



VEGETATION MANAGEMENT PLAN

**Lot 112 DP 1073791
Lyons Road, Sawtell**

JANUARY 2011

**A REPORT PREPARED FOR
UTILA PTY LTD**

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1. INTRODUCTION

1.1 Background

James Warren and Associates (JWA) have been engaged by Utila Pty Ltd to prepare a Vegetation Management Plan (VMP) for the Riparian Corridors within Lot 112 DP 1073791, Lyons Road, Toormina (**FIGURE 1**).

Concept approval has been granted by the Department of Planning (DoP) - Application No. 08_0080 and Director General's Requirement (DGRs) issued. The DGRs require the consideration of the existing aquatic and riparian environment and proposed water courses.

A Flora and Fauna Assessment was completed by Gunninah Environmental Consultants in 1997 and by JWA in November 2008. A summary of the results of the JWA assessment is included in this report (**SECTION 2**).

1.2 The Subject Site

1.2.1 Description and Location

The subject site, Lot 112 DP 1073791, is situated on the outskirts of Sawtell on the NSW mid-north coast. The site covers an area of approximately 38.5 ha (**FIGURE 2**). Forested wetland covers the eastern third of the site and partially vegetated wetland extends along drainage lines running from the north-west and south-west. The remainder of the site is cleared land currently used for grazing (approximately 25 ha). The site adjoins Bongil Bongil National Park.

1.2.2 Land Use Zones

The site covers the following land use zones:

- 2(a) Residential - Low Density;
- 6(a) Open space - Public Recreation; and
- 7(a) Environmental Protection - Habitat & Catchment.

Land zones are shown in **FIGURE 3**.

1.3 The Proposed Development

The proposed development is for a residential subdivision comprising of 151 low density lots and three land parcels for medium density housing with the potential to accommodate 42 medium density lots. The development will also include associated roads, infrastructure, public open space areas and a residential public reserve.

1.4 Aims and Objectives

1.4.1 Overall Aim

The aim of this VMP is to provide guidelines for the restoration and management of the native vegetation along the riparian corridors of the subject site.



SUBJECT SITE



0 500m

SOURCE: Google Maps

SCALE: 1 : 15 000 @ A4

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FIGURE 1

PREPARED: BW
DATE: 20 May 2010
FILE: N08022_VMP_Locality.cdr

TITLE

LOCALITY PLAN



Legend
[Red Outline] Subject Site

0 50m 100m
1 : 4000

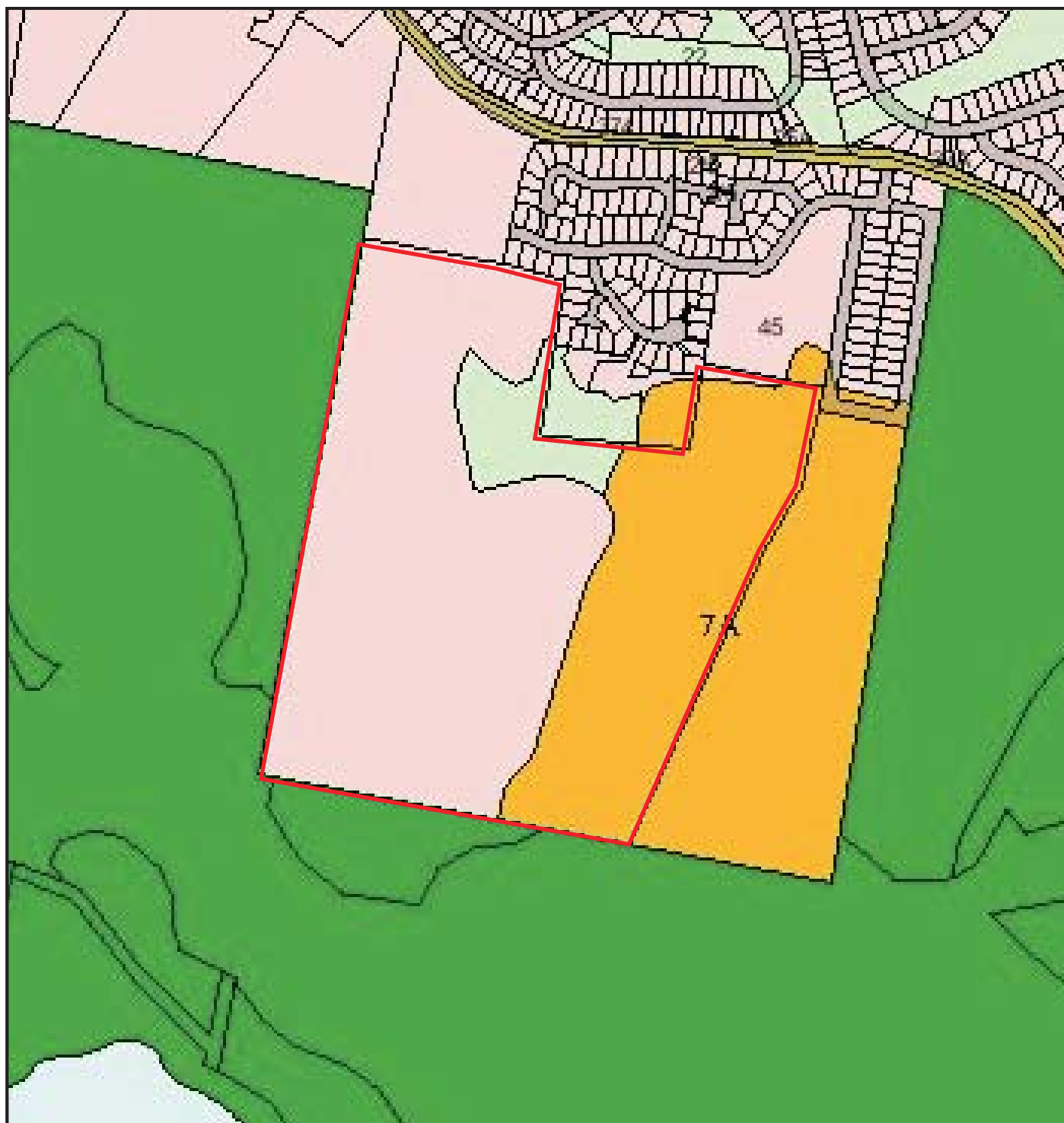
SOURCE: Google Earth 2008 Aerial Photograph
SCALE: 1 : 4000 @ A3
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FIGURE 2

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TITLE
**AERIAL
PHOTOGRAPH**



Legend

- 2a Residential - Low Density
- 6a Open Space - Public Recreation
- 7a Environmental Protection - Habitat & Catchment
- 8 National Park & Reserves
- Subject Site

0 100m 200m



SOURCE: Coffs Harbour City Council - LEP Maps Online

SCALE: 1 : 8000 @ A4

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FIGURE 3

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TITLE

**ZONING
PLAN**



1.4.2 Specific Objectives

The specific objectives of the VMP are:





- To enhance the conserved vegetation by revegetating with indigenous species;
- To buffer the waterways from edge effects and other disturbance related impacts;
- To ensure retained vegetation is of low fire risk;
- To improve the value of the subject site as habitat for fauna groups;
- To improve the value of the subject site as a wildlife corridor;
- To manage weeds using revegetation best practice weed control methods; and
- To utilise revegetation to reduce nutrient and sediment loads and other potential impacts arising from the proposed development.

1.4.3 Areas of Focus - Rehabilitation Area

The Water Management Act 2000 requires that controlled activities carried out in or under waterfront land are now regulated. The document “Guidelines for controlled activities - Riparian corridors” (DWE 2008) outlines appropriate widths for riparian corridors and how much riparian vegetation should be protected or re-established. The Rehabilitation Area (RA) will cover the Core Riparian Zone (CRZ) as set out following the Guidelines (DWE 2008). The area roughly covers the Freshwater Wetlands, the north-west and south-west drainage lines, and a portion of the Swamp Sclerophyll Forest in the east of the site (**SECTION 2.3**). Required buffer widths are also included in the VMP (**FIGURE 4**).



Legend

-  1st Order Watercourse
-  2nd Order Watercourse
-  Core Riparian Zone
-  Subject Site

0 50m 100m
1 : 4000

SOURCE: JWA Site Investigations; Worley
Parsons (Ref: Fig3.pdf); Google Earth 2008 Aerial
SCALE: 1 : 4000 @ A3
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FIGURE 4

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DATE: 20 May 2010
FILE: N08022_VMP_CRZ.cdr

TITLE
**REHABILITATION
ZONE - CORE
RIPARIAN ZONE**



2. EXISTING VEGETATION VALUES

2.1 Introduction

The subject site consists of a combination of forested wetland, wetland and grazing land. The majority of native vegetation has been cleared leaving the site highly degraded and modified. Forested wetland covers the eastern third of the site and partially vegetated wetland extends along drainage lines running from the north-west and south-west.

2.2 Vegetation Communities

2.2.1 Background

A vegetation assessment was completed by two (2) scientists from JWA in November 2008. Six (6) vegetation communities were identified and are listed in **TABLE 1**. A species list compiled and is contained in **APPENDIX 1**. The location and extent of vegetation communities is shown in **FIGURE 5**. A further assessment was carried out in October 2009 specifically examining the riparian corridors and compiling a weed species list (**APPENDIX 1**).

TABLE 1
VEGETATION COMMUNITIES PRESENT ON THE SUBJECT SITE

1	Tall open swamp sclerophyll forest (<i>Eucalyptus robusta</i>)
2	Tall open/closed swamp sclerophyll forests (<i>Melaleuca quinquenervia</i>)
3	Tall open dry sclerophyll forest (Mixed species)
4	Low closed sedgeland/wet pasture (<i>Juncus usitatus</i> +/- <i>Chorizandra cymbaria</i> / <i>Philydrum lanuginosum</i>)
5	Low closed grassland with scattered trees
6	Dams

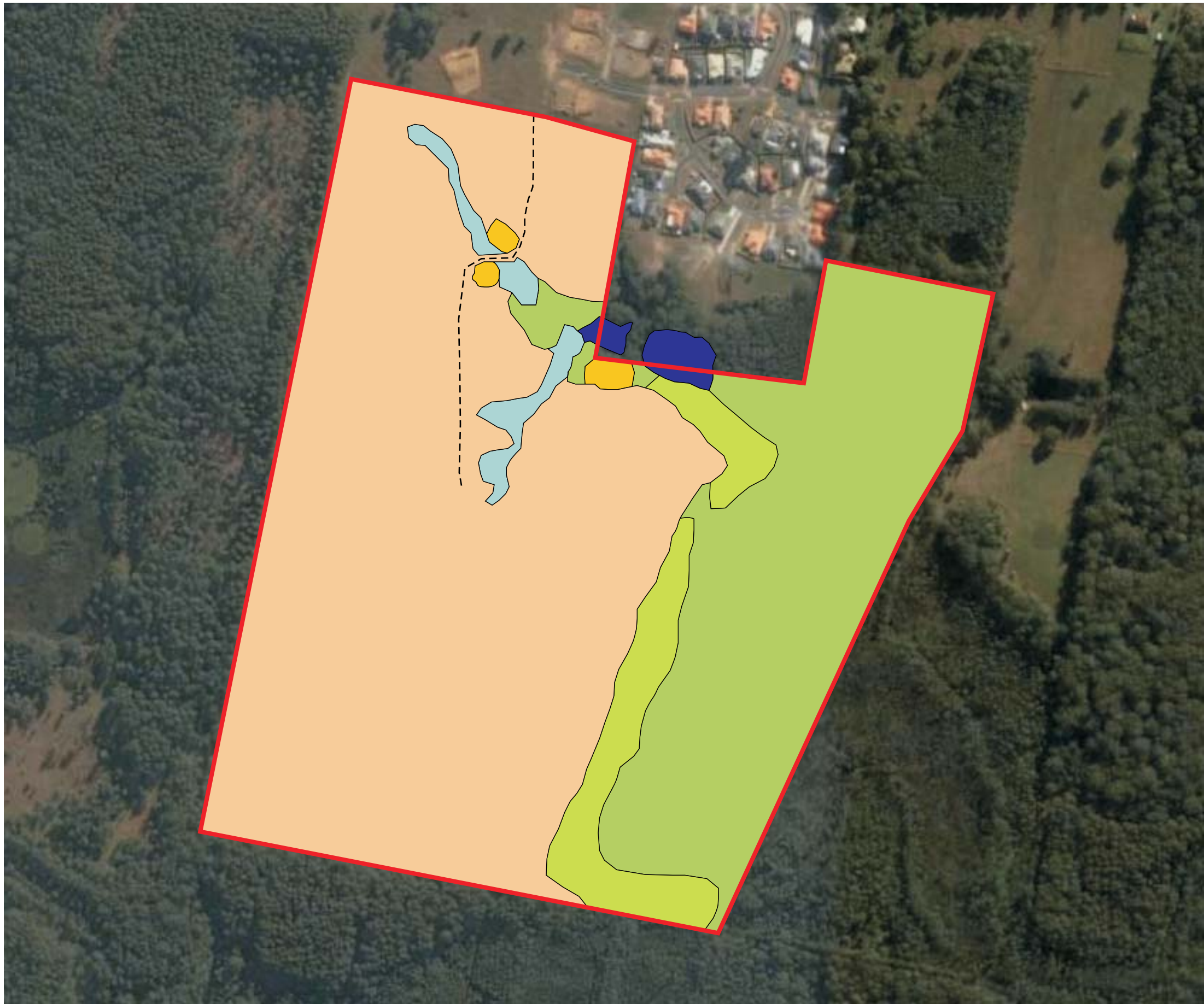
2.2.2 Community 1 - Tall open swamp sclerophyll forest (*Eucalyptus robusta*)

Location and area

This community occurs in the low-lying eastern portion of the subject site fringing the paperbark swamp and also as a small patch adjacent to the constructed dams (**FIGURE 5**).

Description

The canopy of this community is generally comprised of mature Swamp mahogany (*Eucalyptus robusta*) up to 25m in height. There are also scattered occurrences of mature Broad-leaved paperbark (*Melaleuca quinquenervia*) and Blackbutt (*E. pilularis*), particularly adjacent to the constructed dams.



Legend

- Community 1: Tall open swamp sclerophyll forest (*Eucalyptus robusta*)
- Community 2: Tall open / closed swamp sclerophyll forest (*Melaleuca quinquenervia*)
- Community 3: Tall open dry sclerophyll forest (Mixed species)
- Community 4: Low closed sedgeland / wet pasture (*Juncus usitatus* +/- *Chorizandra cymbaria* / *Philydrum lanuginosum*)
- Community 5: Low closed grassland with scattered trees
- Community 6: Dams
- - - Existing Track
- Subject Site

0 50m 100m
1 : 4000

SOURCE: JWA Site Investigations;
Google Earth 2008 Aerial Photograph
SCALE: 1 : 4000 @ A3
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FIGURE 5
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DATE: 20 May 2010
FILE: N08022_VMP_Vegetation.cdr

TITLE
**VEGETATION
COMMUNITIES**



The midstorey in this community is generally comprised of a mixture of Blueberry ash (*Elaeocarpus reticulatus*), Willow bottlebrush (*Callistemon salignus*) and Black wattle (*Callicoma serratifolia*) and is quite dense in some areas. Blackwood wattle (*Acacia melanoxylon*) is common along the interface of this community and adjacent cleared land.

The groundcover is generally dominated by a mixture of Red-fruited saw-sedge (*Gahnia sieberana*) and Curly sedge (*Restio tetraphyllus*). Other species present include Blady grass (*Imperata cylindrica*), Bracken (*Pteridium esculentum*), Kangaroo grass (*Themeda triandra*), Long-leaved matrush (*Lomandra longifolia*), and Wiry panic (*Entolasia stricta*) in drier areas, as well as Bristle rush (*Chorizandra cymbaria*) and *Blechnum camfieldii* in wetter areas.

Conservation status

This vegetation community is representative of the Endangered Ecological Community (EEC) Swamp sclerophyll forest on the floodplain as gazetted by the NSW Scientific Committee on 17th December 2004.

The conservation status of this community is therefore considered to be high.

2.2.3 Community 2 - Tall open/closed swamp sclerophyll forest (*Melaleuca quinquenervia*)

Location and area

This community occurs in the low-lying eastern portion of the subject site and also fringing the constructed dams (FIGURE 5).

Description

The canopy of this community is comprised entirely of Broad-leaved paperbark (*Melaleuca quinquenervia*) up to 20m in height. The midstorey in this community is generally absent and restricted to scattered occurrences of Melastoma (*Melastoma affine*), Cheese tree (*Glochidion ferdinandi*) and Blueberry ash.

The groundcover is also generally absent due to the presence of standing water however Common reed (*Phragmites australis*) occurs in some areas. There are also scattered occurrences of Red-fruited saw-sedge, Curly sedge, Bristle rush, *Blechnum camfieldii* and Swamp millet (*Isachne globosa*). Slender knotweed (*Persicaria decipiens*) is common fringing the constructed dams.

Conservation status

This vegetation community is representative of the Endangered Ecological Community (EEC) Swamp sclerophyll forest on the floodplain as gazetted by the NSW Scientific Committee on 17th December 2004.

The conservation status of this community is therefore considered to be high.



2.2.4 Community 3 - Tall open dry sclerophyll forest (Mixed species)

Location and area

This community occurs as scattered patches of mature trees retained within the grassland community and adjacent to the constructed dams (FIGURE 5).

Description

The canopy of this community is comprised of a mixture of species including Tallowwood (*E. microcorys*), Blackbutt, Red mahogany (*E. resinifera*), Pink bloodwood (*Corymbia intermedia*), Swamp mahogany, Smooth-barked apple (*Angophora costata*) and Turpentine (*Syncarpia glomulifera*).

The midstorey in this community is absent due to past clearing activities and continued grazing of cattle. The groundcover is comprised of a mixture of introduced grasses and common agricultural weeds.

Conservation status

The conservation status of this vegetation community is considered to be low to moderate, because it is a small and isolated, and is highly disturbed by grazing cattle.

2.2.5 Community 4 - Low closed sedgeland/wet pasture (*Juncus usitatus* +/- *Chorizandra cymbaria* / *Philydrum lanuginosum*)

Location and area

This community occurs in the low-lying drainage lines in the central and northern portions of the subject site (FIGURE 5).

Description

This community is comprised of a mixture of hydrophytic plant species the most common of which include Common rush (*Juncus usitatus*), Swamp buttercup (*Ranunculus inundatus*), Bristle rush and Frogmouth (*Philydrum lanuginosum*), and introduced pasture grasses. There are also occurrences of Swamp water fern (*Blechnum indicum*), Slender knotweed, Jointed twig-rush (*Baumea articulata*) and Tall sedge (*Carex appressa*).

Regenerating Broad-leaved paperbarks also occur sporadically within this community.

Conservation status

This vegetation community is representative of the EEC Freshwater wetlands on coastal floodplain as gazetted by the NSW Scientific Committee on 17th December 2004. However, continued disturbance by grazing cattle, and the presence of introduced grasses and agricultural weeds have significantly reduced the conservation value of this area. This community is therefore considered to have a moderate conservation status.



2.2.6 Community 5 - Low closed grassland with scattered trees

Location and area

The majority of the subject site is comprised of grassland with scattered trees having been substantially cleared for grazing purposes (**FIGURE 5**).

Description

This community is comprised of a mixture of native and introduced grasses as well as commonly occurring agricultural weeds, and is heavily grazed by cattle.

Conservation status

The conservation status of this community is considered to be low.

2.2.7 Community 6 - Dams

Location and area

Two (2) constructed dams occur on the northern boundary of the subject site (**FIGURE 5**).

Description

Fringing vegetation is comprised of a mixture of Eucalyptus species (Community 3) and Broad-leaved paperbarks (Community 2).

Vegetation within the dams includes Slender knotweed, Grey sedge (*Lepironia articulata*), Common rush, Water lilies (*Nymphaea* sp.), Java pondweed (*Potamogeton javanicus*) and Cumbungi (*Typha orientalis*). Water primrose (*Ludwigia peploides*) also occurs and forms dense floating mats in some areas.

Conservation status

The conservation status of the dams on the subject site is considered to be low-moderate.

2.3 Endangered Ecological Communities

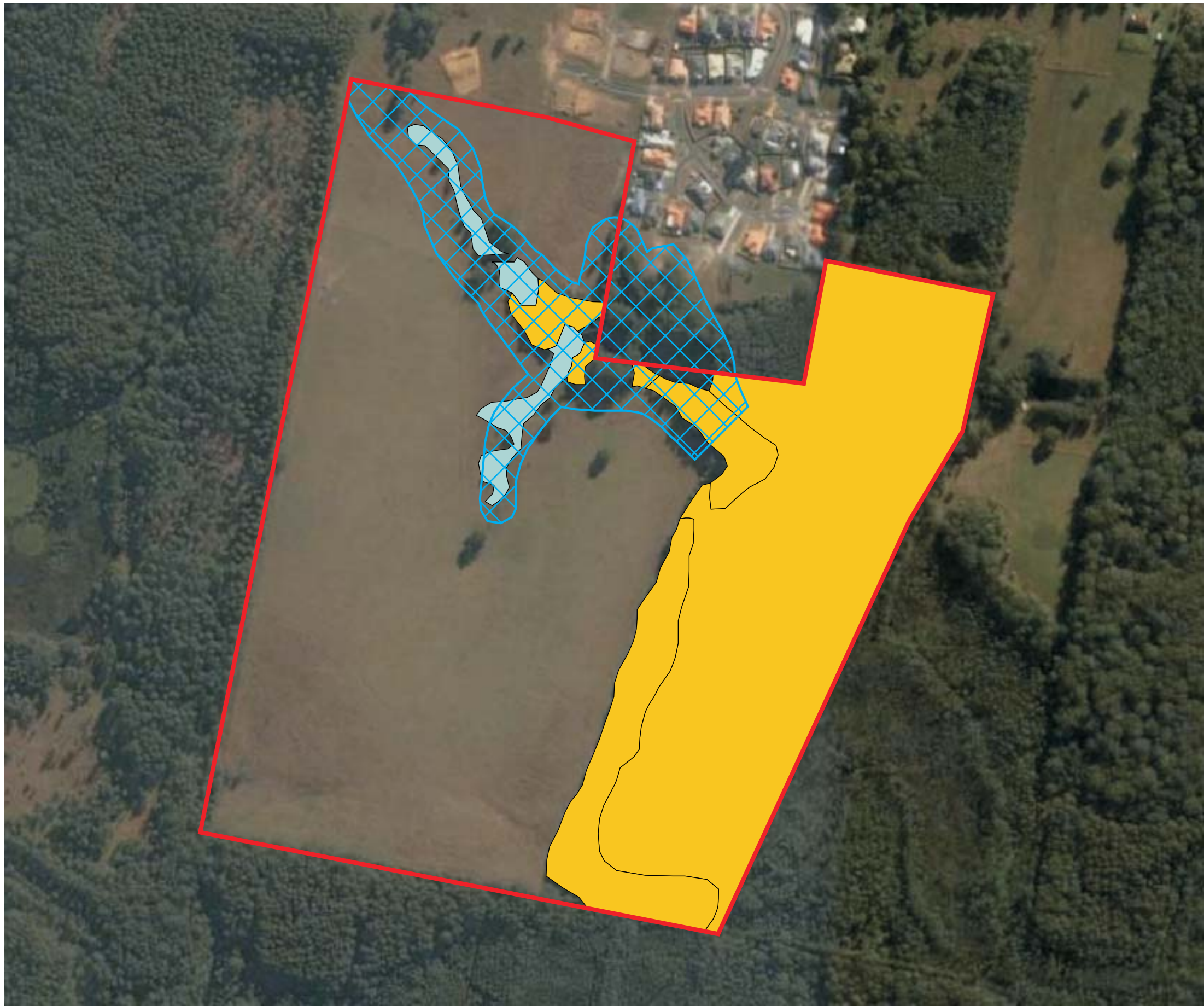
There are two EECs on the subject site:

- Swamp sclerophyll forest on the floodplain (i.e. Vegetation communities 1 & 2);
- Freshwater wetlands on coastal floodplain (i.e. Vegetation community 4);

EECs are shown in **FIGURE 6**. The outline of the buffers to these communities is also shown.

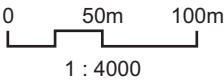
2.4 Significant Flora

No Threatened species, as defined by the Threatened Species Conservation Act 1995 and the Fisheries management Act 1994, were recorded from the subject site.



Legend

- Swamp Sclerophyll Forest on Coastal Floodplain
- Freshwater Wetland on Coastal Floodplain (Degraded)
- Core Riparian Zone
- Subject Site



SOURCE: JWA Site Investigations;
Google Earth 2008 Aerial Photograph
SCALE: 1 : 4000 @ A3
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FIGURE 6
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TITLE
**ENDANGERED
ECOLOGICAL
COMMUNITIES**



2.5 Fauna Corridors

Extensive areas of vegetation occur to the west, south and east of the site comprising of Bongil Bongil National Park (west & south) and the land zoned as 7a Environmental Protection (east). At present there is a very poor link between the vegetation to the east and west comprising of highly degraded land along the creek. The rehabilitation of the CRZ will create a fauna corridor linking habitat to the west and east of the site via a riparian corridor (**FIGURE 2**) significantly improving the current situation.



3. SITE REGENERATION STRATEGY

3.1 Introduction

Large areas of the Subject site have been cleared and used for agriculture, which has provided opportunities for exotic weeds to colonise and establish. While most areas of intact vegetation remain in good condition, with only low to moderate levels of weed invasion, exotic species will persist and compete with native species for limited resources (e.g. light, nutrients and water). This acts as a limiting factor for regeneration of native species. Therefore, in order to enhance the natural values of the site, weed removal and weed control is required.

Regeneration will be encouraged within the RA. The drainage lines in the north-west of the site are not proposed for development with the exception of possible Bio-retention Basin at the edge of the buffer zone (**FIGURE 7**). The drainage lines, including the buffer widths, will be subject to management through weed removal and control, assisted regeneration and extensive revegetation. Initial works are expected to be completed within one (1) year of commencement, followed by a minimum five (5) years monitoring and maintenance period.

3.2 Regeneration Aims

The objectives of the site regeneration strategy are to:

- Remove weeds utilising “best practice” protocols (**APPENDIX 2**);
- Improve the current habitat values of the site; and
- Provide a buffer to ecological features from potential impacts of the proposed development.

The site regeneration strategy consists of three phases as follows:

- Weed Control;
- Assisted Regeneration; and
- Revegetation.



4. WEED CONTROL

4.1 Introduction

The vegetation within the riparian areas consists of both native and exotic weeds. The introduction of weeds is probably due to the disturbance of the area by cattle grazing. This section of the report provides an assessment of the weeds present and a plan for weed control. The weed control program is divided into two phases: primary and secondary weeding. Primary weeding involves the removal of established exotic weed species and secondary weeding involves the maintenance of the Rehabilitation Areas to prevent subsequent weed infestations. Weed control will be undertaken over the entire RA identified in **SECTION 1.4.3 (FIGURE 4)**.

4.2 Weed Species Inventory

Vegetation communities present generally exhibit low to moderate weed infestations. Most weeds occur in riparian areas in the north-west of the site, while fewer weeds occur within the Swamp Sclerophyll Forest. The field survey identified a number of weed species occurring within the proposed RA (**TABLE 2**).

TABEL 2
WEED SPECIES OCCURRING WITHIN THE RIPARIAN CORRIDOR

<i>Family</i>	<i>Botanical Name</i>	<i>Common Name</i>
Asclepiadaceae	<i>Asclepias curassavica</i>	Cotton Bush
Asteraceae	<i>Ageratina adenophora</i>	Crofton weed
Asteraceae	<i>Baccharis halimifolia</i>	Groundsel Bush
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed
Cunoniaceae	<i>Tradescantia albiflora</i>	Wandering Jew
Juncaceae	<i>Juncus cognatus</i>	
Lauraceae	<i>Cinnamomum camphora</i>	Camphor laurel
Ochnaceae	<i>Ochna serrulata</i>	Mickey mouse plant
Poaceae	<i>Andropogon virginicus</i>	Whiskey grass
Poaceae	<i>Axonopus fissifolius</i>	Narrow leaf carpet grass
Poaceae	<i>Paspalum dilatatum</i>	Paspalum
Poaceae	<i>Urochloa panicoides</i>	Liverseed Grass
Verbenaceae	<i>Lantana camara</i>	Lantana

4.3 Primary Weeding

Weed eradication will be undertaken on a progressive basis through localised treatment of grass and herbaceous species via mechanical removal (hoe/rake, hand pulling and/or slashing) or with Roundup Biactive©. Woody weed species will be hand pulled or controlled using weed control techniques listed within **APPENDIX 2**.

All chemical users should be experienced and licensed in accordance with the relevant legislation. Utmost care must be taken when utilizing chemicals to ensure that no drift occurs outside of the treatment area, especially into the adjacent creek. Spraying should not occur on windy days or within 24 hours of predicted rainfall.



Vegetation Management Plan

Primary weeding should commence at the start of the active growing period (approximately November), or on an as needed basis.

Preparation before spraying, in the form of manual clearing weeds from around native plants, must be carried out.

Weed material that does not contain any fertile parts will be mulched and spread on the ground and any weeds that may have fertile parts present will be disposed of at an approved waste disposal facility such as Council landfills or transfer stations.

The following additional procedures will be followed:

- Before any primary weeding commences all native species within the treatment areas will be located and clearly marked for retention;
- Native seedlings/saplings will be mulched; and
- Careful hand weeding will occur at least 50 cm around retained native species.

4.4 Secondary Weeding

Secondary weeding involves the eradication of weeds that have been overlooked or re-shoot after primary treatment. Secondary weeding will occur 3 to 4 months after primary weeding and no later than 6 months.

Maintenance should be undertaken at the following times:

- 2 weeks after primary weeding;
- 1 monthly for the 1st year;
- 3 monthly for the 2nd and 3rd years; and
- 6 monthly in the 4th and 5th years.



5. ASSISTED REGENERATION

5.1 Introduction

Natural regeneration refers to the natural process by which plants replace or re-establish themselves. Natural regeneration can be described as the “regrowth” or “vegetative recovery” which occurs spontaneously, by seed or otherwise, and after a stress or disturbance (Cremer 1990; Temple & Bungey 1980). As long as mature and healthy native plants occur on the Subject Site, natural regeneration is an option (Petrie 1999). Natural regeneration is a powerful tool that can be used to re-establish native vegetation. It ensures that the new growth is derived from genetic material that currently occupies the site and is adapted to local conditions. Additionally, the chance of out breeding depression is reduced.

5.2 Implementation

Assisted regeneration will take place, after primary weeding, in areas where there is significant cover of native vegetation (**FIGURE 8**). Natural regeneration will be continually monitored for the life of the program (**SECTION 5**). Where natural recruitment is poor, active revegetation through planting will be completed (i.e. Adaptive Management **SECTION 9**). Revegetation methods will follow those outlined in **SECTION 6** of this report.



6. REVEGETATION

6.1 Introduction

Revegetation planting will be undertaken in areas cleared of native vegetation within the CRZ (**FIGURE 9**). Additional plantings may be undertaken as Adaptive Management dictates (**SECTION 9**).

This section will outline the species, planting layouts and methods that will be used for plantings.

6.2 Plantings within the Core Riparian Zone

6.2.1 Introduction

This section outlines the strategy for the revegetation of cleared areas within the CRZ.

6.2.2 Species List

Species to be planted will include groundcovers, shrubs and trees in order to obtain a fully structured native vegetation community. Species will be chosen from those naturally occurring on the site (**APPENDIX 1**). If possible seed should be collected from the area and used to grow seedlings to plant. If this is not possible, plants should be obtained from a local nursery that can demonstrate local provenance.

6.2.3 Planting Methodology

During planting the following actions will be implemented:

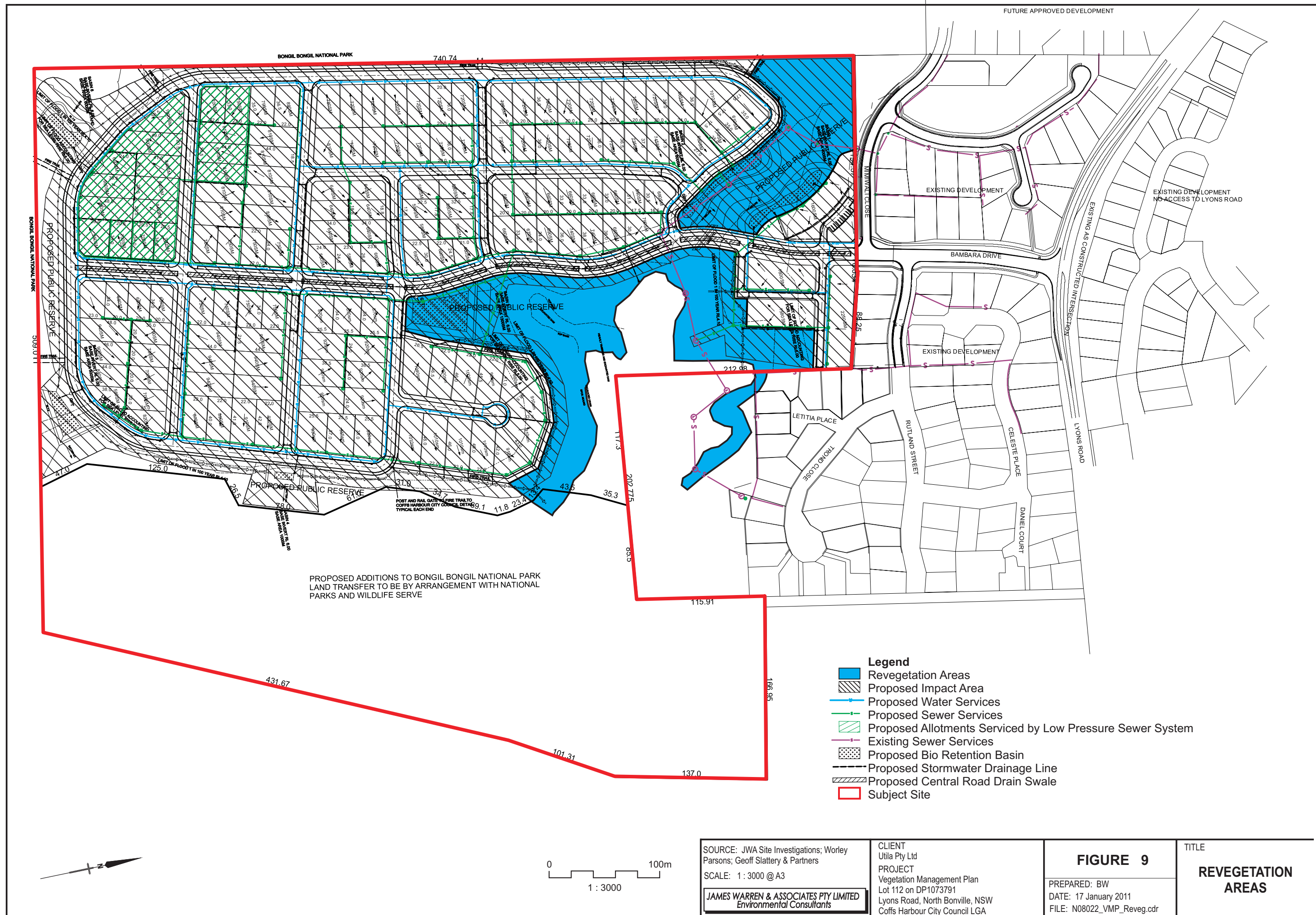
- Planting will commence after the completion of primary weeding;
- Trees, shrubs and groundcovers will be planted at spacings of 2m, 1m and 0.5m respectively;
- All plants will be sun hardened;
- All plantings will be well watered, appropriately fertilised and heavily mulched with organic material or weed mat;
- Plants will be hand watered as necessary; and
- Plants that fail to survive will be replaced.

6.2.4 Maintenance Requirements

Fertiliser and mulch will be applied again in the second and subsequent growing seasons or when needed. All plantings that fail will be replaced.

Maintenance should be undertaken at the following times:

- 2 weeks after initial plantings;
- 1 monthly for the 1st year;
- 3 monthly for the 2nd and 3rd years; and
- 6 monthly in the 4th and 5th years.





7. PROTECTIVE MEASURES

7.1 Introduction

This section outlines how the natural values of the site will be protected.

7.2 Signage

Signs will be posted along the RA boundary stating “No Entry - Native Plant Revegetation Area”. Signage should also have an educational theme providing information about Wetlands and Swamp Sclerophyll Forests and the associated flora and fauna.

7.3 Fencing

If it is considered that the RA is exposed to physical damage through trampling and/or vandalism or weeds are being introduced via dispersal by humans and/or animals, an exclusion fence will be erected. This will be part of an adaptive management strategy. A fencing plan will be developed by a Fencing Contractor in consultation with the Bush Regenerator. The fencing plan should consider the following issues:

- Construction (either temporary, constructed with star pickets and smooth galvanized wire, or permanent constructed using coppers logs);
- Fauna exclusion of fauna friendly (depending on the rate of mammal herbivory); and
- The fence will be retained until the plantings are considered to be sufficiently established.



8. MONITORING AND REPORTING

8.1 Introduction

Monitoring is very important in ensuring the continuing success of the rehabilitation of the CRZ. Monitoring and reporting ensures that rehabilitation and management activities are meeting set objectives and allows for adaptive management strategies to be introduced if necessary. The existing landowner should be responsible for engaging an appropriately qualified person to develop and implement a monitoring plan.

Monitoring and reporting can be divided into three phases:

- Monitoring of all activities including weeding and planting (Bush Regenerator).
- Monitoring of progress of rehabilitation including plant growth and natural recruitment (Ecologists).
- Reporting that combines the result of the above monitoring against performance criteria (Ecologists).

8.2 Bush Regeneration Monitoring

The Bush Regenerator will keep detailed work sheets recording:

- All work completed each day;
- Site conditions;
- Chemicals used;
- Problems encountered; and
- Future works required.

An example of a Daily Work Record Form is provided (**APPENDIX 3**). These records and general comments on progress will be provided to the Ecologist for consideration and inclusion in the overall monitoring reports.

8.3 Ecological Monitoring

Ecological Monitoring should be carried out for 5 years. The 1st monitoring visit should be undertaken six (6) weeks after the primary weeding; then at three (3) monthly intervals for first year and then six monthly until the completion of the project.

The following data should be collected:

- Name of data recorder;
- Date and prevailing weather;
- Canopy height of native and exotic species;
- Percentage cover of canopy and ground strata - native and exotic species;
- Number and relative abundance - native and exotic species;



- Four (4) photos (north, east, south, west) are to be taken at two (2) permanent photo points;
- Damage which may have occurred since the last visit;
- General check on the plants growing conditions (water, mulch, nutrients/fertiliser);
- Notification of weeds species present should be recorded and reported to the contracted Bush Regenerator;
- Loss or erosion of topsoil from re-vegetated areas;
- Records of new native volunteer species, their location and number;
- Increase or decrease in cover of native and weed species within the ground and canopy strata;
- Survival rate and condition of planted species; and
- Reasons for their death or failure to thrive.

An example of a Monitoring and Evaluation Record sheet is provided as **APPENDIX 4**.

8.4 Monitoring Reports

All reports will be submitted to the existing owner for distribution to the Coffs Harbour Shire Council and the Department of Planning. The first report will be submitted three months after the initial plantings. Continued reports will be provided every six months for a period of three years and yearly for the final two years.

The monitoring reports should discuss the following:

- Results of the bush regeneration monitoring including any general comments from the Bush Regeneration Team Leader and all daily work record forms;
- Problems since the previous inspection (i.e. plant mortality, broken tree guards, fertiliser or mulch requirements, vandalism or broken fences);
- The effect the above problems;
- Measures taken or proposed to rectify any problems; and
- The success or failure of measures implemented to rectify problems.

The Coffs Harbour Shire Council and the DoP will acknowledge the receipt of each monitoring report and provide comments as necessary.



9. ADAPTIVE MANAGEMENT

Adaptive management is an approach that involves learning from management actions and using those lessons to improve upon the overall plan. The principles of adaptive management have been incorporated into the administration of restoration projects within a variety of governmental authorities and programs (Thom 1997). Comprehensive, long-term monitoring is a component of adaptive management as adaptive management strategies rely on the accumulation of evidence supporting decisions that demand changes in action.

An adaptive management approach involves an integrated process of firstly monitoring, then reviewing and responding to the health and conditions of the plantings, natural regeneration and the status of the weed infestation. Alteration to the design and maintenance of works required, to ensure the objectives of the VRP are achieved, are then made.

Adaptive management strategies that may be required but not confined to are:

- Variation in areas that will be planted (i.e. where assisted regeneration fails to result in an acceptable level of revegetation);
- Variation of species to be planted according to soil and moisture conditions;
- Replacement of plantings that do not survive;
- Fencing;
- Alteration of timing of weed control or weed control methods.

Before the implementation of any adaptive management strategy a brief report is be provided to the Landowner and the Coffs Harbour City Council detailing the proposed management actions and the predicted outcomes. These will be determined on the basis of information from the reports provided by either the Bush Regenerator or the Ecologists reports. Coffs Harbour City Council must then approve the adaptive management techniques in writing prior to implementation.



10. REFERENCES

- DEW (2000) Guidelines for controlled activities. Riparian corridors. NSW Government Department of Water and Energy.
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- Cremer K W (ed)(1990) Trees for Rural Australia, Inkata Press.
- Petrie (1999) Natural Regeneration: Principles and Practice. Land for Wildlife Note No. 8 November 1999.
- Temple and Bungey (1980) Revegetation: methods and Management, State Pollution Control Commission, NSW.
- Thom, Ronald M. 1997. From Advanced Habitat Restoration Training materials, presented at Norrie Point Environmental Centre, Staatsburg, NY, June 1997.



APPENDIX 1 - NATIVE PLANT SPECIES LIST

Family	Botanical Name	Common Name
Apiaceae	<i>Centella asiatica</i>	Pennywort
Apocynaceae	<i>Parsonsia straminea</i>	Common silkpod
Araceae	<i>Gymnostachys anceps</i>	Settlers flax
Araliaceae	<i>Polyscias sambucifolia</i>	Elderberry panax
Blechnaceae	<i>Blechnum indicum</i>	Swamp Fern
Casuarinaceae	<i>Allocasuarina torulosa</i>	Forest Oak
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak
Cunoniaceae	<i>Callicoma serratifolia</i>	Black Wattle
Cyperaceae	<i>Cyperus stradbokensis</i>	
Cyperaceae	<i>Gahnia sieberana</i>	Saw Sedge
Cyperaceae	<i>Restio tetraphyllus</i>	Curly Sedge
Cyperaceae	<i>Gahnia clarkei</i>	Tall saw-sedge native
Dennstaedtiaceae	<i>Histiopteris incisa</i>	Batswing fern
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Soft Bracken Fern
Dilleniaceae	<i>Hibbertia scandens</i>	Guinea Flower
Dilleniaceae	<i>Hibbertia vestita</i>	
Epacridaceae	<i>Leucopogon lanceolatus</i>	Lance-leaf Beard-heath
Euphorbiaceae	<i>Phyllanthus gunnii</i>	Blunt Spurge
Fabaceae Faboideae	<i>Hardenbergia violacea</i>	False Sarsparilla
Fabaceae Faboideae	<i>Indigofera australis</i>	Native Indigo
Fabaceae Faboideae	<i>Pultenaea dentata</i>	Egg and Bacon Pea
Fabaceae Mimosoideae	<i>Acacia melanoxylon</i>	Blackwood
Fabaceae Mimosoideae	<i>Acacia floribunda</i>	Sally wattle
Flacourtiaceae	<i>Scolopia braunii</i>	Flintwood
Juncaceae	<i>Juncus continuus</i>	
Juncaceae	<i>Juncus polyanthemus</i>	
Juncaceae	<i>Juncus usitatus</i>	Rush
Lobellaceae	<i>Pratia purpurascens</i>	Whitroot
Lomandraceae	<i>Lomandra hystrix</i>	
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling lily
Moraceae	<i>Ficus watkinsiana</i>	Strangler fig
Myrtaceae	<i>Angophora costata</i>	Smooth barked apple
Myrtaceae	<i>Archirhodomyrtus beckleri</i>	Rose Myrtle
Myrtaceae	<i>Callistemon salignus</i>	Willow-Leaved Bottlebrush
Myrtaceae	<i>Eucalyptus grandis</i>	Flooded Gum
Myrtaceae	<i>Eucalyptus intermedia</i>	Pink Bloodwood
Myrtaceae	<i>Eucalyptus microcorys</i>	Tallowwood
Myrtaceae	<i>Eucalyptus pilularis</i>	Blackbutt
Myrtaceae	<i>Eucalyptus resinifera</i>	Red Mahogany
Myrtaceae	<i>Eucalyptus robusta</i>	Swamp Mahogany
Myrtaceae	<i>Leptospermum juniperinum</i>	Prickly Tea tree
Myrtaceae	<i>Lophostemon suaveolens</i>	Swamp turpentine
Myrtaceae	<i>Lophostemon confertus</i>	Brushbox
Myrtaceae	<i>Melaleuca quinquenervia</i>	Broad-Leaved Paperbark
Myrtaceae	<i>Syncarpia glomulifera</i>	Turpentine



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Philydraceae	<i>Philydrum lanuginosum</i>	Frogsmouth
Phormaceae	<i>Dianella caerulea</i>	Blue Flax Lily
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet pittosporum
Poaceae	<i>Cynodon dactylon</i>	Couch
Poaceae	<i>Imperata cylindrica</i>	Blady grass
Poaceae	<i>Leersia hexandra</i>	Swamp ryegrass
Poaceae	<i>Themeda australis</i>	Kangaroo Grass
Proteaceae	<i>Banksia spinulosa</i>	Hill Banksia
Proteaceae	<i>Persoonia stradbokensis</i>	Geebung
Rhamnaceae	<i>Alphitonia excelsa</i>	Red Ash
Santalaceae	<i>Exocarpus cupressiformis</i>	Native Cherry
Sapindaceae	<i>Dodonaea viscosa</i>	Hop Bush
Thymeleaceae	<i>Pimelea ligustrina</i> subsp. <i>ligustrina</i>	Tall rice Flower
Ulmaceae	<i>Trema tomentosa</i>	Native Peach
Xanthorrhoeaceae	<i>Xanthorrhoea fulva</i>	Grass Tree



APPENDIX 2 - WEED CONTROL METHODS

The following are control techniques that are to be utilised during site regeneration works:

- **Cut Stump Method** - This method involves cutting plant stems as close to ground level as possible and immediately painting the cut stump with herbicide. This treatment can also be applied as a basal bark application to the first 15-20 cm (entire circumference) of an uncut stem if the adult bark has not yet developed. Chemical use with this application is dependant on the proximity of the weed to naturally ponding water or waterways and whether or not the chemical is registered for aquatic use.
- **Basal Bark Method** - This method involves applying a herbicide to the lower 35-45 cm bark around the entire stem using a hand-pump backpack sprayer fitted with a shut-off at the wand tip and an adjustable cone nozzle or a small, ATV (All Terrain Vehicle)-mounted sprayer with a shut-off at the wand tip and an adjustable cone nozzle.
- **Ring Barking** - This method involves removing the lower bark from the stem using a sharp implement to expose the phloem and xylem tissue to the outer environment thereby destroying it.
- **Spray Method** - There are two (2) types of spraying methods that will be employed where appropriate:
 - Selective blanket spraying: The area must initially be checked for the presence of any native species. Any weeds within 2 m of the drip zone of existing native species will be removed by hand. Alternatively, native species will be covered with impermeable material (e.g. a tarpaulin) for protection during spraying;
 - Spot spraying: The spray nozzle will be kept close to ground to avoid any overspray. Individual weeds will be spot-sprayed at the site. This method of spraying will be employed as native species are interspersed throughout the exotic grasses; and
 - Herbicides specific to each target species, where appropriate, will be identified prior to the implementation of any works. Herbicides will be applied in accordance with the manufacturer's specifications and when environmental conditions are most preferred (e.g. wind and rainfall).



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- **Stem Injection** - Herbicides may be applied directly to the plant via stem injection. This involves applying a herbicide to the plant directly through drilling a hole into the stem and inserting the chemical. Axe cuts for stem injection can also be used. Cuts can be made at regular intervals around the stem and should leave a “pocket” in to which the chemical must be immediately injected. Axe cuts should penetrate the cambium layer, but not the hardwood.
- **Wick Wiping** - This method employs vehicle-mounted (broad acre application) or hand-held equipment (small area/single plant application) to wipe or brush concentrated herbicide onto weeds. The herbicide is applied from permeable rope that is permanently connected to a reservoir containing Glyphosate. For purposes of weed control where accessibility to the infestation is low, a hand held ‘wick wipe’ will be used. This will also be incorporated for the control of emergent species. This method is particularly safe to use in areas where weed species are interspersed with native plants as there is no spray drift of herbicide.
- **Cutting and Chipping** - Manual weeding may involve cutting and chipping, pulling, digging or slashing and is preferred, depending on the growth stage and situation as detailed:
 - Where native plants are growing within a weed infestation and the use of selective herbicide is not possible;
 - Where inadequate foliage is present to allow for successful uptake of herbicide e.g. Mile-a-minute runners typically exhibit this trait; and
 - When hand weeding, the stem must be grasped firmly at the base of the plant and pulled. A trowel, mattock or sharp knife may be needed to loosen the soil. Care must be taken not to leave behind stems or other plant pieces that may re-shoot. Hand weeding should also be undertaken at times when weeds are not seeding to reduce dispersal and spread. Hand pulling is not recommended for some weed species as they readily sucker if their roots are disturbed e.g. *Lantana camara*. This method will be employed when removing exotic grass species within retained vegetation.

APPENDIX 1 contains the site species list. Weed species are marked with an asterisk.



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APPENDIX 3 - BUSH REGENERATOR'S DAILY WORK RECORD

Name.....

Date

RA

Site Name / Location

Date Time to

Team/Staff

Growing conditions			Temperature / Humidity		Weather conditions		Wind direction / Speed	
Zone(s) / Work locations			Hours	Weeds treated			Method	New T.S. encountered / Location
Chemicals used / Rates / Totals								Notes and comments
Equipment used	Round-up	Associate	Herbicide	Pulse		Water	Number mixed	
Daily Chemical Totals								



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APPENDIX 4 - MONITORING AND EVALUATION FORM

Assessor.....					Progress on Weed Control
Date.....					.....
MZ.....					.....
Weather.....					Progress on Enhancement Plantings
General Conditions .....					.....
	Existing Natives	Volunteer Natives	Weeds	Plantings	.....
Canopy Height	.....	.....	.....	.....	Progress on Natural Regeneration
% Cover Canopy	.....	.....	.....	.....	.....
% Cover Ground	.....	.....	.....	.....	.....
Photos (Photo #)	North	South	East	West	Damage to Site
Point 1	.....	.....	.....	.....	.....
Point 2	.....	.....	.....	.....	Adaptive Management Strategies
Summary of Management Works.....					.....
.....					Requirements for on Going Maintenance
.....				