JAMES WARREN & Associates Pty Ltd

ENVIRONMENTAL CONSULTANTS

AMENDED

VEGETATION REHABILITATION PLAN

LOTS 2 & 3 DP 244652

URLIUP ROAD, BILAMBIL

MAY 2009

A REPORT PREPARED TO
PLATEAU NOMINEES PTY LTD

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1. INTRODUCTION

1.1 Background

James Warren and Associates (JWA) have been engaged by Plateau Nominees Pty Ltd to complete a Vegetation Rehabilitation Plan (VRP) for the Riparian Zone of Lots 2 & 3 DP 244652 Urliup Road, Bilambil.

The Subject Site was previously used as a quarry resulting in the removal of the majority of the original native vegetation. The site is highly disturbed and infested with exotic weeds, many of which are listed as noxious. Some patches of forested vegetation occur along the property boundaries and the within the Riparian Zone. Camphor laurel dominates in these areas but there are some remaining elements of Riparian rainforest. It appears that the site is currently used as an unofficial bike track for local youths.

A Flora and Fauna Assessment has been completed by James Warren and Associates. Vegetation communities, Flora and Fauna, and Threatened Species on the site were identified (JWA 2009).

The Proposed development consists of fifty-two (52) Residential Lots, Open Space, Drainage Reserves and Roads. The implementation of a VRP will enhance the natural environment of this degraded and derelict site.

1.2 Aims and Objectives

1.2.1 Overall Aim

The aim of this VRP is to provide guidelines to re-vegetate the above mentioned Land to a point where minimal maintenance will be required in the long term. The Land will be restored to a composition and structure that significantly improves the present condition.

1.2.2 Specific Objectives

The specific objectives required to achieve the above aim are:

1. to re-establish, through natural regeneration and revegetation, a Sub-tropical Riparian Rainforest;
2. to achieve a closed canopy that will reduce potential threats;
3. to stabilise the creek banks and reduce erosion;
4. to provide a habitat corridor for native fauna;
5. to monitor and provide detailed monitoring reports on the rehabilitation progress to the Tweed Shire Council (TSC); and
6. to adjust the management practices if and as necessary.

1.2.3 Timing and Responsibility

- The VRP will be implemented by Plateau Nominees Pty Ltd over a period of 5 years.
- The initial stages of the VRP (i.e. primary weeding and enhancement plantings; Sections 3 and 5) will be completed prior to the release of the final Plan of Subdivision.

- Ownership of the Rehabilitation Area will be transferred to the Tweed Shire Council upon registration of the Plan of Subdivision.
- The remainder of VRP (i.e. maintenance and monitoring; Sections 3 and 7) will be implemented over a period of 5 years.
- Work will be carried out by the appropriately qualified persons **(APPENDIX 1).**

1.3 The Subject Site

1.3.1 Description and Location

The Subject Site consists of land described as Lots 2 & 3 DP 244652, Urliup Road, Bilambil and covers an area of approximately 4.5 hectares adjacent to Bilambil Creek **(FIGURE 1 and 2).**

1.3.2 Land Use Zones

The Subject Site is zoned 2(d) Village (**FIGURE 3;** TSC 2008).

1.3.3 Areas of Focus – Rehabilitation Area

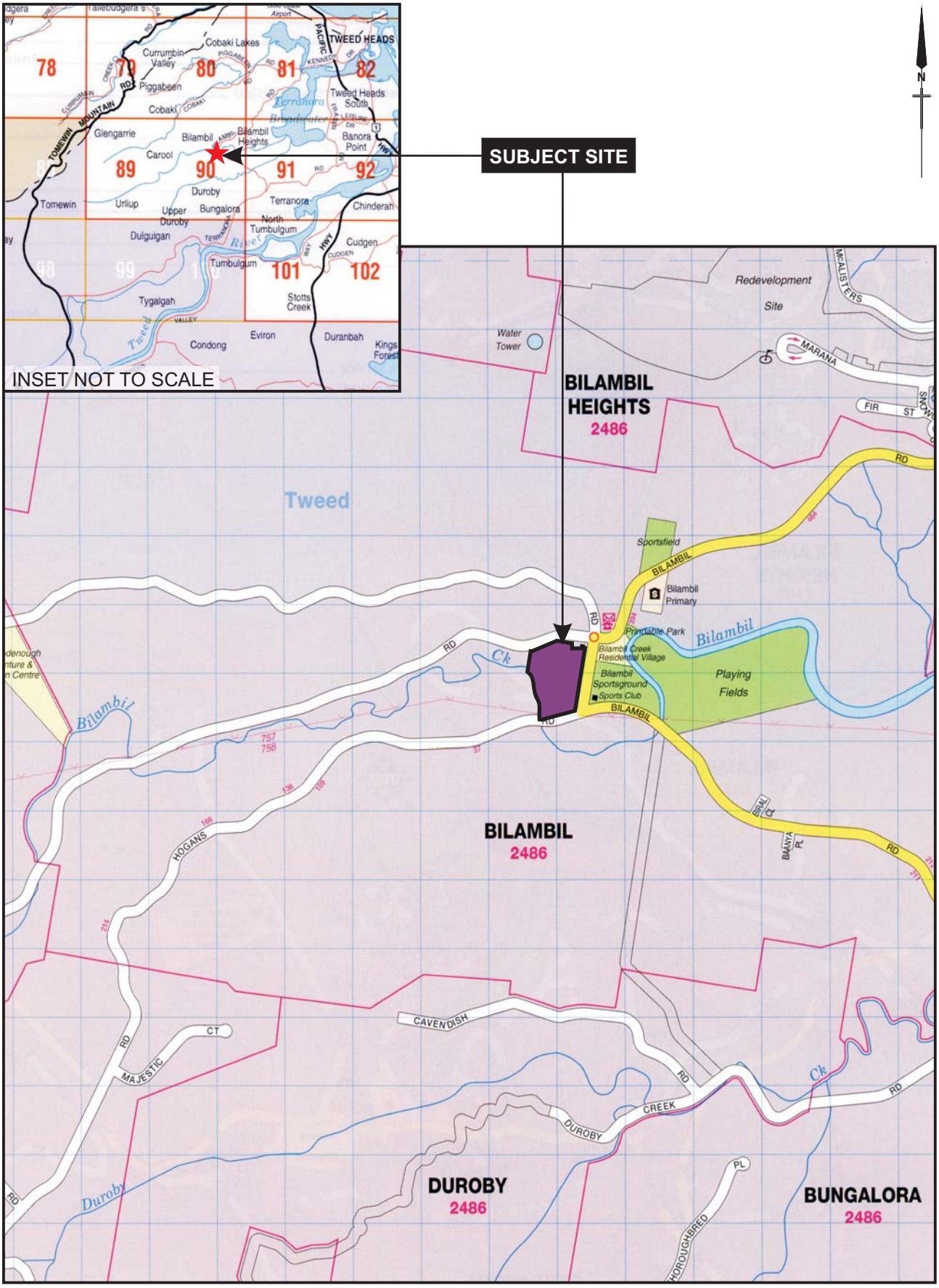
Rehabilitation consists of the strip of land along the eastern bank of Bilambil Creek. The strip extends from the Power Easement in the south to the site boundary in the north. The area will be weeded and enhanced by appropriate riparian rainforest species, maintained and monitored.

The Subject Site, with development layout and VRP focus area, is illustrated in **FIGURE 4**.

1.3.4 Management Issues

There are several management issues that will be addressed by this VRP including the following:

- Weed control;
- Natural regeneration;
- Revegetation;
- Indirect impacts on local Nature Reserve;
- Pedestrian traffic;
- Maintenance; and
- Monitoring.



SOURCE: Brisbane UBD SCALE: 1 : 20 000 @ A4 JAMES WARREN & ASSOCIATES PTY LIMITED Environmental Consultants	CLIENT John Sherwood / Jackson International Pty Ltd PROJECT Vegetation Rehabilitation Plan Lots 2 & 3 DP244652 Urliup Road, Bilambil, NSW Tweed Shire Council LGA	**FIGURE 1** PREPARED: BW DATE: 06 August 2008 FILE: N08003_VRP_Locality.cdr	TITLE **LOCALITY PLAN**

Legend
Subject Site

N

0 50m

SOURCE: Google Earth 2008 Aerial Photograph

SCALE: 1 : 2000 @ A4

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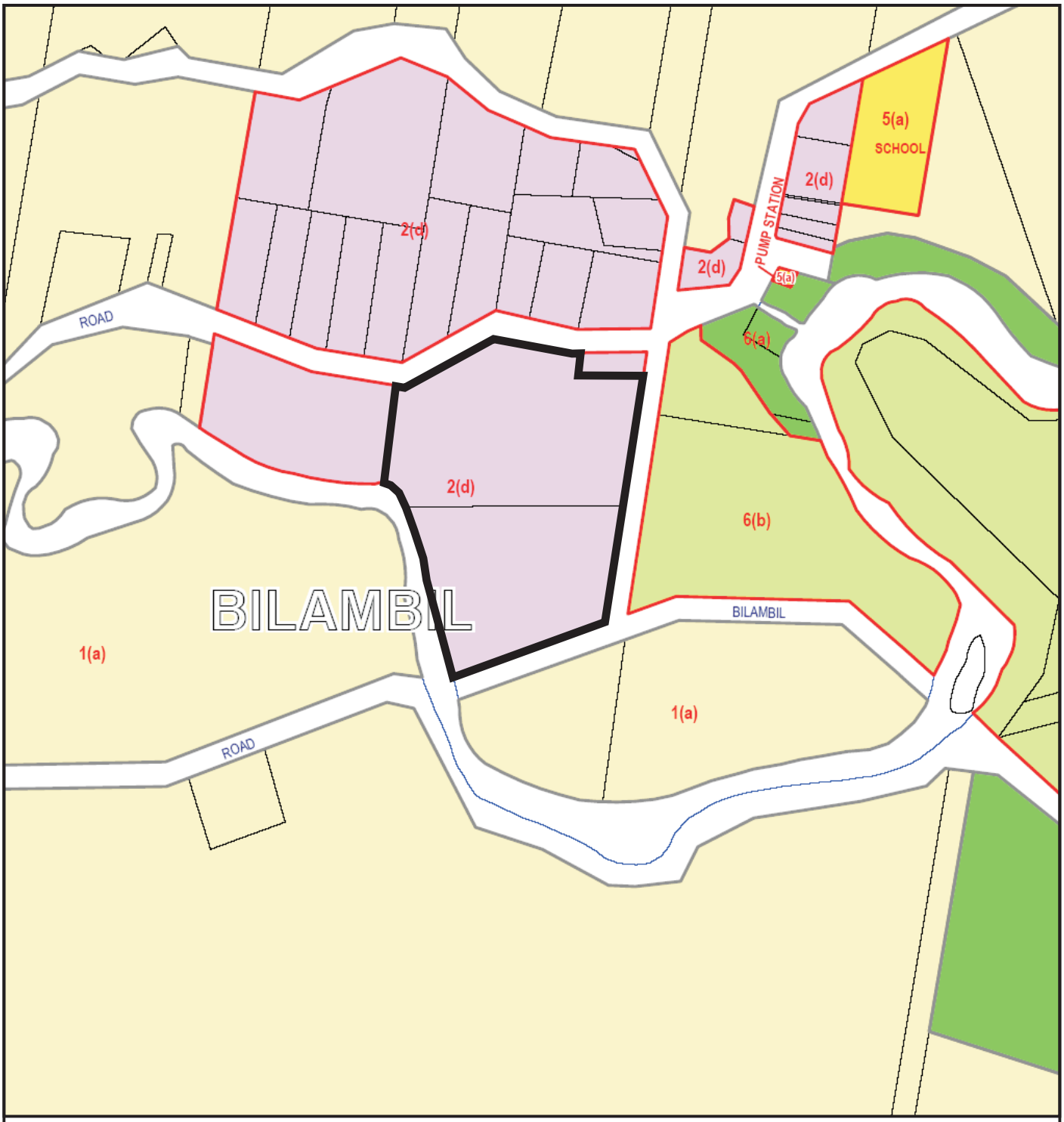
FIGURE 2

PREPARED: BW
DATE: 06 August 2008
FILE: N08003_VRP_Aerial.cdr

TITLE

AERIAL PHOTOGRAPH



Legend

1. Rural
   - 1(a) 1(a) Rural
2. Residential
   - 2(d) 2(d) Village
5. Special Uses
   - 5(a) 5(a) Special Uses
6. Open Space
   - 6(a) 6(a) Open Space
   - 6(b) 6(b) Recreation
   - Subject Site

N

0 150m

SOURCE: Tweed Local Environmental Plan 2000 SCALE: 1 : 5000 @ A4 JAMES WARREN & ASSOCIATES PTY LIMITED Environmental Consultants	CLIENT John Sherwood / Jackson International Pty Ltd PROJECT Vegetation Rehabilitation Plan Lots 2 & 3 DP244652 Urliup Road, Bilambil, NSW Tweed Shire Council LGA	**FIGURE 3** PREPARED: BW DATE: 06 August 2008 FILE: N08003_VRP_Zoning.cdr	TITLE **ZONING PLAN**

Legend

- Riparian Management Zone
- Easement / Landscape Areas / Regeneration Area
- Low creek bank
- High creek bank
- Batter
- Proposed Footpath (2m wide)
- Subject Site

Important Notes:

KERBING SHOWN IS INDICATIVE ONLY AND SUBJECT TO FINAL DETAILED DESIGN

(A) PROPOSED EASEMENT FOR ACCESS 2 WIDE (SUBJECT TO FINAL DETAILED DESIGN)
(B) PROPOSED EASEMENT TO DRAIN SEWER AND WATER 3 WIDE (SUBJECT TO FINAL DETAILED DESIGN)
(C) PROPOSED RESTRICTION ON TITLE TO PROVIDE ADDITIONAL VISTOR CARPARK ONSITE (SUBJECT TO FINAL DETAILED DESIGN)
(D) PROPOSED EASEMENT FOR SERVICES VARIABLE WIDTH (SUBJECT TO FINAL DETAILED DESIGN)
(E) PROPOSED EASEMENT TO DRAIN WATER VARIABLE WIDTH (SUBJECT TO FINAL DETAILED DESIGN)

0 25m
1 : 1 000

SOURCE: JWA Site Investigations; B & P Surveys (Ref: 17154D-D.pdf)
SCALE: 1 : 1000 @ A3

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FIGURE 4

PREPARED: BW
DATE: 25 May 2009
FILE: N08003_VRP_Layout.cdr

TITLE

PROPOSED DEVELOPMENT LAYOUT

2. FLORA ASSESSMENT

2.1 Introduction

As noted previously, the site was a quarry and most of the native vegetation has been removed. Overall, the site is highly infested with exotic weeds (i.e. Camphor laurel). However, some forested areas remain, especially along Bilambil Creek where there is remnant Riparian Rainforest vegetation. A survey was completed on the 29th April 2008 and vegetation communities were mapped and a plant species list compiled (JWA 2009).

2.2 Flora

2.2.1 Background

The survey recorded the following:

- Five (5) vegetation communities **(FIGURE 5)**;
- Ninety-five (95) flora species **(APPENDIX 2);**
- One (1) threatened flora species i.e. the Rough-shelled bush nut (*Macadamia tetraphylla*). This plant is listed as Vulnerable under the NSW *Threatened Species Conservation Act* (TSC 1995) and the *Commonwealth Environment Protection and Biodiversity Conservation Act* (EPBC 1999).
- One (1) regionally significant species i.e. the White fig (*Ficus virens*) (Sheringham & Westaway 1995)

2.3 Community Descriptions

A summary of the vegetation communities is provided **(TABLE 2)** and a brief description of each follows.

TABLE 1
VEGETATION COMMUNITIES PRESENT ON THE SUBJECT SITE

1	Tall Closed Forest (*Cinnamomum camphora* ± mixed Rainforest species)
2	Mid-high Open Forest (*Cinnamomum camphora)*
3	Low Open Woodland (*Acacia melanoxylon*)
4	Mid-high Open Forest (*Jagera pseudorhus*)
5	Low Closed Herbland (Mixed weed species.)

Community 1 - Tall Closed Forest (*Cinnamomum camphora* ± mixed Rainforest species)

Location and area

Community 1 occurs along the western boundary of the Subject Site, flanking Bilambil Creek, and covers approximately 366 m^2. The majority of this community occurs on the very steep eastern bank of Bilambil Creek.

Legend

- Community 1: Tall Closed Forest (*Cinnamomum camphora* +/- Mixed rainforest species)
- Community 2: Mid-high Open Forest (*Cinnamomum camphora*)
- Community 3: Low Open Woodland (*Acacia melanoxylon*)
- Community 4: Mid-high Open Forest (*Jagera pseudorhus*)
- Community 5: Low Closed Herbland (Mixed weed species)
- Rough-shelled bush nut (*Macadamia tetraphylla*)
- Subject Site

N

0 50m

SOURCE: JWA Site Investigations; Google Earth 2008 Aerial Photograph

SCALE: 1 : 2000 @ A4

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FIGURE 5

PREPARED: BW
DATE: 06 August 2008
FILE: N08003_VRP_Vegetation.cdr

TITLE

VEGETATION COMMUNITIES

Description
The canopy is dominated by Camphor laurel between ten (10) – fifteen (15) metres high. Other species occurring include Blue quandong and Weeping lilly pilly, Brown kurrajong, Foambark, Guioa and Bloodvine.

The mid-storey contains Camphor laurel and various rainforest species such as Weeping lilly pilly, Red kamala, Foambark, Sandpaper fig, Hairy pittosporum, Hard quandong, Sweet pittosporum, Macaranga, Guioa, and Blackwood wattle. Some weed species also occur including Coral tree, Umbrella tree, Mickey mouse plant, Winter senna and Chinese burr.

The ground cover is dominated by Mat rush. Other natives occurring are Cunjevoi, Birdnest fern, Basket grass, Blue flax lilly and Maiden hair fern. Weed species include Camphor laurel seedlings, Mist flower, Singapore daisy, Parramatta grass and Mickey mouse plant.

Community 2 - Mid-high Open Forest (*Cinnamomum camphora)*

Location and area
Community 2 occurs as elongated patches along Urliup and Bilambil Roads and covers an approximate 0.2 hectares.

Description
The canopy is dominated by Camphor laurel to ten (10) metres high.

Camphor laurel also forms part of the mid-storey with other rainforest pioneer species including Red Kamala, Macaranga, Guioa, Foambark and Blackwood wattle. Weeds found are Large leaved privet, Umbrella tree, Lantana, Celtis, Cocos palm, Smooth senna, Guava, Mickey mouse plant, Winter senna and Chinese burr. Wines such as Siratro, Dutchman's pipe and Silver-leaved desmodium are also present.

The ground cover in this community is dominated by Mistflower, Broad leaved Paspalum, Molasses grass, Singapore daisy, Crofton weed, Camphor laurel seedlings, Parramatta grass and Mickey mouse plant.

Community 3 - Low Open Woodland (*Acacia melanoxylon*)

Location and area
Two (2) small patches of vegetation (397 m^2) in the centre of the site are described as Community 3.

Description
The canopy is dominated by Blackwood wattles approximately four (4) – six (6) metres high. The native vine Silk-pod also occurs.

A mid-storey is absent in this community.

The ground cover is comprised of Broad-leaved paspalum, Mist flower, Lantana, Silver leaved desmodium and Singapore daisy. Large boulders, dead leaves and bare rock are also prominent.

Community 4 - Mid-high Open Forest (*Jagera pseudorhus*)

Location and area
Community four (4) occurs around one (1) large Foambark.

Description
The canopy of this community is formed by an old growth Foam bark. A few regenerating native species are present including a White fig, Red kamala, Brush cherry, Guioa and one (1) stem of the threatened species Rough-shelled bush nut (*Macadamia tetraphylla*) **(FIGURE 5).** Weeds, grasses and herbs that occur across the majority of the site form the ground cover.

Community 5 - Low Closed Herbland with Scattered trees (Mixed exotic weed species)

Location and area
Community 5 occurs over the majority of the Subject Site covering approximately 4.3 hectares.

Description
The vegetation in this community has colonised most of the site, probably after quarrying ceased. It is comprised almost entirely of exotic weeds including, Blue billy goat weed, Annual ragweed, Crofton weed, Lantana, Rattlepod, Stinking rodger, Chinese burr, Groundsel, Molasses grass, Castor oil plant, Singapore daisy, Cotton bush, Coastal morning glory, Winter senna, Farmers friends, Silver leaved desmodium, Madeira vine and Foxtail grass. Some scattered Camphor laurels and Slash pine are present and there are very few native species.

2.4 Conservation Significance of Vegetation Communities

Overall, the conservation status of the vegetation on the Subject Site is low because of the dominance of Camphor laurel, presence of other exotic species and the overall low species diversity. However, the presence of rainforest species along Bilambil Creek provides an ideal basis for rehabilitation.

2.5 Weed Species Assessment

Many exotic weed species were recorded on site. These plants will be eradicated using approved bush regeneration methods (Section 3.2 & **APPENDIX 3**).

3. WEED CONTROL

3.1 Introduction

This section formulates a plan for weed control within the Rehabilitation Area dividing the weed control program into two areas: 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.

3.2 Methods

3.2.1 Primary weeding

The Rehabilitation Area is dominated by many species of weeds. Primary weeding is designed to target these exotic species. The following 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;
- The majority of primary weeding will be undertaken by hand reducing the probability of damage to young regrowth or seedlings;
- Camphor laurel will be treated with a variety of methods **(APPENDIX 3);**
- Other persistent, woody weeds will be treated with herbicide using the "cut and paint" method;
- Careful hand weeding will occur at least 50 cm around retained native species;
- All plant genetic material (i.e. seeds, flowers and under ground rhizomes) will be removed and disposed of at an approved green waste facility; and
- Utmost care will be taken when utilizing chemicals ensuring drift does not occur outside the treatment areas.

An appropriate removal method for the major weed species is provided **(APPENDIX 3).**

3.2.2 Secondary weeding and maintenance

Regular follow up maintenance will be required. The regeneration team will be required to undertake the following duties:

- Control weeds and grasses by hand weeding;
- Apply supplementary mulch;
- Ensure adequate soil moisture and hand water if necessary;
- Prune or fell pioneer species that are inhibiting the growth of other species; and
- Stake any regenerating natives that have fallen.

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.

4. NATURAL REGENERATION

4.1 Introduction

Natural regeneration refers to the natural process by which plants replace or reestablish themselves. Natural regeneration can be described as the "regrowth" or "vegetative recovery" which occurs spontaneously, by seed or otherwise, 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 outbreeding depression is reduced. An overview of the principles of natural regeneration is provided (**APPENDIX 4).**

4.2 Encouraging Natural Regeneration

Native rainforest species occurring naturally in the RMZ are regenerating. These include the following species:

- Weeping lilly pilly
- Red kamala
- Foam bark
- Sandpaper fig
- Hairy pittosporum
- Hard quandong
- Sweet pittosporum
- Macaranga
- Guioa
- Blackwood wattle

The process of natural regeneration in the RMZ will be improved and facilitated by regular weed control (Section 3). Competition for valuable resources such as nutrients, water and light will be reduced, increasing the chance of survival of native seedlings.

5. ENHANCEMENT PLANTINGS

5.1 Introduction

This section describes the species, planting layouts and methods that will be used for plantings in RMZ after primary weed control is completed.

5.2 Riparian Management Zone

This area is currently dominated by exotic weed species. However, there is an abundance of native seedlings that are presently being out-competed by weeds. After primary weeding and the location of native plants/seedlings/saplings, any gaps of more than **two metres,** will be planted with appropriate native species **(TABLE 3).** Scrubs will be planted 1.5 m apart and trees 2m apart resulting in a planting density of at least 1.5m apart. A planting layout guide and cross section is provided **(FIGURE 6 a & b).**

5.3 Species Selection

Species selected for planting were chosen based on an assessment of the vegetation in nearby forested areas and in consultation with Tweed Shire Council **(TABLE 3).** Species selected are associated with Sub-tropical Riparian Vegetation. Plants will be sourced from local nurseries that can demonstrate propagation from local seed or vegetative stock (i.e. within 5-10km of the site).

RIPARIAN MANAGEMENT ZONE

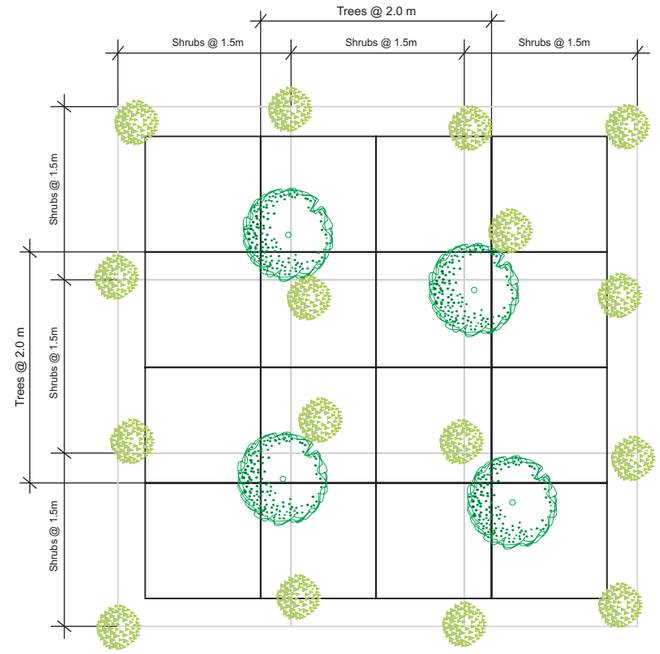
Legend

- Riparian Management Zone
- Batter
- Proposed Footpath (2m wide)
- Low creek bank
- High creek bank
- Cross section
- Subject Site

0 50m

Scale 1 : 1500 @ A3

PLANT LAYOUT GUIDE



LEGEND

- Trees
- Shrubs
- Groundcovers

SOURCE: JWA Site Investigations; B & P Surveys (Ref: 17154D-D.pdf)

SCALE: As shown

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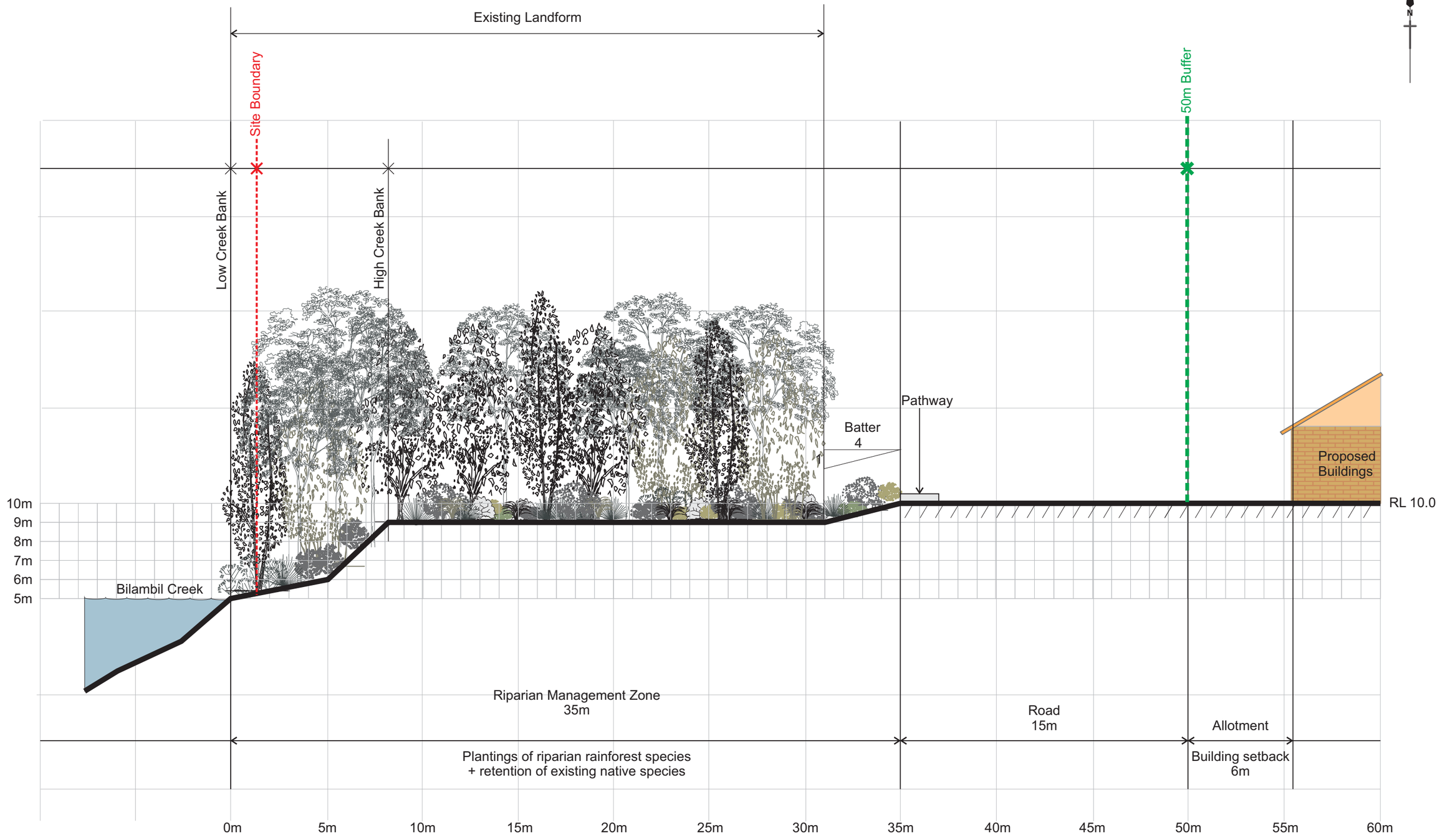
FIGURE 6A

PREPARED: BW
DATE: 25 May 2009
FILE: N08003_VRP_Mgt Zones.cdr

TITLE

RIPARIAN MANAGEMENT ZONE



Note: This schematic is representative only.

0 5m

1 : 200

SOURCE: JWA

SCALE: 1 : 200 @ A3

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FIGURE 6B

PREPARED: BW
DATE: 15 May 2009
FILE:N08003_VRP_cross-section.cdr

TITLE
SCHEMATIC OF PROPOSED RIPARIAN MANAGEMENT ZONES

TABLE 2
SPECIES LIST

Common Name	Botanical Name
Ground covers	
Spiny mat rush	*Lomandra longifolia*
Mat rush	*Lomandra hystrix*
Blue flax lily	*Dianella caerulea*
Tall flax lilly	*Dianella longifolia*
Climbing guinea flower	*Hibbertia scandens*
Cut-grass sedge	*Gahnia aspera*
Pollia	*Pollia crispata*
Tall sedge	*Carex appressa*
Variable sword sedge	*Lepidosperma laterale*
Shrubs	
Common lilly pilly	*Acmena smithii*
Grey myrtle	*Backhousia myrtifolia*
Midgenberry	*Austromyrtus dulcis*
Swamp lily	*Crinum pedunculatum*
Broad-leaved Palm lilly	*Cordyline petiolaris*
Red-fruited Palm lilly	*Cordyline rubra*
Narrow-leaved Palm lilly	*Cordyline stricta*
Coffee bush	*Breynia oblongifolia*
Native ginger	*Alpinia caerulea*
Corkwood	*Duboisia myoporoides*
Birds nest ferns	
Cycads	
Tree ferns	
Wilkea species	
Native raspberry	*Rubus rosifolius*
Plum Myrtle	*Pilidiostigma glabrum*
Stream lily	*Helmholtzia glaberrima*
Fragrant myrtle	*Gossia fragrantissima*
Velvet myrtle	*Lenwebbia prominens*
Narrow – leaved gardenia	*Atractocarpus chartaceus*
Smooth clerodendron	*Clerodendrum floribundum*
Trees	
Water gum	*Tristaniopsis laurina*
Tuckeroo	*Cupaniopsis anacardioides*
Red ash	*Alphitonia excelsa*
Creek sandpaper fig	*Ficus coronata*
Blue quandong	
Plum pine	*Podocarpus elatus*
Macaranga	*Macaranga tanarius*
Weeping lilly pilly	*Waterhousea floribunda*
Brown Kurrajong	
Celerywood	*Polyscias elegans*
Foam bark	
Plum pine	
Morton bay fig	*Ficus macrophylla*
Blue lilly-pilly	*Syzygium oleosum*
Whalebone tree	*Streblus brunonianus*
Maiden's blush	*Sloanea australis*
Giant water gum	*Syzygium francisii*

5.3.1 Planting methodology

During planting the following actions will be implemented:

- Planting will commence after the completion of primary weeding;
- All plants will be sun hardened;
- All plantings will be well watered, appropriately fertilised and heavily mulched with organic material or weed mat;
- All planted trees will be protected by tree guards until they are established and/or the tree guards no longer serve a useful function; and
- Plants will be hand watered as necessary.

5.2.3 Maintenance requirements

Fertiliser and mulch will be applied again in the second and subsequent growing seasons or when needed and 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.

6. PROTECTIVE MEASURES

6.1 Pedestrian Traffic

Signs will be posted along the Restoration Area stating "No Entry – Native Plant Revegetation Area". Signage should also have an educational theme providing information about Sub-tropical Rainforests and the associated flora and fauna.

If it is considered that the Restoration Area is being 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. A fencing plan will be developed by a Fencing Contractor in consultation with the Bush Regenerator. The fencing plan will include the following:

- 1.2m star pickets at 4m intervals with four strands of smooth galvanized wire;
- For fauna exclusion, an appropriate mesh will be used;
- Signage will be erected stating: "No Entry – Native Plant Revegetation Area"; and
- The fence will be retained until the plantings are considered to be sufficiently established.

7. MONITORING AND REPORTING

7.1 Introduction

Monitoring is very important in ensuring the continuing success of any VRP and will be carried out for the duration of this Plan. Plateau Nominees will be responsible for engaging an appropriately qualified person **(APPENDIX 1)** to develop and implement a monitoring plan. Monitoring and reporting responsibilities will be undertaken by both the Bush Regenerator and the Ecologist. The Bush Regenerator will record daily work activities and provide opportunistic feedback to the Ecologist who will prepare reports detailing the progress of the Plan.

7.2 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 Record Form is provided **(APPENDIX 5).** These records and general comments on progress will be provided to the Ecologist for consideration and inclusion in the overall monitoring reports.

7.3 General Monitoring

Monitoring of the VRP will be carried out for 5 years by an appropriately qualified person **(APPENDIX 1)** and should include the following data:

RMZ

- Name of data recorder (i.e. client's ecologist);
- Date and prevailing weather;
- Canopy height 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 each of the 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;
- Reasons for their death or failure to thrive.

Site visits should occur:

- Six (6) weeks after the primary weeding;
- Three (3) monthly after the primary weeding for the first (1st) year of the project;
- Six (6) monthly until the Rehabilitation plan is completed (i.e. 5 years).

Timing of the Monitoring reports are detailed in Table 3 and an example of a monitoring and evaluation pro-forma is included **(APPENDIX 6).**

7.4 Monitoring reports

All reports will be submitted to Plateau Nominees and Tweed Shire Council. The first report will be submitted three (3) months after primary weed control and 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 **(APPENDIX 5)**
- 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 have had on the Rehabilitation Area;
- Measures taken or proposed to rectify any problems; and
- The success or failure of measures implemented to rectify problems.

The Tweed Shire Council will acknowledge the receipt of each monitoring reports and provide comments as necessary.

8. ADAPTIVE MANAGEMENT

Adaptive management is an approach that involves learning from management actions, and using those lessons to improve the next stage (Holling 1978). 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 within this VRP are:

- Construction of a pedestrian and/or fauna exclusion fence;
- Manual removal or chemical control of encroaching invasive plant species;
- Replacement of enhancement plantings that do not survive; and
- Alteration of watering regime according to rainfall.

Before the implementation of any adaptive management strategy a brief report is be provided to Plateau Nominees and the Tweed Shire 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 Ecologist.

9. IMPLEMENTATION STRATEGY

As this VRP is a complex plan involving two management areas, weed control and maintenance, planting, watering, fencing and monitoring by a suite of different professionals, an action plan over time is outlined below **(TABLE 3)**.

TABLE 3
PLAN OF ACTION OVER TIME

Year 1	Year 2	Year 3	Year 4	Year 5
Primary weed control	Secondary weed control	Secondary weed control	Secondary weed control	Secondary weed control
Maintenance 2 weeks after primary weed control				
Initial plantings				
Installation of Tree guards	Removal of tree guards?	Removal of tree guards?	Removal of tree guards?	Removal of tree guards?
Maintenance every month	Maintenance every three (3) months	Maintenance every three (3) months	Maintenance every three (6) months	Maintenance every three (6) months
Adaptive management (if necessary)	Adaptive management (if necessary)	Adaptive management (if necessary)	Adaptive management (if necessary)	Adaptive management (if necessary)
Exclusions fences?				
Bush Regenerators monitoring daily	Bush Regenerators monitoring daily	Bush Regenerators monitoring daily	Bush Regenerators monitoring daily	Bush Regenerators monitoring daily
Monitoring 6 weeks after planting and every 3 months	Monitoring every 6 months	Monitoring every 6 months	Monitoring every 6 months	Monitoring every 6 months
First monitoring Report due 3 months after planting then 6 monthly	Reports every 6 months	Reports every 6 months	Yearly Report	Final Monitoring Report

10. ACQUITTAL OF THE VEGETATION REHABILITATION PLAN

The Tweed Shire Council will resume responsibility for the management of the Rehabilitation Area after a period of not less than five (5) years. This will occur once the final monitoring report has been received and it is determined by the Tweed Shire Council's Bushland Officer that the objectives of the Plan have been met. If it is determined that the objectives of the plan have not been meet and JWA disagrees then this will be resolved by a third party. The third party will be an appropriately qualified person, agreed upon by both JWA and the Tweed Shire Council. If the third party supports the Councils determination a supplementary action plan will be prepared to address any outstanding issues.

11. COSTING OF RESTORATION WORKS

A cost estimate for the Rehabilitation area was prepared by JWA. The estimate was produced with consideration of the weed densities in the Rehabilitation Area and the efforts that will be required to remove the exotic species and allow natural regeneration and enhancement planting. It must be noted that this is an estimate.

The approximate cost[1] for rehabilitation and completion of this VRP is outlined below **(TABLE 4).**

TABLE 4
APPROXIMATE TOTAL COSTS FOR REHABILITATION WORKS

Rehabilitation Works	Cost per hour ($)	Requirement	Total Cost ($)
Primary Weed Control	35	400	14 000
Secondary weed Control - maintenance – (5 years)	35	300 hours	10 500
Monitoring/reports	350 per visit	12 visits	4200
		Total Cost	**28700**

The number of trees/shrubs/ground covers to be planted is difficult to calculate until the primary weeding has been completed and the area to be planted out is calculated. However, an estimate has been calculated using the maximum number of plants required at the proposed planting density **(TABLE 5).**

TABLE 4
APPROXIMATE TOTAL COSTS FOR REHABILITATION WORKS

	MZ 1	Total ($)
Trees @ 10.00	1820	18 200
Shrubs @ 10.00	7000	70 000
Ground cover @ 10.00	2000	20 000
Total Cost		**108 200**

NB Cost per plant includes hole preparation and planting.

If adaptive management indicates, fencing the Rehabilitation Area is a potential cost. The cost for approximately 200 meters of exclusion fencing has been calculated from prices quoted from A.R.C Fences Ballina and includes installation **(TABLE 5).**

[1] This is an **estimate only** and quotes from licensed Bush Regenerators, closer to the date of commencement, will provide a more accurate guide to costs.

TABLE 5
FENCING COST

MATERIALS AND LABOUR FOR 80 METRES OF FENCING	Cost
50 star pickets @ $4.60	$203
2 rolls of wire (200 m) @ $32	$64
Labour @ $3.50 per meter	$700
Fauna exclusion mesh (200m x 1.2m) @ $100	$200
Total (200m)	**$836**

12. REFERENCES

Big Scrub Rainforest Landcare Group (2000) Common Weeds of Northern NSW Rainforest. Big Scrub Rainforest Landcare Group, Bangalow NSW.

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James Warren & Associates (2009) Flora and Fauna Assessment (Draft). Lots 2 & 3 DP 244652, Urliup Road Bilambil. A Report to Plateau Nominees Pty Ltd.

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.

TSC (2008) Tweed Shire Council. Local Environment Plan 2000 Map No. 12 http://www.tweed.nsw.gov.au/planningdocs/pdfs/planningdocs/lep_index.htm Viewed 1st July .

APPENDIX 1

Personnel carrying out work within Vegetation Management Plan

The qualifications required by personnel engaged to carry out specific duties within this VRP are outlined below:

(1) Weeding and Plantings
Primary and secondary weed control (maintenance) will be completed by a qualified Bush Regenerator or Regeneration Team.

All bush regeneration workers will hold a TAFE Accredited Certificate 2 in Bushland Conservation & Management (Bush Regeneration Certificate).

All chemical users will be experienced and licensed in accordance with the relevant legislation.

(2) Fencing
Fencing will be carried out by a licensed Fencing Contractor.

(3) Monitoring
An overall monitoring plan will be developed and implemented by an appropriately qualified person (i.e. Ecologist or Bush Regenerator). This person will be independent of the Bush Regeneration Team.

Bush regeneration monitoring will be undertaken by the Bush Regeneration Team Leader.

APPENDIX 2

PLANT SPECIES LIST

Grouping	Family	Botanical Name	Common Name
Ferns and Fern Allies	Adiantaceae	*Adiantum hispidulum*	Rough maidenhair
Ferns and Fern Allies	Aspleniaceae	*Asplenium Australascium*	Bird's nest fern
Ferns and Fern Allies	Cyatheaceae	*Cyathea* sp.	Tree fern
Ferns and Fern Allies	Davalliaceae	*Nephrolepis cordifolia**	Fishbone fern
Ferns and Fern Allies	Dennstaedtiaceae	*Pteridium esculentum*	Bracken fern
Ferns and Fern Allies	Thelypteridaceae	*Christella dentata*	Binung
Gymnosperms	Pinaceae	*Pinus elliottii**	Slash pine
Monocotyledons	Araceae	*Alocasia brisbanensis*	Cunjevoi
Monocotyledons	Araceae	*Syngonium podophyllum*	Arrowhead
Monocotyledons	Arecaceae	*Archontophoenix cunninghamiana*	Bangalow palm
Monocotyledons	Arecaceae	*Syagrus romanzoffiana**	Cocos palm
Monocotyledons	Asparagaceae	*Asparagus aethiopicus**	Asparagus fern
Monocotyledons	Asparagaceae	*Asparagus plumosus**	Climbing asparagus fern
Monocotyledons	Commelinaceae	*Commelina benghalensis**	Hairy wandering jew
Monocotyledons	Commelinaceae	*Tradescantia fluminensis**	Wandering jew
Monocotyledons	Cyperaceae	*Cyperus polystachyos*	Bunchy sedge
Monocotyledons	Flagellariaceae	*Flagellaria indica*	Whip vine
Monocotyledons	Lomandraceae	*Lomandra hystrix*	Stream matrush
Monocotyledons	Lomandraceae	*Lomandra longifolia*	Long-leaved matrush/ Spiny-headed matrush
Monocotyledons	Phormiaceae	*Dianella caerulea*	Blue flax lily
Monocotyledons	Poaceae	*Melinis minutiflora**	Molasses grass
Monocotyledons	Poaceae	*Oplismenus aemulus*	Basket grass
Monocotyledons	Poaceae	*Ottochloa gracillima*	Shade grass
Monocotyledons	Poaceae	*Paspalum dilatatum**	Paspalum
Monocotyledons	Poaceae	*Paspalum wettsteinii**	Broad-leaved paspalum
Monocotyledons	Poaceae	*Pennisetum alopecuroides*	Swamp foxtail
Monocotyledons	Poaceae	*Pennisetum purpureum*	Elephant grass
Monocotyledons	Poaceae	*Setaria* sp.*	Pigeon grass
Monocotyledons	Poaceae	*Setaria sphacelata**	Pigeon grass
Monocotyledons	Poaceae	*Sporobolus africanus**	Parramatta grass
Monocotyledons	Poaceae	*Sporobolus indicus**	Rat's tail grass
Dicotyledons	Apocynaceae	*Parsonsia straminea*	Common silkpod
Dicotyledons	Araliaceae	*Schefflera actinophylla**	Umbrella tree
Dicotyledons	Aristolochiaceae	*Aristolochia elegans**	Dutchmnan's pipe
Dicotyledons	Asclepiadaceae	*Araujia sericifera**	Moth plant
Dicotyledons	Asclepiadaceae	*Asclepias curassavica**	Redhead cotton bush

Grouping	Family	Botanical Name	Common Name
Dicotyledons	Asclepiadaceae	*Gomphocarpus fruticosus**	Narrow- leafed cotton bush
Dicotyledons	Asclepiadaceae	*Gomphocarpus physocarpus**	Balloon cotton bush
Dicotyledons	Asteraceae	*Ageratina adenophora**	Crofton weed
Dicotyledons	Asteraceae	*Ageratina riparia**	Mistflower
Dicotyledons	Asteraceae	*Ageratum houstonianum**	Blue billygoat weed
Dicotyledons	Asteraceae	*Ambrosia artemisiifolia**	Annual ragweed
Dicotyledons	Asteraceae	*Aster subulatus*	Wild aster
Dicotyledons	Asteraceae	*Baccharis halimifolia**	Groundsel
Dicotyledons	Asteraceae	*Bidens pilosa**	Cobblers pegs
Dicotyledons	Asteraceae	*Carduus sp.**	Milk thistle
Dicotyledons	Asteraceae	*Erechtites valerianifolia**	Brazilian fire weed
Dicotyledons	Asteraceae	*Hypochoeris radicata**	Flatweed
Dicotyledons	Asteraceae	*Onopordium acanthum**	Scotch Thistle
Dicotyledons	Asteraceae	*Tagetes minuta**	Stinking roger
Dicotyledons	Asteraceae	*Taraxacum officinale**	Dandelion
Dicotyledons	Asteraceae	*Tithonia diversfolia**	Japanese sunflower
Dicotyledons	Asteraceae	*Tridax procumbems*	Tridax
Dicotyledons	Asteraceae	*Wedelia trilobata**	Singapore daisy
Dicotyledons	Asteraceae	*Xanthium occidentale**	Noogoora burr
Dicotyledons	Basellaceae	*Anredera cordifolia**	Madeira vine
Dicotyledons	Bignoniaceae	*Jacaranda mimosifolia**	Jacaranda
Dicotyledons	Caesalpiniaceae	*Caesalpinia subtropica*	Corky prickle vine
Dicotyledons	Caesalpiniaceae	*Senna pendula**	Winter senna
Dicotyledons	Caesalpiniaceae	*Senna X floribunda**	Smooth senna
Dicotyledons	Convolvulaceae	*Ipomoea cairica**	Coastal morning glory
Dicotyledons	Convolvulaceae	*Ipomoea indica**	Morning glory
Dicotyledons	Elaeocarpaceae	*Elaeocarpus grandis*	Blue quandong
Dicotyledons	Elaeocarpaceae	*Elaeocarpus obovatus*	Hard quandong
Dicotyledons	Euphorbiaceae	*Macaranga tanarius*	Macaranga
Dicotyledons	Euphorbiaceae	*Mallotus philippensis*	Red kamala
Dicotyledons	Euphorbiaceae	*Ricinus communis**	Castor oil plant
Dicotyledons	Fabaceae	*Crotalaria lanceolata**	Rattlepod
Dicotyledons	Fabaceae	*Desmodium intortum**	Green-leaved desmodium
Dicotyledons	Fabaceae	*Desmodium uncinatum**	Silver-leaved desmodium
Dicotyledons	Fabaceae	*Erythrina crista-galli**	Cockspur coral tree
Dicotyledons	Lauraceae	*Cinnamomum camphora**	Camphor laurel
Dicotyledons	Meliaceae	*Dysoxylum mollissimum*	Red bean
SDicotyledons	Mimosaceae	*Acacia disparrima*	Brush ironbark wattle
Dicotyledons	Mimosaceae	*Acacia longissima*	Narrow leaf acacia
Dicotyledons	Mimosaceae	*Acacia melanoxylon*	Blackwood wattle
Dicotyledons	Moraceae	*Ficus coronata*	Creek sandpaper fig
Dicotyledons	Moraceae	*Ficus virens*	White fig
Dicotyledons	Myrtaceae	*Eugenia uniflora**	Brazilian cherry
Dicotyledons	Myrtaceae	*Psidium guajava**	Yellow guava
Dicotyledons	Myrtaceae	*Syzygium australe*	Brush cherry
Dicotyledons	Myrtaceae	*Waterhousea floribunda*	Weeping lilly pilly
Dicotyledons	Ochnaceae	*Ochna serrulata**	Mickey mouse plant

Grouping	Family	Botanical Name	Common Name
Dicotyledons	Oleaceae	*Ligustrum lucidum**	Large-leaved privet
Dicotyledons	Pittosporaceae	*Pittosporum revolutum*	Hairy pittosporum
Dicotyledons	Pittosporaceae	*Pittosporum undulatum*	Sweet pittosporum
Dicotyledons	**Proteaceae**	***Macadamia tetraphylla***	**Rough-shelled bush nut**
Dicotyledons	Sapindaceae	*Cupaniopsis anacardioides*	Tuckeroo
Dicotyledons	Sapindaceae	*Guioa semiglauca*	Guioa
Dicotyledons	Sapindaceae	*Jagera pseudorhus*	Foambark
Dicotyledons	Sterculiaceae	*Commersonia bartramia*	Brown kurrajong
Dicotyledons	Tiliaceae	*Triumfetta rhomboidea**	Chinese burr
Dicotyledons	Ulmaceae	*Celtis sinensis**	Chinese celtis
Dicotyledons	Verbenaceae	*Lantana camara**	Lantana
Dicotyledons	Verbenaceae	*Verbena bonariensis**	Purple top

* Introduced Species

Threatened species are shown in **bold**

APPENDIX 3

METHODS OF REMOVAL FOR SPECIFIC WEED SPECIES

Camphor laurel (*Cinnamomum camphora)*

Camphor laurel is the most common weed tree within the Rehabilitation Area and will require a targeted approach to its removal and eradication. The most appropriate removal methods will include a variety of techniques including the following:

- Stem inject trees greater than 10cm diameter using axe, drill, or a camphor cutter 1:1.5 in Autumn or Spring while actively growing;
- Trees selected for stem injection should not initially impact on the percentage cover of canopy (i.e. Trees adjacent to native species or smaller less significant trees should be stem injected first to allow the understorey to adapt to the changing conditions and to avoid mass germination of Camphor laurel seedling);
- Control of mature trees should be undertaken gradually with a maximum 30% killed per year for the first three (3) years and a maximum 10% each successional year;
- Cut, scrape and paint saplings up to 10cm diameter with glyphosate 1:1.5
- Decaying Camphor laurel deemed to be a OH&S risk will be removed;
- Spray seedlings with Glyphosate at a rate of 200ml per 10 litres water plus 15 ml Protect plus 1.5 g metsulfuron methyl.

Asparagus fern

Asparagus fern is the most common weedy ground cover within the Rehabilitation area and will require a targeted approach to its removal and eradication from the site. The most appropriate removal methods will include a variety of techniques including the following:

- Hand-pull and compost or place in bin;
- Crown out or gouge rhizomes with knife;
- Remove all genetic parts of the species from the site;

During the follow up weeding if Asparagus fern is continuing to invade the Rehabilitation area, the following control methods are recommended:

- Crown out or gouge rhizomes with knife and paint (100%):
- Cut, wait for regrowth and spray when actively growing (1:50 + Li 700);
- Seedlings: hand-pull or spray (1:50 + MM1.5g/10L + Ag 2ml/L).

Wild Tobacco

Occurs through out the Rehabilitation area, several larger specimens (approx 2m high) occur along with an abundance of seedling between 5cm and one (1) metre in height.

The most appropriate removal methods will depend on the size of each specimen and will include a variety of techniques including the following:

- Seedlings: hand-pull
- Shrubs: Cut Scrapee & Paint (1:1.5) or F/I (1:1.5).

Winter Senna

Winter senna is shrubby weed within the Rehabilitation area and will require a targeted approach to its removal and eradication from the site.

The most appropriate removal methods will include a variety of techniques including the following:

- Bag seed or reproductive material;
- Hand pull seedlings;
- Shrubs Cut Scrapee & Paint (1:1.5) or F/I 1(1:1.5) ;

Bitou bush (*Chrysanthemoides monilifera*)

Bitou bush occurs within the Rehabilitation area and will require a targeted approach to its removal and eradication from the site. The most appropriate removal methods will include a variety of techniques including the following:

- Bag and remove seed or reproductive material;
- Hand pull seedlings;
- Shrubs Cut Scrapee & Paint (1:1.5);

While hand weeding is recommended for this species, Bitou bush is very susceptible to Glyphosate, especially during winter. If Bitou bush is continuing to invade the Rehabilitation area after primary weeding efforts, the following control methods are recommended:

- Selective spot spraying with glyphosate (1:200). If the spraying is to be completed during winter a much lower concentration is needed i.e a ratio of (1:400) glyphosate to water will be able to be used in winter. It is considered that at the lower concentration (ratio of 1:400) may not cause harm to native species.

Coastal morning glory (*Ipomoea cairica*)

Coastal morning glory occurs throughout the Rehabilitation area. The most appropriate removal method is to roll up the long runners, then scrape the stem and apply (paint) glyphosate and water (1:1.5).

Lantana

Lantana is also common, occurring only as some small isolated patches. The most appropriate control method is to removed the Lantana using the cut and paint method.

- All of the genetic material (flowers, seeds) is to be bagged and deposed of at an approved green waste facility.
- Lantana is to be cut as low on the main stem as possible then painted with glyphosate at a ration of one (1) part glyphosate to (1.5) parts water.
- Decaying Lantana is to be pilled “High & Dry” to reduce the area of potential colonisation.

Grasses, Ground Covers and other herbaceous weeds

Any exotic grasses and groundcovers such as Ragweed, Fireweed, Crofton weed, Broad-leaved paspalum, Setaria, Molasses grass and Whisky grass will be hand weeded.

APPENDIX 4

Ecological Restoration Principles

Ecological restoration aims to restore pre-existing indigenous ecosystems and ecological processes on disturbed sites, maintaining and developing the natural ecosystem to self perpetuate (Perkins 1992). Perkins (1992) put forward a *restoration continuum* spanning from assisted natural regeneration, the least interventionist, to reconstruction (of original communities on cleared sites) and fabrication (of new communities on changed sites). These activities are undertaken in different circumstances in the field, but the boundaries are blurred, allowing practitioners to consider sites on an individual basis, according to the level of disturbance and the restoration potential identified in the site. The aim of ecological restoration is to restore to the highest practicable extent, and to develop a system that is sustainable in the long term.

In disturbed areas that cannot solely rely on natural regeneration potential, revegetation can be undertaken to reconstruct the original forested communities. Cleared sites can be replanted with species grown from seed collected in nearby local native vegetation. The use of seed of local provenance (origin) is a key principle underpinning the integrity of the work, and avoids possible genetic pollution of local woodland when future pollen exchange takes place between remnant and replanted woodland.

Unfortunately the suite of species that is available is often narrow, determined by practicalities of seed collection, the ability to propagate in a nursery and limits on field establishment in the environmental conditions prevailing on cleared land. Conceptually, this is merely establishing a framework into which additional plant and animal diversity can recruit or be reintroduced once the environment is modified (Perkins 1992).

Cleared sites are seldom completely devoid of native species. It is common to observe paddocks supporting threads of the original ground cover vegetation. This is often apparent in paddocks historically sown with exotic grasses to improve pasture. While the introduced grasses are usually dominant, a surprising diversity of native grasses and groundcovers can often persist. They have remained through a history of sustained grazing and are by definition adapted to grazing. The act of excluding livestock or other management activities can threaten native diversity, as biomass from the introduced grasses smothers these plants. Alternative biomass reduction can be achieved with slashing and fire however these have different effects and their own practical limitations.

Total groundcover biomass is reduced under a developing canopy, a phenomenon also evident in re-growing forest communities. The vigour of exotic grasses is greatly diminished and some are unable to grow, leaving room for native plants that are adapted to the woodland ecosystem. Of course some native plants lose vigour in the forest canopy as well. Revegetation is thus forming an important mechanism for grassland manipulation and as a tool for creating a variety of niches

in the ground layer. At the same time, revegetation is achieving the obvious objectives of increasing habitat values, restoring normal hydrology and increasing the range of species available to recover in a site after disturbance. Revegetation needs to be used in combination with other techniques, and these processes will need to be studied in detail before they can be conclusively described as positive.

The mechanism of planting is likely to be a most important strategy in revegetation of the site, not as an end in itself, but as an important tool to ameliorate changed sites and release ecosystem resilience. While prolonged monitoring needs to be maintained in revegetation areas, there are indications that environmental conditions within the site will change in interesting ways as revegetation develops.

Reference

Perkins, I. 1992. *Land and Vegetation Management Plan for the Horsley Park Corridor.*

APPENDIX 5

Daily Work Record – Urliup Road, Bilambil. Vegetation Rehabilitation Project

Name.....
Date .....
RMZ .....

Weather Conditions					
Site Conditions					
Work completed					
Weeding (Hrs)	Planting (Hrs)	Mulching (Hrs)	Chemicals (Hrs)	Future Work Needed	
Notes					

APPENDIX 6

Monitoring and Evaluation Record

Assessor……

Date ……

MZ ……

Weather……

General Conditions……

	Native	Progress	Exotic	Progress
Canopy Height	……	……	……	……
% Cover Canopy	……	……	……	……
% Cover Ground	……	……	……	……
Number	……	……	……	……
Relative Abundance	……	……	……	……

Photos (Photo #)	North	South	East	West
Point 1	……	……	……	……
Point 2	……	……	……	……

General Conditions	Water	Mulch	Nutrient	Fertiliser	Topsoil
	……	……	……	……	……
	……	……	……	……	……
	……	……	……	…….	……

Volunteer Natives (Species and Location)

……

……

……

Progress on Weed Control

……

……

Progress on Enhancement Planting

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Progress in Natural Regeneration

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Damage to Site

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Adaptive Management Strategies

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Requirements for Ongoing Management Interaction

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