                      BSC</p>

Zone number and vegetation description	Condition rating (1-7)	Recommendations	Priority	Work to be performed by
<p><b>Zone 10. Large expanse of heath to west of Camp Drew</b> access road contained to the west by a fire-trail before entering wet heath.</p>	<p>7</p>	<ul style="list-style-type: none"> <li>Control weeds of southern boundary of Camp Drew.</li> <li>If planting stock is required for future planting associated with the lake consider transplanting material from the fire-trails and the small lake that appears in this zone.</li> </ul>	<p>Medium Low</p>	<p>BSC and contractors Volunteers</p>
<p><b>Zone 11. Large expanse of wet and dry heath to west of zone 10.</b> A predominantly heath system that changes with minor topographical variation to wetlands dominated alternately by <i>Gharnia sieberana</i> or <i>Melaleuca quinquenervia</i>. Where more elevated Banksia, Leptospermum and epacrids prevail (see <b>Appendix 1</b> for complete species list). Overall the area is in good condition with only sporadic weeds on the edges of fire trails.</p>	<p>6-7</p>	<ul style="list-style-type: none"> <li>Treat weeds radiating from urban interface including <i>Tecoma stans</i>, <i>Bryophyllum pinnata</i> and <i>Nephrolepis cordifolia</i>.</li> </ul>	<p>High</p>	<p>BSC (in progress)</p>

## 4.2 Aquatic

### KEY: Condition rating.

- 1 = weed dominated, native plants absent or dead.
- 2 = weed dominated with a few emergent native plants.
- 3 = has structure of aquatic ecosystem or original vegetation type with heavy weed infestation leading to rapid decline.
- 4 = has structure of aquatic ecosystem or original vegetation type with heavy weed but some natural regeneration.
- 5 = has structure of original vegetation type, healthy but threatened by encroaching weeds.
- 6 = vegetation in good order, sporadic weeds.
- 7 = aquatic ecosystem self sustaining, needs no assistance.

**Table 3: Recommendations for aquatic vegetation management**

Site number and vegetation description (see Figure 4)	Condition rating (1-7)	Recommendations	Priority	Work to be performed by
<p><b>Site A</b>                      The northern reaches of the lake are naturally shallow and dominated by small paperbarks, a variety of emergent water plants, interspersed with the floating native species Azolla and Duckweed. There is little open water, only where the paperbarks provide shade. Species diversity is excellent at this site.</p>	7	<ul style="list-style-type: none"> <li>• This site is closing in on itself; there are small paperbarks establishing on islands in the 'middle' of the waterway which are likely to eventually form a paperbark swamp across the northern end of the lake. This is a fairly natural process, except for lack of flow getting though thick vegetation at Site B is preventing good water exchange/ movement, see recommendations for Site B.</li> <li>• Monitor invasion of weeds, there are no weeds at this site at present.</li> </ul>	Low	BSC

Site number and vegetation description	Condition rating (1-7)	Recommendations	Priority	Work to be performed by
<p><b>Site B</b>                      Between the open water of the lake and the closed sections of the northern reach (Site A), Site B is a zone where the Mexican Waterlily seems to be making its way further north into Site A (where there is currently none). This lily and Salvinia dominate this area, taking over areas where native emergent and floating water plants would otherwise occur. These two exotic species seem to be choking the entrance to the northern section of the lake (Site A) and reducing water movement between the northern section and the open water. Shading from the paperbarks on the western bank seem to be preventing Salvinia and Mexican Waterlily growth on the western edge of this site.</p> <p>Need to take into account the 'breeding ground' for the Salvinia weevil, a biological control of the weed.</p>	<p>3</p>	<ul style="list-style-type: none"> <li>Mechanical removal of the Yellow Waterlily and Salvinia, these two exotic plants are choking the entrance and water flow to the northern section of the lake. Removing these species will improve water flow around the lake, especially into the northern section, improve fish passage and prevent the exotic species invading further into the northern section.</li> <li>Allow natural regeneration of native Snowflake Lily, Water Ribbons and species from the Cyperaceae family.</li> <li>Ongoing monitoring of regrowth of Yellow Waterlily and Salvinia* after removal, remove as necessary (see <b>Appendix 4</b> for management and removal techniques of Salvinia).</li> </ul>	<p>High</p>	<p>BSC and contractors                      Volunteers</p>

Site number and vegetation description	Condition rating (1-7)	Recommendations	Priority	Work to be performed by
<p><b>Site C</b>                      On the north-western side of the lake a long island of organic matter has formed. Behind it, where the paperbarks shade only water plants there is a 4 – 5 m wide strip of open water still remaining. On the open-water side Mexican Waterlilies, Snowflake Lilies and floating water plants extend about 5 m from the ‘island’. The ‘organic matter island’ has many more terrestrial species growing on it, such as Swamp Hibiscus, there are also stands of juvenile paperbarks and exotic Whiskey Grass.</p>	<p>5</p>	<ul style="list-style-type: none"> <li>The island of organic matter is naturally occurring and is forming a paperbark swamp behind it, similarly to the very wet paperbark swamp existing mid-way up the western edge of the lake. Further studies into the amount of nutrients the organic ‘island’ contributes to the Lake should be conducted.</li> <li>There appear to be some terrestrial weed species on the island, these should be monitored and controlled as necessary.</li> <li>Mechanical removal of Yellow Lily and Salvinia, both of these exotic species are contributing to the nutrient load in the water and potentially increasing the speed at which the ‘organic island’ is forming.</li> <li>Allow natural regeneration of native Snowflake Lily, Water Ribbons and species from the Cyperaceae family.</li> <li>Ongoing monitoring of regrowth of Yellow Lily and Salvinia* after removal, remove as necessary.</li> </ul>	<p>Medium  Low  High</p>	<p>BSC and contractors Volunteers   BSC BSC  BSC and contractors Volunteers</p>

Site number and vegetation description	Condition rating (1-7)	Recommendations	Priority	Work to be performed by
<p><b>Site D</b> This area is similar to that of Site C, but is characterised by a thick stand of Water Primrose. Behind the primrose area, the 'island' is becoming colonised with more terrestrial species and begins to become more connected with the lake's edge, forming a swampy area where the open water occurs between the terrestrial and aquatic areas in Site C.</p>	6	<p><b>Recommendations for Sites 4-8: Western Side of the Lake</b></p> <ul style="list-style-type: none"> <li>Mechanical removal of Yellow Lily and Salvinia, both of these exotic species are contributing to the nutrient load in the water and potentially increasing the speed at which the 'organic island' is forming.</li> <li>Allow natural regeneration of native Snowflake Lily, Water Ribbons and species from the Cyperaceae family.</li> <li>Where water depths are less than 1.5 m replant and or encourage growth of <i>Baumea articulata</i> (Jointed-twig Rush), <i>Carex fascicularis</i> (Tassel Sedge), <i>Triglochin procerum</i> (Water Ribbons) and <i>Typha orientalis</i> (Cumbungi). All of these species will provide fish habitat, filter run-off and uptake nutrients in the lake.</li> <li>Removal of large stands of native Water Primrose is NOT recommended, however it should be closely monitored for obstructions to water flow or out-competing other natural species including <i>Baumea</i> or Typha. Water Primrose is important in cycling the high nutrient loads in the Lake.</li> <li>Ongoing monitoring of regrowth of Yellow Lily and Salvinia* after removal, remove as necessary.</li> </ul>	High	BSC and contractors Volunteers
<p><b>Site E</b> Site E is again similar to Sites C and D. It forms a headland in the lake, the terrestrial species grow up to the waters 'true edge' in this case, <i>Blechnum</i> and paperbarks are dominant on the edge. The dominant aquatic plant at this site is the Mexican Waterlily, although much of the water surface at this site is clear of water plants.</p>	2		High	BSC and contractors Volunteers
<p><b>Site F</b> Site F is again dominated by the Mexican Waterlily and also Water Primrose. The Jointed-twig Rush occurs for the first time at this site, in a large stand in approximately 1 – 1.5 m of water.</p>	2		Low	
<p><b>Site G</b> The western-most side of the lake has further stands of Jointed-twig Rush, Typha and lilies. This</p>	5			

<p>is the first site where Typha occurs. The native Snowflake Lily is more dominant at this site than the Mexican Waterlily, although it still occurs. There is a large amount of Salvinia within the stands of Jointed-twig Rush. There are also some stands of juvenile paperbarks at this site.</p> <p><b>Site H</b> The south-western corner of the lake is similar to Site G, but is dominated by a thick stand of Water Primrose. Amongst the primrose are both species of lily, Typha and floating plants such as Azolla, Duckweed and Salvinia.</p>	<p><b>5</b></p>			
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Site number and vegetation description	Condition rating (1-7)	Recommendations	Priority	Work to be performed by
<p><b>Site 1</b> The southern section of the lake is used most by people for recreation where many areas are bare of water plants. There are two main stands of water plants at this site dominated by Water Primrose, Azolla, Salvinia and both species of waterlily.</p>	<p>5</p>	<ul style="list-style-type: none"> <li>• A compromise between recreational use and ecological values is required at this site. Water plants should be encouraged in the areas where they currently exist, in association with stands of paperbark forest regenerated on the lake edge.</li> <li>• This section of the lake is likely to be one of the greatest sources of nutrient input, it is important to have water plants as a buffer at this site. Where water depths are less than 1.5 m replant and or encourage growth of <i>Baumea articulata</i> (Jointed-twig Rush), <i>Carex fascicularis</i> (Tassel Sedge), <i>Triglochin procerum</i> (Water Ribbons) and <i>Typha orientalis</i> (Cumbungi). All of these species will provide fish habitat, filter run-off and uptake nutrients in the lake.</li> <li>• Mechanical removal of Yellow Lily and Salvinia*, ongoing monitoring of regrowth of Yellow Lily and Salvinia after removal, remove as necessary.</li> <li>• Allow natural regeneration of native Snowflake Lily, Water Ribbons and species from the Cyperaceae family.</li> </ul>	<p>High</p> <p>High</p> <p>Medium</p>	<p>BSC and contractors Volunteers</p> <p>BSC and contractors Volunteers</p>

Site number and vegetation description	Condition rating (1-7)	Recommendations	Priority	Work to be performed by
<p><b>Site J</b> The eastern side of the lake has been highly modified. It now contains evenly spaced, small stands of paperbarks. There are also stands of Phragmites that are thought to have been planted in the lake as there are no record of these in the lake historically. Amongst the Phragmites, the native Snowflake Lily, but interestingly, not the Mexican Waterlily (this could be a result of water depth &gt;1.5 m). Salvinia and Azolla are also frequent at this site.</p>	<p>5</p>	<ul style="list-style-type: none"> <li>• Similar management for Sites I and J are required, incorporating a compromise between recreational use and ecological values.</li> <li>• Phragmites appears to be a recent addition to the lake and not something that has grown in the lake traditionally. Although the stands are not doing any harm to the lake it is recommended that Typha and <i>Baumea</i> be encouraged to grow in these areas in association with the stands of paperbarks, leaving the 'beach' areas for swimming and recreation.</li> <li>• Mechanical removal of Salvinia*, ongoing monitoring of regrowth of Yellow Lily and Salvinia after removal, remove as necessary.</li> </ul>	<p>Medium</p> <p>High</p>	
<p><b>Site K</b> The north-eastern side of the lake, near the car park and the approaches to the sport and recreation ground there are a number of stands of Typha and paperbarks growing on the lake edge. There are also patches dominated by Mexican Waterlily, accompanied by the Snowflake Lily, Water Primrose, Salvinia, Azolla and Duckweed.</p>	<p>5</p>	<ul style="list-style-type: none"> <li>• Similar management to the western side of the lake is required, this site has little disturbance from recreational users and occurs between the two main areas of recreational use, the general public accessed area to the south-east and the Sport and Recreation Camp to the north-east.</li> <li>• Mechanical removal of Yellow Lily and Salvinia*, both of these exotic species are contributing to the nutrient load in the water and potentially increasing the speed at which the 'organic island' is forming.</li> <li>• Allow natural regeneration of native Snowflake Lily, Water Ribbons and species from the Cyperaceae family.</li> <li>• Where water depths are less than 1.5 m replant and or</li> </ul>	<p>High</p> <p>High</p>	<p>BSC and contractors Volunteers</p> <p>BSC and contractors Volunteers</p>

<p><b>Site L</b> The north-eastern section of the lake in front of the sport and recreation ground has a lot of areas void of aquatic vegetation. There is one main stand of vegetation dominated by Water Primrose and accompanied by both species of lily, Salvinia, Azolla and Duckweed.</p>		<p>encourage growth of <i>Baumea articulata</i> (Jointed-twig Rush), <i>Carex fascicularis</i> (Tassel Sedge), <i>Triglochin procerum</i> (Water Ribbons) and <i>Typha orientalis</i> (Cumbungi). All of these species will provide fish habitat, filter run-off and uptake nutrients in the lake.</p> <ul style="list-style-type: none"> <li>Removal of large stands of native Water Primrose is NOT recommended, however it should be closely monitored for obstructions to water flow or out-competing other natural species including <i>Baumea</i> or <i>Typha</i>. Water Primrose is important in cycling the high nutrient loads in the lake.</li> <li>Ongoing monitoring of regrowth of Yellow Lily and Salvinia* after removal, remove as necessary</li> <li>Similar management to Sites I and J is required, incorporating a compromise between recreational use (by the Sport and Recreation Camp) and ecological values.</li> <li>It is recommended that <i>Typha</i> and <i>Baumea</i> be encouraged to grow in these areas in association with the stands of paperbarks, leaving the ‘beach’ areas for swimming and recreation.</li> <li>Mechanical removal of Salvinia* and the Yellow Lily, ongoing monitoring of regrowth of Yellow Lily and Salvinia after removal, remove as necessary.</li> </ul>	<p>High</p> <p>Low</p>	<p>BSC and contractors Volunteers</p> <p>BSC and contractors Volunteers</p>
	<p>5</p>		<p>High</p> <p>High</p>	<p>BSC and contractors Volunteers</p> <p>BSC and contractors Volunteers</p>

### 4.3 General Vegetation Management Recommendations

- The successful implementation of this plan is dependent on adequate resourcing being maintained over the life of the plan to avoid re-infestation of previously worked areas.
- The plan should be implemented under the supervision / coordination of a suitably qualified and experienced bush regenerator to ensure best practices and the health and safety of workers and the public.
- Keep local residents informed through public information campaigns and encourage support. Local business may contribute to costs and can be provided with recognition and publicity of their contribution.
- Work zones systematically, treating weeds as they are encountered in accordance with the specific methods described in **Appendix 5**. Once an area is treated, workers can move onto the next. It is a good practice to review worked areas prior to commencing work in the current area on each workday, so that regrowth and other problems can be treated immediately and follow-up maintenance is reduced. Refer to **Appendix 7** for necessary tools and equipment.
- Maintain previously worked areas by spraying (except for aquatic weeds) or hand weeding. Avoid creating piles as these are troublesome later; it is better to cut up material and scatter (except for aquatic weeds).
- When breaking new ground always consider what resources are available for follow-up treatments. If you have a team at your disposal confine their activities to an area that they can treat thoroughly or maintenance may become overwhelming. Discuss these limits, objectives and desired results openly with the team as well as the team supervisor to establish a common picture of what needs doing; this will lead to greater mutual satisfaction as well as more effective primary treatment.
- It is recognised that the volunteer time available for this project is limited. This time is best spent in low volume but frequent application of targeted herbicide, monitoring, and coordination of the available labour market programs that offer their services. Volunteer work should not become onerous.
- The continued and increased use of volunteers in rehabilitation activities is to be encouraged.
- Seed of desirable species should be collected when available (eg. December, January for *Banksia integrifolia*, *Acacia sophorae* and *Cupaniopsis anacardioides*). If plant nursery facilities are not available Ballina Council will provide room for groups to hold stock at the Council nursery or there is the option of contacting EnviTE to take delivery of this seed for propagation on a cost recovery basis.

### 4.4 General Management Recommendations

- Landcare and Dunecare groups should continue to apply for assistance from Work for the Dole teams and/ or Green Corps teams. However, care should be taken to allocate tasks to volunteers that are appropriate to the participants' level of skill.
- Frequent liaison with Ballina Shire Council should also be maintained so that council management and staff are familiar with the progress of works at Lake

Ainsworth to enable the provision of Council assistance and resources where possible.

- A brochure or flyer circulated to residents and the local schools may encourage increased volunteer participation and discourage the planting of environmental weeds in local gardens.
- Ballina Shire Council to implement a bush regeneration program utilising Council staff or contractors. The program would provide ongoing assistance to community groups particularly with highly specialised activities such as spot spraying.

**\*Salvinia removal and control (CRC for Weeds, 2003):**

1. Use floating booms to isolate main infestations of salvinia,
2. Remove manually to prevent nutrient release back into the water column,
3. Remove to a location where the Salvinia (dead/ dried or otherwise) has no way of being washed into a waterway; burial or burning is recommended,
4. Follow-up control should be conducted soon after the initial eradication and regularly after that (Salvinia can double its area in 5 - 10 days),
5. Continue use of Salvinia weevil (*Cyrtobagous salviniae*), this will allow longer term control, although this is not the best solution for the Lake as the plants die and sink, releasing nutrients back into the Lake. Also, the weevil is less effective in cooler months, allowing some regrowth of Salvinia. To continue **breeding** of the Salvinia weevil it may be possible to use a floating boom to contain a small area of Salvinia in the Lake if it is necessary. It would NOT be recommended that the boom be placed at the northern and more 'natural' end of the Lake, where current Salvinia weevil breeding is taking place.

## **5. VEGETATION MANAGEMENT ISSUES**

### **5.1 Natural Regeneration**

Adherence to the recommendations in the **Tables 2** and **3** should result in the following sequence of recovery. If this sequence of events is not noted, regeneration activities have not been successful and techniques used may need to be modified or improved.

1. Sprayed areas of weed e.g. Lantana will yellow and die, which will allow more physical space for existing native vegetation to expand and for plantings to be undertaken;
2. Green trash, that has been evenly chopped and left on the ground, will break down and form a moisture retentive mulch (weeds must not be piled up). Aerial vines, that have been severed and left in trees, will deteriorate, so that light is slowly increased allowing plants beneath to acclimatize to increased levels of light and salt. Don't pull vines or material, such as Morning Glory or Lantana from trees, cut at head height to allow maintenance access and allow debris to fall;
3. Plantings are most successful in late summer when rain is likely or in spring if water is available. These plantings will gather impetus and within a three to four year period create a canopy. With the resultant decrease in light, germination of weeds in these areas should be much reduced.

### **5.2 Revegetation**

#### **5.2.1 Plant Selection Guidelines**

Care should be taken to use an appropriate species that has been grown from seed collected nearby. Planting nursery propagated material of uncertain origin is not the preferred option. Many species, such as *Banksia integrifolia*, have a very broad geographic range but genetic differences are found across this range. Trees found on the site have adapted to the specific conditions that occur at these sites.

## 5.3 Threatened Flora Species and Ecological Communities

### 5.3.1 Threatened Flora Species

North-east New South Wales is known to support the highest number of rare or threatened plant species in Australia and is equal to the wet tropics for faunal diversity. The main threats affecting biodiversity along the Ballina Shire coastline include the introduction and establishment of exotic species, pollution, direct exploitation and habitat loss resulting from habitat fragmentation, modification and disturbance. The objective of the *Threatened Species Conservation Act 1995* (TSC Act) is to conserve threatened species, populations and ecological communities of native animals and plants (NSW NPWS 2002).

The TSC Act provides for the:

- protection of all threatened plants and animals native to NSW (excluding fish and marine vegetation),
- preparation of recovery and management strategies,
- preparation of threat abatement plans for the management of key threatening processes,
- designation of areas as critical habitat for threatened species, populations and ecological communities, and
- consideration of threatened species in development control and environmental planning.

### 5.3.2 Guidelines for working in areas where threatened flora, fauna and ecological communities occur

When threatened species are identified, strategies are required to be implemented to ensure their protection prior to undertaking any works. Responsibility for the recovery of threatened flora species rests with the Department of Environment and Conservation (DEC) (formerly NSW NPWS) who are required to prepare Recovery Plans for each species. At present, Recovery Plans have been prepared for only a small number of species and communities, many more are in preparation. Recovery actions should be carried out in accordance with those plans, and supervised by DEC or their agents (Landmark Ecological Services Pty. Ltd et al, 1999). **Table 4** lists the threatened flora species present along the Ballina Shire coastal areas including habitat and locations.

Those undertaking works in areas where threatened species occur or within a threatened community require a Section 132C licence (application for a scientific licence for the purpose of science, education or conservation) under the *National Parks and Wildlife Act 1974* (NP&W Act). A NPWS *Checklist for Bush Regeneration Activities* is also required to be completed prior to carrying out works (see **Appendix 6**).

While littoral rainforest species occur throughout the site they do not form a continuous vegetation type. Consequently it is unlikely that the site will qualify for the status of “Endangered Ecological Community - Littoral Rainforest”.

## 5.4 Fire

Soils are low in nutrients and in some cases waterlogged at the study site; consequently the vegetation has evolved to a state where fire plays an important role in nutrient recycling. The species present often have volatile foliage that encourages flammability and are equipped with mechanisms, such as epicormic buds and lignotubers, which allow them to recover after fire (**Plate 9**). Fire, as well as enriching the soil with ash, also plays an important role in the germination of many of the species present. The period since last burn, season, and fuel loads will influence the type of fire and its duration. Fire regime has important implications for the ability of species to regenerate as too long between fires or too frequent fires will result in loss of diversity. Infestations of weeds can also alter the way an area burns and affect the vegetation's ability to recover after fire. It is, however, beyond the scope of this report to include a detailed prescription for fire and its management.



**Plate 9: *Xanthorrhoea* in Zone 9 resprouting following a controlled burn**

**Table 4: NSW NPWS threatened flora species of Ballina Shire coastal areas**

<b>FAMILY CODE</b>	<b>SPECIES</b>	<b>COMMON NAME</b>	<b>TSC Act</b>	<b>ROTAP</b>	<b>FORM</b>	<b>HABITAT</b>	<b>LOCATIONS (other)</b>
AGAVACEAE	<i>Cordyline congesta</i>	Toothed Palm-lily	n/a	2RC-	shrub	In and on the margins of warmer rainforest on coastal lowlands	North of the Clarence River
LAURACEAE	<i>Cryptocarya foetida</i>	Stinking Cryptocarya	V	3VCi	tree	littoral rainforest	North from Iluka, Q
MIMOSACEAE	<i>Archidendron hendersonii</i>	Laceflower	V	n/a	tree	Variety of habitats including coastal sand	From North Qld. To the Richmond River
MYRTACEAE	<i>Syzygium hodgkinsoniae</i>	Red Lilly Pilly	V	3VC-	tree	Usually found in riverine and subtropical rainforest on rich alluvial or basaltic soils.	A restricted range from the Richmond River in North-east NSW to Gympie in Qld.
ORCHIDACEAE	<i>Acianthus amplexicaulis</i>	Mosquito Orchid	n/a	3RC-	orchid	Variety of habitats including coastal sand	Lamington NP, Broken Head NR, Bundjalung NP, Dorrigo NP, Yuraygir NP
	<i>Phaias australis</i>	Southern Swamp Orchid	E	3VCa	orchid	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas	Qld. and North-east NSW as far south as Coffs Harbour.
RUTACEAE	<i>Acronychia littoralis</i>	Scented Acronychia	E	3ECi	tree	littoral rainforest and coastal areas	Iluka to Kingscliff

\*Threatened Species Conservation Act 1995 (TSC Act) V = vulnerable, E = endangered

## **6. OTHER ISSUES**

### **6.1 Aboriginal Relics**

Consultation with the Department of Environment and Conservation, Northern Rivers Region Sites Officer (6627 0205) should occur prior to undertaking works to determine if any identified sites/ objects have been recorded under the Aboriginal Heritage Information System (AHIMS) and to determine subsequent management/consultation requirements to ensure their protection. Training should be pursued for supervising regenerators in the identification of Aboriginal sites/ objects that may be inadvertently uncovered during works.

While the proposed works will create minimal disturbance, artefacts or shell middens could be encountered during restoration works. It is an offence against the NSW NP&W Act (Section 90:1) for a person who, without obtaining the consent of the Director General, knowingly destroys, defaces or knowingly causes or permits destruction or defacement or damage to a relic or Aboriginal place.

### **6.2 Fauna**

Local birdwatchers frequent a number of trails amongst the heath at Lake Ainsworth. Birds can be useful surrogates or indicators of biodiversity. Monitoring of birds can provide information on the distribution of diversity and signal changes to ecosystems. Importantly, birds – often noisy, colourful and active during the day, are relatively easy to observe, which make monitoring accessible, unobtrusive, cost efficient and, not least enjoyable (Olsen Weston, Cunningham and Silcocks, 2003).

Loss and fragmentation of habitat in remaining natural areas are primary threats to the conservation of biodiversity, ecological processes and natural systems throughout the world (Scotts, 2003). The vegetated coastal strips of Ballina have the potential to link to areas that have been declared Key Habitats and Corridors by DEC.

Threatened nectar-eating fauna that would benefit from habitat extension of all vegetation types include the Regent Honeyeater (*Xanthomyza phrygia*) and Common Blossom-bat (*Syconycteris australis*). The Black- (*Pteropus alecto*) and Grey-headed Flying Fox survive on a diet of fruit and nectar and aid the spread of seeds and the pollination of native flowers. The presence of these vulnerable species will aid natural regeneration.

Fauna surveys were not undertaken as part of this study nor were lists located.

### **6.3 Signage**

“Most signage is used to enhance public safety, to control undesirable behaviour or to educate the community by raising awareness and understanding. Unnecessary signage is poor signage” (Kidd, R. 2001).

Signage can be a useful way to advertise stewardship of an area and to guide behaviour. It can also be used to raise awareness of issues and to interpret interesting natural features. Signs should be durable and aesthetically in keeping with the surrounds in which they will be positioned. Messages should be positive and ideally give reasons why an activity is undesirable for an area, for example: *Erosion prone area under repair please do not enter* rather than *Keep Out!*

A Landcare group may start off with one sign advertising the group but be aware that different sponsoring agencies and labour market programs may also want to advertise their involvement. For this reason, placement of the initial sign should be assessed for its ability to “carry” a number of others without becoming an eyesore. Any proposed new signage is subject to the Local Government Act and will require a Development Application to be assessed by Council prior to its placement.

Many different materials and styles are available for signs. For those placed permanently, they need to be robust, durable and attractive. Hardwood signs with routed lettering used by DEC best meet this criterium. For temporary signs such as might be used to advertise working bees, spray activities or temporary track closures, lightweight polyflute signs with laser-cut lettering are the most appropriate. These are available from your local sign writer.

Note that consent to erect permanent signs will be required from Ballina Shire Council and may entail the preparation of a Development Application; discuss with Council prior to undertaking Development Application. Council is currently preparing a Signage Development Control Plan for the Coastal Reserve.

### **6.4 Fencing**

There are a number of wire fences on both sides of the lake which have been erected over time to control pedestrian access and to protect vegetation. In many cases these fences have served their purpose and can now be removed, superfluous fences can be visually obtrusive as well as potentially hazardous to the public. Negotiations in regard to their removal, with the volunteer groups who originally installed them are currently under way.

### **6.5 Rubbish Dumping**

Dumping of rubbish and garden waste is a problem in most natural areas. It is also one of the main ways that exotic plants are introduced in vegetation remnants. Explanatory signage and personal communication with anyone observed dumping may discourage the practice, and always remove any rubbish found when working.

## 7. MONITORING

It is important to monitor the project through “before and after” photography. This provides a record of progress that will prove useful to attract further funding and identify successful techniques, as well as providing reassurance to volunteers that their work has been useful. The gradual success of rehabilitation works is best seen when specific photo points are established during the initial stages of the project and continually used.

- Photo points should be established in pairs identified with a permanent marker (stake or picket) about 10 m apart;
- Place each within sight of the other in an area where change will be evident;
- Place your back against one peg and take a photo with the other in the central focal point and then repeat the process from the other peg;
- Photographic records should be taken at least seasonally (i.e. every three to six months) and after major events, such as big plantings, storms or fires.

Records of working bees, including attendance, activities undertaken, weather constraints, successes and failures are also invaluable monitoring tools. An example of a work record sheet is included in **Appendix 8**.

Another important aspect of monitoring is maintaining species lists. The flora and weed lists in this plan (**Appendices 1 and 2**) should be continually updated as new species are recorded. It is also useful to create a fauna species list for the site that acts as an ongoing record of opportunistic sightings. This information should be shared with land managers such as Ballina Shire Council, the Department of Infrastructure, Planning and Natural Resources and DEC, Parks and Wildlife Division.

The management strategies and actions detailed in this plan are intended to provide a basis for the successful establishment of local native plant communities resembling those existing on the site prior to European settlement or replicating other sites in close proximity.

It is important that plan implementation takes into consideration changing site conditions. Regular monitoring will provide feedback on the success or failure of management strategies and allow adaptation of the rehabilitation techniques and implementation schedule to achieve maximum effectiveness in weed control and vegetation restoration.

## 8. CONCLUSION

Ballina Shire Council's initiation of this plan demonstrates support for the provision of sustainable and appropriate bush regeneration and coastal land management principles in the area. The plan aims to improve habitat for wildlife, conserve threatened species and forest types, reduce erosion, improve public amenity, and encourage wider community interest and participation in managing the coastal environment.

Bush regenerators and councils working in coastal sites must be aware of legislative changes that have been introduced to protect the fragility of coastal zones. Issues relating to undertaking work in threatened ecological communities and at sites where threatened species have been recorded has been covered in this document.

The plan provides strategies, methods and a prioritised work program for restoration of vegetation in the Lake Ainsworth catchment.

Weed infestation, fire, and urban encroachment have created an altered environment in need of protection and remediation. The recommendations aim to restore the existing vegetation structure of the ten zones.

The existing native vegetation at Lake Ainsworth is valuable in environmental, social, recreational and economic terms. Sustainable management will provide benefits to those who use this scenic area of coastline into the future.



**Plate 10: *Banksia aemula* in full bloom, Zone 10**

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## Appendix 1a: Native Plant Species List (Lake Ainsworth Catchment)

### Trees and Shrubs

Family	Scientific name	Common name	Zones	1	2	3	4	5	6	7	8	9	10	11
Mimosaceae	<i>Acacia sophorae</i>	Coastal Wattle		*	*	*	*	*	*	*	*	*	*	*
Mimosaceae	<i>Acacia suaveolens</i>	Scented Wattle		*	*	*	*	*	*	*	*	*	*	*
Mimosaceae	<i>Acacia melanoxylon</i>	Sally Wattle		*	*	*	*	*	*	*	*	*	*	*
Mimosaceae	<i>Acacia ulicifolia</i>	Prickly Moses		*	*	*	*	*	*	*	*	*	*	*
Myrtaceae	<i>Acmena smithii</i>	Lilly Pilly		*	*	*	*	*	*	*	*	*	*	*
Rutaceae	<i>Acronychia imperforata</i>	Beach Acronychia		*	*	*	*	*	*	*	*	*	*	*
Sapindaceae	<i>Alectryon coriaceus</i>	Beach Birdseye				*	*	*	*	*	*	*	*	*
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black Sheoak				*	*	*	*	*	*	*	*	*
Araceae	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm				*	*	*	*	*	*	*	*	*
Myrtaceae	<i>Austromyrtus dulcis</i>	Midgen berry		*	*	*	*	*	*	*	*	*	*	*
Proteaceae	<i>Banksia aemula</i>	Wallum Banksia			*	*	*	*	*	*	*	*	*	*
Proteaceae	<i>Banksia ericifolia</i>	Heath Leaved Banksia												
Proteaceae	<i>Banksia integrifolia</i>	Coast Banksia		*	*	*	*	*	*	*	*	*	*	*
Proteaceae	<i>Banksia oblongifolia</i>													
Euphorbiaceae	<i>Breynia oblongifolia</i>	Breynia			*									
Cupressaceae	<i>Callitris columellaris</i>	White (Coast) Cypress							*					
Casuarinaceae	<i>Casuarina glauca</i>	Swamp She-oak		*										*
Sterculiaceae	<i>Commersonia bartramia</i>	Brown Kurrajong			*			*						
Agavaceae	<i>Cordyline congesta</i>	Toothed Palm-Lily			*									
Myrtaceae	<i>Corymbia intermedia</i>	Pink Bloodwood		*	*	*	*	*	*	*	*	*	*	*

**Trees and Shrubs (continued)**

Family	Scientific name	Common name	1	2	3	4	5	6	7	8	9	10	11
Lauraceae	<i>Cryptocarya triplinervis</i>	Three Vein Laurel	*										
Sapindaceae	<i>Cupaniopsis anacardioides</i>	Tuckeroo	*	*	*	*	*	*	*			*	
Sapindaceae	<i>Dodonea triquetra</i>	Hop Bush	*		*				*	*		*	
Euphorbiaceae	<i>Duboisia myoporoides</i>	Soft Corkwood	*	*	*	*	*	*	*			*	
Elaeocarpaceae	<i>Elaeocarpus reticulatus</i>	Blueberry Ash		*	*	*							*
Myrtaceae	<i>Eucalyptus robusta</i>	Swamp Mahogany										*	*
Moraceae	<i>Ficus fraseri</i>	Sandpaper Fig					*						
Moraceae	<i>Ficus macrophylla</i>	Moreton Bay Fig			*								
Euphorbiaceae	<i>Glochidion sumatranum</i>	Umbrella Cheese tree		*	*	*			*				
Sapindaceae	<i>Guioa semiglauca</i>	Guioa		*	*	*		*	*				
Malvaceae	<i>Hibiscus tiliaceus</i>	Cottonwood				*							
Malvaceae	<i>Hibiscus diversifolius</i>	Swamp Hibiscus				*					*	*	*
Myrtaceae	<i>Homoranthus sp.</i>				*						*	*	*
Myrtaceae	<i>Leptospermum trinervium</i>										*	*	*
Epacridaceae	<i>Leucopogon parviflorus</i>	Coastal Beard Heath			*	*	*	*	*		*	*	*
Myrtaceae	<i>Lophostemon confertus</i>	Brushbox	*		*								*
Myrtaceae	<i>Lophostemon suaveolens</i>	Swamp Box											*
Euphorbiaceae	<i>Macaranga tanarius</i>	Macaranga					*						
Myrtaceae	<i>Melaleuca quinquenervia</i>	Paperbark	*	*	*	*	*	*	*		*	*	*
Rutaceae	<i>Melicope elleryana</i>	Pink Euodia		*	*	*							*
Epacridaceae	<i>Monotoca elliptica</i>	Beard Heath		*	*	*	*	*	*		*	*	*
Rutaceae	<i>Nematolepis squamea</i>	Satinwood	*	*	*	*					*	*	*
Pandanaceae	<i>Pandanus tectorius</i>	Pandanus	*										
Proteaceae	<i>Persoonia adenantha</i>	Geebung		*	*	*	*	*	*		*	*	*
Proteaceae	<i>Persoonia tenuifolia</i>	Fine-leaf Geebung			*	*	*	*	*		*	*	*
Pittosporaceae	<i>Pittosporum revolutum</i>	Hairy Pittosporum			*	*	*	*	*	*	*	*	*

**Trees and Shrubs (continued)**

Family	Scientific name	Common name	1	2	3	4	5	6	7	8	9	10	11
Euphorbiaceae	<i>Ricinocarpos pinifolius</i>	Wedding Bush			*		*						
Epacridaceae	<i>Styphelia viridus</i>	Five - Corner			*		*						
Myrtaceae	<i>Syzygium oleosum</i>	Blue Lilly Pilly	*		*								
Thymeleaceae	<i>Wikstroemia indica</i>	Bushmans Boot Lace		*	*							*	*
Xanthorrhoeaceae	<i>Xanthorrhoea johnsonii</i>	Grass Tree		*	*		*				*	*	*
Xanthorrhoeaceae	<i>Xanthorrhoea macronema</i>			*	*								*

**Vines**

Family	Scientific name	Common name	1	2	3	4	5	6	7	8	9	10	11
Vitaceae	<i>Cayratia clematidea</i>	Slender Grape					*						
Philesiaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily	*		*		*		*				
Fabaceae	<i>Glycine clandestina</i>	Glycine	*		*						*	*	
Gleicheniaceae	<i>Gleichenia dicarpa</i>	Pouched Coral Fern											*
Dilleniaceae	<i>Hibbertia scandens</i>	Twining Guinea Flower	*	*	*		*		*	*	*	*	*
Fabaceae	<i>Kennedia rubicunda</i>	Dusky Coral Pea	*	*	*		*		*		*	*	
Moraceae	<i>Maclura cochinchinensis</i>	Cockspur		*	*								
Asclepiadaceae	<i>Marsdenia rostrata</i>	Milk Vine			*		*						
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Vine		*	*						*	*	*
Apocynaceae	<i>Parsonsia straminea</i>	Common Silk Pod	*	*	*		*					*	
Smilacaceae	<i>Smilax australis</i>	Austral Sarsaparilla	*	*	*		*		*				
Menispermaceae	<i>Stephania japonica</i>	Snake Vine	*		*		*		*				

**Grasses, Groundcovers & Ferns**

Family	Scientific name	Common name	1	2	3	4	5	6	7	8	9	10	11
Adiantaceae	<i>Adiantum hispidulum</i>	Rough Maiden Hair			*								
Aspleniaceae	<i>Asplenium australasicum</i>	Birdsnest Fern		*	*	*							
Blechnaceae	<i>Blechnum indicum</i>	Swamp Water Fern	*	*	*	*						*	*
Faboideae	<i>Bossiaea ensata</i>											*	*
Cyperaceae	<i>Caustis recurvata</i>										*	*	*
Apiaceae	<i>Centella asiatica</i>		*	*	*	*					*	*	
Commeliniaceae	<i>Commelina cyanea</i>	Commelina	*	*	*								
Dicksoniaceae	<i>Culcita dubia</i>	False Bracken Fern											*
Cyperaceae	<i>Cyperus enervis</i>	A Sedge	*										
Liliaceae	<i>Dianella caerulea</i>	Flax Lily	*	*	*	*	*				*	*	*
Anthericaceae	<i>Dichopogon fimbriatus</i>	Nodding Chocolate Lilly										*	
Droseraceae	<i>Drosera sp.</i>	Sundew			*	*							*
Poaceae	<i>Eragrostis interrupta</i>	Blue Love Grass	*										
Cyperaceae	<i>Gahnia aspera</i>	Red-fruited Saw Sedge			*								
Cyperaceae	<i>Gahnia sieberana</i>				*	*						*	*
Poaceae	<i>Imperata cylindrica</i>	Blady Grass	*	*	*	*	*					*	*
Cyperaceae	<i>Isolepis nodosa</i>	Knobby Club Rush	*	*	*	*							
Cyperaceae	<i>Leperonia articulata</i>				*	*							*
Lomandraceae	<i>Lomandra longifolia</i>	Mat Rush		*	*	*						*	
Poaceae	<i>Oplismenus aemulus</i>	Basket Grass	*		*								
Polypodiaceae	<i>Platyterium superbum</i>	Staghorn Fern		*	*	*							



### Appendix 1b: Weed (Exotic) Species List

Family	Name	Common Name	1	2	3	4	5	6	7	8	9	10	11
Polygonaceae	<i>Acetosa sagittata</i>	Turkey Rhubarb								*			
Agavaceae	<i>Agave americana</i>	Century Plant				*							
Asteraceae	<i>Ageratina adenophora</i>	Crofton Weed		*									*
Asteraceae	<i>Ageratum houstonianum</i>	Blue Billy-Goat Weed		*		*							*
Poaceae	<i>Andropogon virginicus</i>	Whisky Grass											*
Asparagaceae	<i>Asparagus aethiopicus</i>	Ground Asparagus		*		*	*	*	*				
Crassulaceae	<i>Bryophyllum delagoense</i>	Mother of Millions				*	*	*	*				
Crassulaceae	<i>Bryophyllum pinnatum</i>	Resurrection Plant					*	*	*				*
Asteraceae	<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>	Bitou Bush		*	*	*	*	*	*				*
Lauraceae	<i>Cinnamomum camphora</i>	Camphor Laurel		*	*	*							
Asteraceae	<i>Conyza albida</i>	Fleabane		*									
Poaceae	<i>Digitaria didactyla</i>	Couch Grass		*									
Fabaceae	<i>Erythrina X sykesii</i>	Coral Tree					*						
Myrtaceae	<i>Eucalyptus torrelliana</i>	Cadaghi					*						
Myrtaceae	<i>Eugenia uniflora</i>	Surinam Cherry					*						
Euphorbiaceae	<i>Euphorbia cyathophora</i>	Painted Spurge						*	*				
Euphorbiaceae	<i>Euphorbia tirucalli</i>	Caustic Bush					*						
Colchicaceae	<i>Gloriosa superba</i>	Glory Lily		*									
Convolvulaceae	<i>Ipomoea cairica</i>	Coastal Morning Glory		*	*	*	*	*	*	*			*
Verbenaceae	<i>Lantana camara</i>	Lantana		*	*	*	*	*	*	*			*
Myrtaceae	<i>Leptospermum laevigatum</i>	Coast Tea Tree		*	*	*	*	*	*	*			
Fabaceae	<i>Macropitium atropurpureum</i>	Siratro		*	*	*	*	*	*	*			
Poaceae	<i>Melinis minutiflora</i>	Molasses Grass				*							
Davalliaceae	<i>Nephrolepis cordifolia</i>	Fishbone Fern					*	*	*	*			*
Ochnaceae	<i>Ochna serrulata</i>	Mickey Mouse Bush					*	*	*	*			
Passifloraceae	<i>Passiflora suberosa</i>	Corky Passionfruit				*	*	*	*	*			



## Appendix 2: Aquatic Species List

### Aquatic plants - Native

### Site

Family	Scientific name	Common name	A	B	C	D	E	F	G	H	I	J	K	L
Apiaceae	<i>Hydrocotyle verticillata</i>	Shield Pennywort	*											
Azollaceae	<i>Azolla sp.</i>	Azolla	*	*			*			*	*	*	*	*
Blechnaceae	<i>Blechnum indicum</i>	Swamp Fern	*			*	*							
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak					*	*				*		
Cyanophyceae	<i>Cyanobacteria</i>	Blue-green Algae												
Cyperaceae	<i>Baumea articulata</i>	Jointed-twig Rush	*					*						
	<i>Carex fascicularis</i>	Tassel Sedge	*											
	<i>Eleocharis sp.</i>	Spike-rush	*			*								
	<i>Lepironia articulata</i>	Lepironia	*		*									
Juncaceae	<i>Juncus sp.</i>	Rush					*							
Juncaginaceae	<i>Triglochin procerum</i>	Water Ribbons	*	*			*	*						*
Lemnaceae	<i>Lemna sp.</i>	Duckweed	*	*		*					*	*	*	*
Lentibulariaceae	<i>Utricularia sp.</i>	Bladderwort	*											
Malvaceae	<i>Hibiscus diversifolius</i>	Swamp hibiscus			*	*	*	*	*	*	*	*	*	*
Menyanthaceae	<i>Nymphoides indica</i>	Water Snowflake			*	*	*	*	*	*	*	*	*	*
Myrtaceae	<i>Melaleuca quinquenervia</i>	Paperbark	*	*	*	*	*	*	*	*	*	*	*	*
Onagraceae	<i>Ludwigia peploides ssp. montevidensis</i>	Water Primrose	*	*	*	*	*	*	*	*	*	*	*	*
Poaceae	<i>Phragmites australis</i>	Common Reed										*		
Polygonaceae	<i>Persicaria attenuata</i>	Smartweed			*	*				*	*	*	*	*
	<i>Persicaria stigosa</i>	Knotweed	*											
Typhaceae	<i>Typha orientalis</i>	Bullrush							*	*			*	*

**Aquatic Plants - Weeds**

Family	Scientific name	Common name / Site	Site											
			A	B	C	D	E	F	G	H	I	J	K	L
Asteraceae	<i>Sphagneticola trilobata</i>	Singapore Daisy												*
Nymphaeaceae	<i>Nymphaea mexicana</i>	Yellow Waterlily		*	*	*	*	*	*	*	*	*	*	*
Poaceae	<i>Andropogon virginicus</i>	Whiskey Grass			*	*	*	*	*	*	*	*	*	*
Salviniaceae	<i>Salvinia molesta</i>	Salvinia		*	*	*	*	*	*	*	*	*	*	*

## Appendix 3: Weed Profiles

### TREES & SHRUBS

#### ***Agave* sp**

#### **Century Plant**

#### **Agavaceae**

Sometimes incorrectly called Yucca, which is a separate family. Native to Southern USA & Mexico. A large family of distinctive succulents often used as 'sculptural plants' The plant was originally introduced as an ornamental and now occurs as a garden escapee in many parts of Australia (Auld and Medd, 1992). Agave spreads from either 'plantlets' borne on the flower spike or from 'off-sets' that emerge from the roots of the parent plant.

#### ***Chrysanthemoides monilifera subsp. rotundata***

#### **Bitou Bush**

#### **Asteraceae**

*Native of South Africa. A bushy shrub that can also climb, it grows on sand dunes and forest margins near beaches and poses a serious threat to native sand dune vegetation (Harden, 1992, p.315).through its ability to overwhelm plant communities on the coastal system. Up to 48,000 seeds per plant can be produced with a viability of up to seven years. Fruits are attractive to birds and reputedly foxes. There is increasing evidence that long-term domination of coastal frontal dunes by Bitou Bush leads to instability and increased erosion (Stanley et. al., 1989). It is a declared Weed of National Significance and It is a declared Class 4 weed (2006).Targeted aerial spraying with Glyphosate or Melsulfuron is sometimes used as a control method and a number of biological control insects are active following their release.*

#### ***Cinnamomum camphora***

#### **Camphor Laurel**

#### **Lauraceae**

Native of China and Japan. A large tree of spreading habit that can grow to approximately 25-30 metres. It has abundant seed production, effective dispersal mechanism, mainly by birds, and some seed dormancy. It is a hardy, long-living competitive tree which can also reproduce rapidly by suckering to form single species stands. Camphor Laurel prefers deep, well-drained red soil but will grow well on alluvial soil; it cannot, however, tolerate prolonged flooding (Firth, 1992, p.69). It is extensively naturalized in coastal areas on the North Coast of NSW (Harden, 1990, p.144). It is a declared Class 4 weed (2006).

#### ***Lantana camara***

#### **Lantana**

#### **Verbenaceae**

Native of tropical South America. A scrambling shrub that often forms dense thickets and can climb over 20 metres into trees. It grows best on well-drained, fertile soils including nutrient-enriched sands, roots also develop on branches which contact the ground, aiding its spread. It produces abundant seed, which is effectively dispersed by birds. Cut pieces can form roots and reshoot, particularly in moist conditions. According to Richard Lamb of Sydney University, when Lantana is present, particularly in sclerophyll communities, litter fall and nutrient turnover is altered, populations of native seeds are depleted, new seedlings are suppressed, soil structure is altered and micro-climate is changed, and some

nutrients may be mobilized and lost to neighboring communities and others accumulated in unnatural amounts. These changed conditions seem to further favour Lantana and other weeds over native species (Buchanan, 1989, p.72) and in many forest areas can block secondary succession. It is a declared Class 4 weed (2006).and weed of national significance (WON).

### ***Leptospermum laevigatum***

#### **Coast Tea Tree**

##### **Myrtaceae**

A dense shrub native to sand dunes and coastal cliffs south of Nambucca Heads. Introduced to Northern NSW beaches in the 1960's/70's following sandmining operations as part of their erosion control process (Bitou Bush was also planted during this period). Old stands have now formed monocultures where modified conditions hinder the germination of other species. While easily propagated in the nursery, seed germination in the wild is not prolific, perhaps due to ant predation. Groves of *L. laevigatum* are highly flammable, timber is dense and hard to cut.

### ***Ochna serrulata***

#### **Mickey Mouse Bush**

##### **Ochnaceae**

Shrub two to three metres high. Native of South Africa, often cultivated as a garden specimen. Leaves narrow glossy, mid-green, margins toothed. Yellow flowers in spring followed by red and black fruit. Seed is distributed by birds. Has an anchor like root system that will often break when hand removal is attempted.

### ***Schefflera actinophylla***

#### **Umbrella Tree**

##### **Araliaceae**

Native of North Queensland and naturalized in coastal districts of northern NSW. A tree to ten metres high, often multi-stemmed and sometimes epiphytic on rainforest trees (Harden, 1992, p.87), making removal difficult. Birds disperse its red fruit. Adventitious roots form readily from stem segments that remain in contact with the ground.

### ***Senna pendula* var. *glabrata***

#### **Winter Senna (Flowers Easter time in Northern NSW)**

##### **Fabaceae**

*Native of South America. A spreading shrub to three metres high widely naturalized in coastal areas .It produces a large number of seeds, which have a long viability. and are spread by water, ants, rodents and birds. It can also regenerate from cut material in moist conditions.*

(Note: Native members of this family have flattened seed pods rather than cylindrical).

## **CLIMBERS**

### ***Acetosa sagittata***

#### **Turkey Rhubarb**

##### **Polygonaceae**

Native of South Africa. A sprawling or ascending perennial herb which produces beet-like tubers. Leaves are heart shaped terminating in a drawn out point, stems are green and weak, it bears profuse papery hop-like flowers that ripen from green to light brown before they are blown away in the wind. Resistant to Glyphosate.

### ***Asparagus aethiopicus***

Ground Asparagus

##### **Asparagaceae**

Native of South Africa. A sprawling groundcover with thorned stems up to two metres long, profuse green berries form which turn red when ripe. New growth emerges from an underground 'crown' which if removed will kill the rest of the plant. The fleshy mechanisms found amongst the roots are for water storage, the plant will not re-grow from these. Ground Asparagus is extensively naturalized in coastal districts and is a serious weed of bushland, it can form a total ground cover thereby preventing any germination of native species and inhibiting those that are present. This plant appears to be resistant to Glyphosate but is affected by Metsulphuron.

### ***Gloriosa superba***

#### **Glory Lily**

##### **Colchicaceae**

A native of Africa and Asia this plant has been widely marketed by the horticulture industry, even at times by mail order. It is a Perennial herb with climbing stems to 4m that flower, produce fruit and die back annually The underground rhizomes that appear like a piece of rubbery polystyrene survive and will send up new growth in summer. Leaves are glossy and lanceolate with the leaf tip modified to a climbing tendril. The wheel shaped flowers are orange, yellow or red appearing on the north coast in autumn, these are followed by a fleshy, green capsule that dries and opens to reveal bright orange/brown seeds. Extremely difficult to control regrows readily from seed & roots. Spread by birds and humans. All parts of this plant are highly poisonous.

### ***Ipomoea cairica***

#### **Coastal Morning Glory**

##### **Convolvulaceae**

Native of tropical Africa and Asia. A vine that can enshroud and smother trees frequently seen on coastal dunes and the edge of wetlands. The vines can travel long distances along the ground and will take root and divide many times. To distinguish aerial or ground vines from native vines scrape the bark to reveal milky sap. Unlike some morning glory species it produces viable seed; these are dispersed by water or birds.

### ***Macroptilium atropurpureum***

#### **Siratro**

##### **Faboideae**

Native of Central and North America. introduced to Australia as a leguminous stock feed. Climbing, twining vine with, stems two to three metres long. Leaves three-foliolate two to seven centimetres long, upper surface dark green lower

surface densely whitish pubescent. Magenta pea flower followed by a small flat pea pods.

***Passiflora suberosa***

**Corky Passionfruit**

**Passifloraceae**

Native of South America. A slender vine with corky stems and small black fruit occasionally naturalized in disturbed rainforest in warmer areas (Harden, 1990, p.435). Its foliage cover inhibits photosynthesis of supporting plants, which can also be damaged by its weight. Leaves 3 lobed, pointed at ends. Birds and animals disperse its seed.

***Passiflora subpeltata***

**White Passionflower**

**Passifloraceae**

Native of Brazil. A climber which is a widespread weed along the coast on margins of rainforest and moist gullies (Harden, 1990, p.435). Its foliage cover inhibits photosynthesis of supporting plants, which can also be damaged by its weight. Birds and animals disperse its seed. Leaves pale green with 3 blunt lobes. Fruit are large and green to yellow in colour.

***Solanum seaforthianum***

**Brazilian Nightshade**

**Solanaceae**

A native of South America, this climber has been promoted as an ornamental by the horticultural industry it is now a common weed on the north coast of NSW. Its foliage is dull mid green in colour and deeply lobed. Mauve blue flowers with yellow stamens are borne in clusters, these are followed by orange, grape sized berries that are consumed and spread by birds.

***Tecomaria capensis***

**Tecomaria- Cape Honeysuckle**

**Bignoniaceae**

*An ornamental climber/shrub originating from Southern and Eastern Africa often cultivated as a hedge, where support is available it will climb. It has pinnate leaves arranged in whorls of 3 and red trumpet shaped flowers borne on the end of branches. Not observed to easily spread from seed or cuttings. This plant is only really a problem where a cultivated or relic specimen has encroached on neighbouring bushland.*

## **HERBS, GROUNDCOVERS AND GRASSES.**

### ***Ageratina adenophora***

#### **Crofton Weed**

#### **Asteraceae**

Native of Mexico. Erect, perennial, branched herb one to two metres high, growing in disturbed moist sites on fertile soils (Harden, 1992, p.151). Its seeds are dispersed mainly by wind. It can form a dense cover inhibiting and sometimes preventing natural native regeneration. Crofton weed is said to be poisonous to horses

### ***Ageratina riparia***

#### **Mistflower**

#### **Asteraceae**

Native of Mexico. Erect, perennial, sometimes decumbent herb, 0.3-1 metres high. Grows in disturbed damp sites, often in or near rainforests (Harden, 1992, p.151). Its seeds are dispersed mainly by wind, and vegetative fragments can carry downstream. It can form a dense cover, inhibiting and sometimes preventing natural native regeneration. It is a declared Category 4 weed (2006). Mist weed can cause respiratory problems in horses if browsed when the plant is flowering.

### ***Ageratum houstonianum***

#### **Blue Billy Goat**

#### **Asteraceae**

Native of Central America and the West Indies, widely cultivated as an ornamental bedding plant. In Northern NSW it is a common weed on riparian zones, edges of the rainforest, in all coastal situations and roadsides. It is a small, branched herb, 0.3-1 metre high, leaves are soft and coarsely hairy with some resemblance to Lantana. Florets are blue-mauve. Seed is spread by wind and water.

### ***Bryophyllum delagoense***

#### **Mother-of-millions**

#### **Crassulaceae**

Native of South Africa and Madagascar. Erect, succulent, perennial herb. Flowers are pendulous, red, radiating as the spokes of a wheel. Foliage are small grey & white succulent. Plantlets develop at the leaf tips forming a carpet of tiny plants, making it difficult to control. The plant also often suckers at the base and is naturalized near habitation (Harden, 1990, p.528).

### ***Bryophyllum. pinnatum***

#### **Resurrection Plant**

#### **Crassulaceae**

Native of S. Africa and Madagascar. Erect, succulent, perennial herb with light green leaves that have a crenate margin. It can sucker at the base and is often naturalized near habitation (Harden, 1990, 528). Plantlets develop at the leaf margins forming a carpet of tiny plants, making it difficult to control.

### ***Melinis minutiflora***

#### **Molasses Grass**

#### **Poaceae**

A native of Africa. A stoloniferous perennial grass up to 1.2 metres high. Foliage is hairy with a strong musty scent when brushed against. Forms dense colonies and may inhibit natural native regeneration.

***Melinus repens***

**Red Natal Grass**

**Poaceae**

A native of South America the grass is a perennial or annual with erect slender stems up to 1m high. Flowers are a panicle of small red to crimson spikelets, particularly conspicuous on roadsides when lit by the setting sun. *M. repens* is a widespread roadside and railway embankment weed, particularly in coastal NSW and QLD. (Auld & Medd, 1999).

***Pennisetum purpureum***

**Elephant or Bharna grass**

**Poaceae**

A tall grass capable of growing to 3m native to South Africa. Often used as a windbreak. Spreads through rhizomes to form dense thickets inhibiting natural native regeneration.

***Sphagneticola trilobata***

**Singapore Daisy**

**Asteraceae**

Low-growing mat with dark green deeply lobed leaves. Blooms profusely with 30mm yellow-orange flowers resembling marigolds or zinnias, which are borne singly on the end of each robust stem. Plant creeps and roots at nodes, making a dense ground cover. Often used in landscaping embankments. Difficult to control, spreads through plant pieces dispersed by garden waste dumping or by water.

***Watsonia meriana* cv. *bulbillifera***

**Bugle Lily**

**Iridaceae**

Native of South Africa. Erect perennial herb to 2m tall. 5-6m strap-like leaves at base grow to 80cm, with prominent mid-vein & leaves on flower stem much smaller. Tubular orange/red flowers on a usually unbranched stem. Aboveground parts die back to an underground corm each year. Rarely seeds, instead reproduces by growing new corms and up to 50 "cormils" in clusters on the flower stem. Corms are coated with a coarse, fibrous "tunic". Mainly spread by humans, also water (BFNS 2004). Control is extremely difficult (R. Buchanan, 1995, pers. comm.).

## AQUATIC PLANTS

### ***Salvinia molesta***

#### **Salvinia**

#### **Salviniaceae**

A native of South America, this weed is declared noxious in all of Australia. Free-floating plant to about 20cms long, with leaflets to 3cms. Prefers stationary or slow moving waterbodies where nutrients are high. Spreads primarily by fragmentation, under optimum conditions it can double the area it covers in 5-10 days. Capable of choking wetlands, killing fish, reducing water quality and harbouring mosquitos. Biological control is possible using the weevil *Cyrtobagous salviniae*, or by limiting nutrients into the system or by flooding with saline water (Sainty & Jacobs, 2003).

### ***Nymphaea mexicana***

#### **Yellow Waterlily or Mexican Waterlily**

#### **Nymphaeaceae**

A native of Mexico. A perennial with floating leaves, yellow flowers and vertical knobbly rhizomes, preferring slow moving waterbodies in NSW & Qld. New plants may become detached when small and establish elsewhere. Spread is often human assisted, they were planted in the early 1900s by acclimitisation societies. Once established it can block waterways and is difficult to eradicate (Sainty & Jacobs, 2003).

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**Source:** adapted from Joseph, R. 1995. *Rainforest Remnants Restoration and Rehabilitation Project Incorporating Plant Pest Species Survey and Prior Works Documentation: Boatharbour Nature Reserve*. NSW National Parks and Wildlife Service, Alstonville.

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**DECLARED WEEDS MARCH 2006  
(SOURCE NORTH COAST WEED AUTHORITY)**

**Control Categories**

The following Control Classes apply to noxious weeds in the local control authority area covered by the Far North Coast County Council.

- Class 1:** The plant must be eradicated from the land and the land must be kept free of the plant. Owners or occupiers of land must notify Far North Coast Weeds within 3 days after becoming aware that the weed is present
- Class 2:** The plant must be eradicated from the land and the land must be kept free of the plant. Owners or occupiers of land must notify Far North Coast Weeds within 3 days after becoming aware that the weed is present
- Class 3:** The plant must be continuously suppressed and destroyed
- Class 4:** 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
- Class 5:** Owners or occupiers of land must notify Far North Coast Weeds of the presence of the weed on land or for sale within 3 days after becoming aware that the weed is present.

## Appendix 4: Salvinia management and removal techniques:

Integrated management is recommended for Lake Ainsworth, incorporating weed harvesting, removal by hand, containment with floating booms, the Salvinia weevil (biological control) and continual monitoring. The main aim of integrating these techniques is to eradicate the Salvinia and continued control.

Steps for successful control:

1. Initial removal of large infestations in areas where little native vegetation occurs should be carried out using a mechanical weed harvester. This should be done in cooler months (May – August) to ensure minimal impact on nutrient levels in the Lake and minimum regrowth of the Salvinia
2. Floating booms should be used to contain any remaining infestations until they can be removed manually
3. A ‘sweep’ of the hard to reach areas and areas populated with native vegetation will need to be completed by hand from dinghies on the lake
4. The Salvinia weevil should be released to control any remaining infestations caught behind the floating booms (late winter, early spring is the best time to release the weevil, at least 100 weevils should be released at a time)
5. Floating booms should be left in place for a few months (at least two) after Salvinia has been removed, to contain future outbreaks while follow-up monitoring and removal is completed (follow-up monitoring should be regular and on-going)
6. Floating booms should also be used where new outbreaks are identified in follow-up monitoring
7. Herbicide is not recommended.



Above: Floating boom containing a mat of *Salvinia molesta* at the inflow of Reedy Ck into the Stanley River- ready for the release of Salvinia weevils. Source: SEQWater.



Above: Use of a floating boom to control spread of Salvinia from main source area. Photo source, Dept Land & Natural Resources, Hawaii (Lake Wilson).

“More than a year after successfully controlling a crippling infestation, Lake Wilson remains almost completely Salvinia-free. DLNR's Division of Aquatic Resources does monthly monitoring of the lake. Presently the only location where a few Salvinia plants still exist is on the South Fork amidst an area of California grass less than one acre in size. This area is completely enclosed by a floating oil boom to prevent any chance of the small plants from escaping, and the California grass which provides cover is being removed with the use of an aquatic harvester.” Dept Land and Natural Resources, Hawaii (Lake Wilson).



Above: Before and after mechanical harvester use on Salvinia. Photo source, Dept Land & Natural Resources, Hawaii (Lake Wilson).

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### **Yellow Waterlily management and removal techniques:**

The Yellow Waterlily is notoriously difficult to eradicate. An essential part of its control is follow-up monitoring and removal where necessary. An advantage of Lake Ainsworth is the water colour, once the leaves of the waterlily are removed then the plant is unable to photosynthesise and dies off. However, it is recommended in the case of Lake Ainsworth, that as much of the plant as possible be removed from the Lake, so that nutrient levels are kept in-check.

Steps for successful control:

1. Initial removal of large infestations in areas where little native vegetation occurs should be carried out using a mechanical weed harvester. This should be done in cooler months (May – August) to ensure minimal impact on nutrient levels in the Lake and minimum regrowth of the lily. Up-rooting of the whole plant is important to reduce re-growth and to avoid nutrient release into the Lake from decaying plants.
2. Removal of remaining plants will need to be completed by hand from dinghies on the lake especially in hard to reach areas and areas populated with native vegetation.
3. Follow-up monitoring should be regular and on-going to contain future growth.
4. Herbicides may be necessary, but are a last resort.

**Note:** A native waterlily also occurs in the Lake and is of significant ecological importance, when removing the Yellow Waterlily it will be important to have as little disturbance as possible to the native Snowflake Waterlily.

### **Mechanical Methods**

Mechanical controls such as cutting and harvesting are popular methods of controlling waterlilies. Cutting is less efficient than harvesting because cut plants must then be removed from the water. Harvesters both cut and collect the plants. Both methods create open areas of water. However, because waterlilies grow in shallow water and grow rapidly, they must be cut several times a year. Harvesting has been used extensively on Long Lake, Thurston County to control waterlilies.

Underwater rototilling (called rotovation) was successfully used to remove waterlilies from a small Seattle area lake where the drowning of two people was attributed to the presence of dense plant beds. Rotovation dislodges the large, fleshy waterlily rhizomes which can then be removed from the water. Although rotovation is a much more expensive process than harvesting or cutting, it results in the permanent removal of waterlily rhizomes.

Thurston County has experimented with using a barge-mounted backhoe to excavate waterlily rhizomes from the sediment. Like rotovation, excavating the rhizomes results in permanent removal of the plant. Both rotovation and excavation requires that the project proponent obtain a number of environmental permits before proceeding. (Source: Dept Ecology, Washington State).

### **Trial of reed mats to reduce nutrients, weed growth and algae outbreaks:**

The trial use of floating reed mats in the Lake is recommended to reduce increase nutrient uptake in the Lake. Further investigation of other trials in Australia is recommended before commencing use of the mats. However, studies have shown that they have been successful in reducing nutrient levels in very nutrient-rich waterbodies (refer to article below). It would also be recommended that plants naturally occurring in the Lake be used on the floating reed mats, for example *Typha orientalis*, *Carex fascicularis* and *Baumea articulata*.

Studies have shown that it's possible to remove excess nutrients from manure lagoons by growing plants on floating mats. Agricultural Research Service ([ARS](#)) scientists in Tifton, Ga., have been studying how to most efficiently use this method to extract excess nitrogen and phosphorus from wastewater so it won't become an environmental problem.

Soil scientist [Robert Hubbard](#), in the ARS [Southeast Watershed Research Unit](#) at Tifton; plant pathologist [Jeffrey Wilson](#) and geneticist [William Anderson](#) at the ARS [Crop Genetics and Breeding Research Unit](#) in Tifton; and colleagues Larry Newton, John Ruter and Gary Gascho at the [University of Georgia](#) are trying to determine the feasibility of removing excess nutrients in this way.

Lagoons are commonly used to store wastewater from confined-feeding dairy and swine operations. The nutrient-laden water is generally applied to land as fertilizer. But if it's not applied properly, any excess nitrogen and phosphorus may eventually contaminate drinking water, impair soil quality and cause "dead zones" in surface waters.

One research phase has been completed and a second is under way. The first phase was conducted in small tanks, the mats tested on full-strength wastewater, half-strength wastewater, or an inorganic solution. Vegetation was grown atop floating rafts constructed of PVC pipe and chicken wire that was covered with jute erosion-control matting.

In that phase, cattail grew the best on full-strength wastewater, produced the most biomass, and removed the most nutrients. Studies showed that harvesting cattail from the floating rafts could remove an average of 493 grams of nitrogen and 73 grams of phosphorus per square meter per year.

Now the second phase of research is being conducted at [Southern Select Farms](#), a commercial hog farm in Tifton that has a single anaerobic lagoon. A new type of floating mat, consisting of plastic foam covered with braided coir—the coarse fibers from the outer shell of coconuts—will be tested. It was designed in cooperation with [Maryland](#) and [Charleston Aquatic Nurseries](#), located in Jarrettsville, Maryland, and Johns Island, South Carolina, respectively.

Several different plant species seem to be good candidates, including St. Augustine grass, coastal Bermudagrass, and giant reed, which have potential as a source of bioenergy fuel.



Giant reed, which has shown the greatest biomass production potential for floating platforms on wastewater lagoons, is examined by technician Bobby Shiver (left) and soil scientist Robert Hubbard just before harvesting. (United States Dept of Agriculture).

## Appendix 5: Weed Treatment Methods

1. **“Cut-scrape-paint”**: this method applies to all woody shrubs, trees and some vines.
  - (a) Cut plant low to the ground at an angle.
  - (b) Apply Glyphosate immediately at the rate of 1 part Glyphosate: 1.5 parts water, with a paintbrush approximately 1.5 centimetres wide.
  - (c) Scrape sides lightly to reveal green tissue and apply the herbicide to the scraped area.
  - (d) 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 *Schefflera actinophylla*, must be removed from the parent and either composted on site or removed from the site.
2. **“Gouge-paint”**: this 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. (Asparagus).
  - (a) 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).
  - (b) Apply 1 part Glyphosate: 1.5 parts water immediately, with a paint brush approximately 1.5 centimetres wide.
3. **“Stem Injection”**: this method applies to all woody trees and shrubs with a diameter of about six to ten centimetres or greater.
  - (a) 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.
  - (b) Apply herbicide immediately into the cut using a tree-injecting device (if using Glyphosate, apply at the rate of 1 part Glyphosate: 1.5 parts water).
  - (c) 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.
  - (d) Treat all visible lateral roots as per (a).
4. **“Scrape-ditch-paint”**: this method is applicable to many species of vines where it is desirable to treat the vines intact, particularly those with aerial tubers such as *Anredera corifolia* (Madeira Vine) or those which will propagate from segments, e.g. *Delairia odorata* (Cape Ivy).
  - (a) 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.
  - (b) Apply undiluted Glyphosate with a paintbrush.
  - (c) 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.
5. **“Spraying”**: this 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, such as Protec® is added (in the past LI700® has been used. Protec® is an oil based alternative which is effective and more versatile in its applications), is added. Metsulfuron can also be used for resistant

species and grasses. It should be used with a surfactant, such as Protec® (Previously Protec® has been used for this purpose).

**Note:** where both Glyphosate and Metsulfuron 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.

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

**Dilution Rates (Glyphosate: water):**

- Plants with more or less succulent leaves, e.g. *Tradescantia fluminensis*, *Anredera cordifolia* (autumn to winter is the suggested time for spraying these plants), *Chlorophytum* spp. etc.  
1 part Glyphosate: 50 parts water + Protec®
- *Lantana camara*  
1 part Glyphosate: 100 parts water
- Other soft-leaved plants, annuals and grasses  
1 part Glyphosate: 100 parts water
- *Chrysanthemoides monilifera* subsp. *rotundata*  
1 part Glyphosate: 150 – 400 parts water

**Dilution Rates (Metsulfuron: water):**

- 1.5g Metsulfuron: 10 litres water + Protec®:

6. **“Overspray”:** this method is applicable to large, dense infestations of such plants as *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) and *Lantana camara* (Lantana), 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.

- (a) Spray over the top of the infestation, using a weak solution of Glyphosate.  
**Note:** any native plants that may be under the weed will be protected by the foliage cover of the weed.
- (b) Leave the sprayed plants intact so that native seedlings can establish under the shelter provided.

**Note:** Lantana – 1 part Glyphosate: 100 parts water

Bitou Bush – 1 part Glyphosate: 150 parts to 400 parts water

**Alternatively:** weeds can be cut and flattened with bush-hooks or loppers and the subsequent regrowth sprayed with Glyphosate.

**Note:** 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.

7. **“Crowning”:** this 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).

- (a) 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.
- (b) Insert the knife close to the base of the plant at a slight angle, with the tip well under the root system.
- (c) 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.
- (d) Remove the plant. Make sure that the base of the plant where the roots begin is completely removed.

Source: adapted from Joseph, R., 2001. *Course Notes from Certificate II in Bushland Regeneration*. TAFE, Wollongbar. Treatment Methods for Common Weeds

**Note: Ratios for Application of Herbicide**

*Dilution ratios for application of a mix of herbicide (Glyphosate based such as Round Up®) and water are provided. For example, 1:50 means that one part by volume of herbicide is mixed with fifty parts by volume of water. All cut, scrap and paint at 1:1.5 refers to Glyphosate. For some weeds a combination of Glyphosate and Metsulfuron is recommended, however a permit will be required for this off label usage.*

Protec ® is added in some treatments to assist the transfer of the herbicide through the surface tissue – particularly plants with waxy leaves, such as Camphor Laurel, Madeira Vine and Wandering Jew.

For more detail on control method techniques refer to **Appendix 5: Weed Removal and Control Techniques**. A chemical operators recording sheet has been included in **Appendix 15**.

**Trees and Shrubs**

Scientific Name	Common Name	Control Method
<i>Chrysanthemoides monilifera</i> spp. <i>Rotundata</i>	Bitou Bush	Hand pull young seedlings, cut, scrape & paint <b>1:1.5</b> small plants. Over spray mature plants if no risk to native seedlings, <i>glyphosate 1:200</i>
<i>Cinnamomum camphora</i>	Camphor Laurel	Stem inject <b>1:15</b> larger trees, cut scrape and paint <b>1:1.5</b> small plants. Spray seedlings <i>glyphosate 1:50 + Protec ®</i>
<i>Lantana camara</i>	Lantana	Lopper and cut, scrape and paint base <b>1:1.5</b> . Spray regrowth <i>glyphosate 1:100 + Protec®</i>
<i>Leptospermum laevigatum</i>	Coast Tea Tree	Cut close to ground and bag seed.
<i>Ochna serrulata</i>	Mickey Mouse Bush	Cut, scrape and paint <b>1:1.5</b> . Spray seedlings <i>glyphosate 1:50 + Protec®</i> Difficult to pull will regrow from broken root. Paint stem on larger specimens with neat <i>glyphosate</i> to a height of 50 cm
<i>Schefflera actinophylla</i>	Umbrella Tree	Hand pull seedlings and bag. Cut, scrape and paint or stem inject <b>1:1.5</b> . Cut sections, can regrow if left on the ground
<i>Senna pendula</i> var. <i>glabrata</i>	Winter Senna	Hand pull young plants or spray seedlings <i>glyphosate 1:50 + Protec. ®</i> Cut, scrape and paint <b>1:1.5</b> . Stem inject large specimens <b>1:1.5</b> , bag seeds. Crowning also possible

**Vines and Scramblers**

<b>Scientific Name</b>	<b>Common Name</b>	<b>Control Method</b>
<i>Asparagus aethiopicus</i>	Ground Asparagus	Hand remove (crowning of rhizome). Spray Metsulfuron <b>1.5g/10L</b> and <b>Protec® 20ml/10L</b> .
<i>Gloriosa superba</i>	Glory Lily	Difficult to control, spray foliage <i>glyphosate</i> ( <b>1:50 + Protec®</b> + mefsulfuron (1 gram: 10L) in spring when plants are small – September/October. Follow-up required.
<i>Ipomoea cairica</i>	Coastal Morning Glory	Hand pull, cut scrape and paint <b>1:1.5</b> . Roll up vines, spray <i>glyphosate</i> <b>1:100 + Protec®</b>
<i>Ipomoea indica</i>	Blue Morning Glory	Cut, scrape and paint stem <b>1:1.5</b> . Hand pull running stolons, roll up and allow to dry out by suspending above ground. Spray small plants and seedlings <i>glyphosate</i> <b>1:50 + Protec®</b> . Bag fruit
<i>Solanum seafortianum</i>	Climbing Nightshade	Hand pull or scrape and paint <b>1:1.5</b> . Best to locate the flower. If in seed, bag the fruit

**Herbs, Ferns and Grasses**

<b>Scientific Name</b>	<b>Common Name</b>	<b>Control Method</b>
<i>Bryophyllum delagoense</i>	Mother of Millions	Hand removal of all plants where possible; spray plantlets. Metsulfuron <b>1.5g/10L</b> with <b>Protec®</b>
<i>Bryophyllum delagoense</i>	Resurrection Plant	Hand removal of all plants where possible; spray plantlets <i>glyphosate</i> <b>1:50</b> with Brush Off <b>1.5g/10L</b> and <b>Protec®</b>
<i>Sphagneticola trilobata</i>	Singapore Daisy	Trial Metsulfuron <b>1.5g/10L</b> with <b>Protec® 20ml/10L</b>

Note: Unless otherwise stated the herbicide recommended for the techniques described above is Glyphosate e.g. Roundup®. Protec® should be used as per manufacturer's instructions. An off label permit is required from the National Registration Authority for any combination of herbicides or for rates not described on the product labels.

## Appendix 6: 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.

<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. The Wildlife Atlas is accessible on the NPWS Web Site <a href="http://www.nationalparks.nsw.gov.au">www.nationalparks.nsw.gov.au</a> .			See Tables 1& 2
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:.....			See attached s132c Licence application
Other members of the group that have bush regeneration training or experience. Name: ..... Qualifications/experience: ..... Name: ..... Qualifications/experience:.....			See attached s132c Licence application

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 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.			See attached lists for examples
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</i>			

<i>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>	Yes	No	
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>			

<p>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></p>			
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\*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.

Please sign below, keep a copy for your records and attach all original pages of checklist, and any additional information, to your application form.

<p>I, the undersigned, agree that the proposed bush regeneration activities are in accordance with all items checked above, additional information attached and the licence application form.</p>		
<p>_____</p> <p>Name (please print)</p>	<p>_____</p> <p>Signature</p>	<p>_____</p> <p>Date</p>

**Acknowledgements**

These guidelines have been developed by Dianne Brown, Annette McKinley and Maria Matthes of the Threatened Species Unit, Conservation Programs and Planning Division, National Parks and Wildlife Service, Northern Directorate, with assistance from the following people: Hank Bower (Byron Shire Council), Sue Bower, Conservation Ecologists Association, Mike Delaney (Envite), R. John Hunter (NPWS), Bob Jarman (Landcare), Rosemary Joseph (NPWS), Lisa King (Envite), Stephanie Lymburner (Australian Association of Bush Regenerators), Tein McDonald (Australian Association of Bush Regenerators), Kate McKenzie (Landcare), Julie Mousley (Landcare), John Ross, Maurizio Rossetto (Royal Botanic Gardens, Sydney), Barbara Stewart, Lisa Wellman (NPWS), Carolyn Woods (Landcare).

## Appendix 7: Tools and Equipment Required

### *Non-consumables*

- Plastic or steel boxes for equipment storage
- Leather pouches with belts to secure secateurs and knives
- Felco® secateurs (no.5)
- Victorinox® boning knives with non-slip handles
- Sandvik® loppers (no.16)
- Large bow saw
- Small pruning saws
- Poison pots, stands, and paintbrushes
- Goggles for mixing and applying herbicide
- Tomahawk or cordless drill (for tree injection)
- Tree injection unit
- Sharpening stone
- Post hole shovels for tree planting
- Hoses
- Wheel barrow
- Chemical measuring container
- Rubber gloves for measuring and applying herbicide
- Gardening gloves
- 15 litre backpack spray unit with Rega® nozzle
- Fertilizer (or other large) sacks for weed and tuber removal
- Black builders' plastic for composting
- Native plant and weed identification manuals
- Hand lens
- Camera
- First aid kit
- Tarp for laying tools out on when the ground is wet (various other uses i.e. erecting sunshade, rain protection etc.)

### *Consumables*

- Aerosol oil for tool maintenance (WD40® or Inox®)
- Tree fertilizer tablets (Agriform®)
- Diary/ journal
- Work record sheets (see Appendix 7)
- Flagging tape
- Photographic film
- Glyphosate (Roundup®)
- Metsulfuron (Brushoff® or Brush Killer®)
- Agral® – surfactant
- Spray marker dye
- Fencing material – timber posts, pig wire, shade cloth
- Trees for planting
- Nitram® – fertiliser
- Water crystals or wetting agent
- Tree guards
- Stakes or star pickets for photo points

## Appendix 8: Regeneration Record Sheet

This Ballina Shire Council Bush Regeneration Record Sheet is designed to record bush regeneration activities carried out each day. The records provide a valuable tool for monitoring project work. It is recommended that Landcare groups maintain a file of these records and also provide copies to Ballina Shire Council.



**Ballina Shire Council**  
**BUSH REGENERATION RECORD SHEET**

Supervisor: \_\_\_\_\_

ZONE / LOCATION: \_\_\_\_\_ Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

NAMES OF VOLUNTEERS:	ADDRESS	time start	time finish	signature	total hrs worked
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

(More space provided on back of form for additional volunteer names) Daily total hrs worked \_\_\_\_\_

Weather Conditions: (temperature, wind speed / direction, prevailing rain, cloud cover etc.) \_\_\_\_\_

Work Completed: (area, distance, number of plants, comments on previous works; primary or follow-up, monitoring, reminders etc.) \_\_\_\_\_

Did any Accidents / Incidents / Near Misses occur etc? (please circle) YES / NO (if YES please attach incident statement or give brief report) \_\_\_\_\_

Comments or Observations: (fauna sightings, new weeds etc.) \_\_\_\_\_

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**HERBICIDE APPLICATION RECORD SHEET (for chemical use only)** Permit No. Used: \_\_\_\_\_  
*The Pesticides Amendment Regulation as part of the Pesticides Act, 1999 requires responsible personal to complete this form within 24 hours of herbicide application, and then lodged with Ballina Shire Council to be filed for 3 years.*

NAME OF CHEMICAL CERTIFIED WORKER (S):	spray time start	spray time finish	signature
1.			
2.			
3.			

TARGET WEED SPECIES: (insert common or botanic names) \_\_\_\_\_ Date of Chemical Application: \_\_\_\_/\_\_\_\_/\_\_\_\_

HERBICIDE APPLIED: (insert trade or chemical name) \_\_\_\_\_

CONCENTRATION USED: (enter as ratio e.g. 1:15) \_\_\_\_\_ OR \_\_\_\_\_ gm/ml per \_\_\_\_\_ litres  
 + \_\_\_\_\_ gm/ml per \_\_\_\_\_ litres (if cocktail)

VOLUME APPLIED (total amount for this session): \_\_\_\_\_ litres

ADDITIONAL CHEMICAL AGENT (S) APPLIED (insert name and application rate): \_\_\_\_\_

METHOD OF APPLICATION: \_\_\_\_\_

Location of Work: (Describe area where chemical applied or mark on attached map. Incl. nearest watercourse or lake / pond) \_\_\_\_\_

PRECAUTIONS TAKEN TO PROTECT SUSCEPTABLE THREATENED / VULNERABLE SPECIES:

Species Name(s):	Precautions Taken:

Insert Bush Regeneration Site Map Here:



VOLUNTEER NAMES (Cont/d)	ADDRESS	time start	time finish	signature	total hrs worked
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					

## **Appendix 9: Notes and attendance from Oral History morning tea:**

### **Lake Ainsworth Oral History: NOTES**

(Fri 8<sup>th</sup> Sept 2006)

#### **Attendance**

Cassie Burns, WetlandCare Australia  
Andy Erskine, EnviTE  
James Brideson, Ballina Shire Council  
Gary Varga, Ballina Shire Council  
Lyn Walker, Ballina Environment Society & Lake Ainsworth Access Group  
Les Hynes, Lennox Head Landcare  
Malcolm Milner, Lennox Head Landcare  
Dick Jensen, Residents Association  
Dave Pont, Ecotech  
Dorothy Thompson, Lennox Heritage Committee  
Delia Gibbon,  
Gladys Malcahy, Lennox Head Residents Association  
Brian Smith, Lennox Head Residents Association  
Marelle Lee, Richmond River Historical Society  
Yvette Chasling

#### **General Observations**

- Late 1800s – Gold mining near the Lake
- 1960s and 70s – Sand mining near the Lake
- It is thought that dog and horse manure add to the current nutrient level in the Lake
- Many more Ducks, Pelicans and Seagulls on the Lake – less Owls, Swans, Swamp hens
- Sand banks have formed and been removed from the south-eastern area of the Lake (1990's)
- Boggy, vegetation matter, peat - area in south-eastern corner in early 1940s – 1950s
- The road where the markets are held used to be swamp
- There were 2 breaches of the Lake by the sea reported, 1930's and 1970's. In both cases the breach occurred next to the pump station at Sport and Rec camp, sea only entered at high tide on both occasions
- Fires in the heath were much more frequent. They were lit almost yearly as hazard reduction for Camp Drewe. A photo presented shows the whole western bank burnt out in 1953.
- "Drainage at northern end of lake was disturbed when dirt road (western rd) was installed"

## Vegetation Changes

- Less reeds now than 30 or more years ago (*Typha*, *Lepironia*, *Cyperus*, *Baumea*). Council removed a significant of reeds and rushes at least twice, once in 1957 (for swimmers) and again in 1990s (for skiers). Much more *Baumea* than now, growing in with the *Typha*
- *Typha* dense on western side 1950's - 60's. *Baumea* all around western side
- 1992, little vegetation around the southern and eastern sides of the Lake at all
- Phragmites in Lake for first time ever, not native to Lake
- More lilies now than 30+ years ago, "water lilies only at northern end of lake, blue only") check species, some appear to be exotic sp. *Nymphaea Mexicana*
- Blue green algae much worse, getting worse over last 30+ years, although there was some 40 - 50 years ago
- Algae like *Spyrogyra* used to grow at northern end of the Lake
- *Salvinia* was present in the 1990s
- Northern end of the Lake traditionally dominated by plant thought to be Water Ribbons (*Triglochin* sp.) and the Native Lily
- Some *Persicaria* found around the Lake
- The eastern side of the lake was kept bare of vegetation until 1992 when *M. quinquenervia* were planted.

## Vegetation List (provided by Mrs. Chaseling)

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|---|---|
| <ul style="list-style-type: none"> <li>• Ti-tree (<i>Leptospermum</i>)</li> <li>• Honey suckle (2 sp Banksia)</li> <li>• She oak (2 sp)</li> <li>• Round reeds (<i>Baumea</i>, <i>Lepironia</i>)</li> <li>• Bulrushes (<i>Typha</i>)</li> <li>• Duck-weed (<i>Azolla</i>)</li> <li>• Knobbly water plant (possibly <i>Triglochin</i> sp)</li> <li>• Blue water-lilies</li> <li>• Moss (coloured)</li> <li>• Moss (spongy)</li> <li>• Moss (Green &amp; ferny) (possibly Coral Fern)</li> <li>• Blady grass</li> <li>• Couch</li> <li>• Kikuyu</li> <li>• Shivery grass</li> <li>• Dwarf pine</li> <li>• Dwarf gum (2" thick)</li> </ul> | <ul style="list-style-type: none"> <li>• Midginberry</li> <li>• Five-corners</li> <li>• Sturt desert pea (this would be <i>Kennedia rubicunda</i>)</li> <li>• Wild sultanas</li> <li>• Pandorea</li> <li>• Blackboy</li> <li>• Cutting grass (<i>Gahnia</i>)</li> <li>• Buttercup</li> <li>• Dog wattle</li> <li>• Vanilla plant</li> <li>• Tick plants</li> <li>• Geebung</li> <li>• Sally wattle (west of road)</li> <li>• Lilly pilly</li> <li>• Melaleuca</li> <li>• Wild violets (native violet)</li> <li>• Sulphur plant</li> <li>• Ferns (<i>Blechnum</i> &amp; others)</li> <li>• Spikey plant</li> </ul> |
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- White flowered shrub
- Yellow pea shrub
- Bracken fern
- Aromatic plant

#### Weeds

- Phragmites (Native but introduced to Lake?)
- Norfolk pines

#### Fauna

- Swamp pheasant
- Water dragon
- Pee-wee
- Magpie
- Frogs
- Kingfisher
- Willy wag-tail
- Swamp hen
- Kookaburra
- Fan-tail
- Plover
- Blue crane
- Cormorant
- Dragonfly
- Snakes
- Water snakes

- Sheoak (Native but introduced to Lake?)
- Yellow lilies
- Salvinia
- White lily (tiny) (Native, Water Snowflake *Nymphoides indica*)
- Umbrella tree
- Lantana

- Ibis
- Swift
- Swallow
- Tortoise
- Native fish
- Ducks
- Eels
- Owls
- Echidna
- Bandicoot
- Kangaroo/Wallaby

#### Exotic Fauna

- Catfish
- Bass
- Cane toad
- Mosquito fish