



VEGETATION MANAGEMENT PLAN

**LOTS 30 & 31 SECTION C DP 5464
WARRIEWOOD ROAD
WARRIEWOOD**

**APRIL 2013
(REF: 3020V)**

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PREFACE

This Vegetation Management Plan has been prepared by *Conacher Environmental Group* to identify matters in relation to the management of vegetation within the riparian corridor area of Lots 30 & 31, Section C, DP 5464, Warriewood Road, Warriewood.

PROJECT TEAM

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SECTION 1

INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

This Vegetation Management Plan (VMP) provides details on the management of land within the identified riparian corridor area to achieve the objectives of establishing a vegetated riparian zone on waterfront land for the proposed development of Lots 30 & 31, Section C, DP 5464, Warriewood Road, Warriewood. Photos of the subject site have been provided in Appendix 1.

The subject site is within the Warriewood Valley Urban Land Release Area. Pittwater 21 DCP states that waterfront land in a degraded state should be restored and rehabilitated.

This VMP has been prepared generally incorporating the methodologies outlined in the Guidelines for Controlled Activities Vegetation Management Plans prepared by the NSW Government Office of Water (2012). The primary objective of this VMP is to provide a stable watercourse and riparian corridor which emulates the native vegetation communities in the area.

In preparing this VMP, a number of existing reports have been utilised. Brief details on these are provided below:

i. *Urban Bushland Management Guidelines (Dept. of Planning, 1991)*

The Department of Urban Affairs and Planning's Guidelines for Preparing Management Plans for Urban Bushland have been followed when preparing this management plan. The Urban Bushland Management Guidelines (Dept. of Planning, 1991) contain a number of relevant strategies, which are aimed at maintaining and enhancing native flora and fauna and their habitats.

ii. *NSW DPI Office of Water Guidelines for Controlled Activities*

A controlled activity is an activity undertaken on waterfront land. The NSW DPI Office of Water has issued the following relevant guidelines for Controlled Activities on Waterfront Land:

- Outlet Structures;
- Riparian Corridors;
- Vegetation Management Plans; and
- Watercourse Crossings.

These guidelines were considered when preparing this VMP for the Riparian Corridor area of the site.

iii. *Flora And Fauna Assessment Report, Proposed Development Lots 30 & 31 Section C DP 5464, Warriewood Road, Warriewood (Conacher Environmental Group 2013a)*

This report was prepared to identify the ecological characteristics of the site and provide an assessment of the likely impact of the proposal on nationally and state listed threatened flora and fauna and their habitats in accordance with the *Environment*

Protection and Biodiversity Conservation Act (1999) the Environmental Planning and Assessment Act (1979) and the Threatened Species Conservation Act (1995).

1.2 IMPLEMENTATION OF THE VMP

The VMP is to be implemented for a minimum of two years after the completion of works or until such time as a minimum 80 per cent survival rate of each species planted and a maximum 5 per cent weed cover for the treated riparian corridor controlled activity is achieved. Annual progress reports are to be submitted to the NSW Office of Water and Pittwater Council until the completion of the works required.

1.3 SITE DETAILS

The planning and cadastral details of the subject site are provided in Table 1.1.

TABLE 1.1 SITE DETAILS	
Location	Lots 30 & 31, Section C, DP 5464, Warriewood Road, Warriewood.
Area	Approximately 2.3 hectares
Grid Reference	342425 E 6271160 N
Local Government Area	Pittwater
Existing Land Use	Rural residential
Proposed Development	Residential subdivision

1.4 EXISTING VEGETATION CHARACTERISTICS

The vegetation communities within the site have been described and mapped by *Conacher Environmental Group (2013a)* and consist of Disturbed Swamp Forest and Cleared Land with Predominantly Exotic Vegetation. Vegetation community descriptions are provided below, and vegetation community locations are shown in Figure 1.

DISTURBED SWAMP FOREST

Structure:

Canopy: To 25 metres high, with 30% Projected Foliage Cover (PFC).

Sub-canopy: To 6 metres high, with 50% PFC.

Shrubs: To 1 metres high, with 5% PFC.

Groundlayer: To 0.5 metres high, with 0-60% PFC.

Floristics:

(Characteristic Species)

Canopy: *Casuarina glauca*, and *Eucalyptus robusta*, *Erythrina x sykesii* and *Ficus benjamina*.

Sub-canopy: *Ficus benjamina* and *Cinnamomum camphora*.

Shrubs: *Colocasia esculenta* and *Erythrina crista-galli*.

Groundlayer: *Tradescantia fluminensis*, *Paspalum sp.* and *Ipomoea indica major*.

Weeds: *Erythrina x sykesii*, *Ficus benjamina*, *Cinnamomum camphora*,
Colocasia esculenta, *Erythrina crista-galli*, *Tradescantia fluminensis*.

Classification:

This vegetation community is mapped by DECCW (2009) as Coastal Flats Swamp Mahogany Forest. The vegetation present is characteristic of a highly disturbed variant of this map unit.

This vegetation community corresponds to the endangered ecological community Swamp Sclerophyll Forest on Coastal Floodplains as listed within the *TSC Act* (1995).

The features that distinguish the vegetation present from the Swamp Oak Floodplain Forest EEC are the occurrence of *Eucalyptus robusta* and the lack of influence of saline ground water.

Variation:

The projected foliage cover within the groundlayer stratum was patchy and variable across the site.

Disturbance:

This vegetation community has been subject to severe disturbances over a long time period. Disturbances include dumping of rubbish and fill material, extensive weed invasion in all stratum layers and vegetation clearing. These disturbances have resulted in a lack of native shrub cover and simplification of the groundlayer stratum.

Weed Invasion:

Weed invasion is moderate throughout all strata of this community. Prior to surveys extensive weed removal works had been undertaken however regrowth of weeds was occurring.

Location and Distribution:

This community is restricted to the southern sections of the site within the immediate vicinity of Narrabeen Creek. This community occupies approximately 0.3 hectares as shown in Figure 1.

CLEARED LAND WITH PREDOMINANTLY EXOTIC VEGETATION

This community encompasses the areas of the site which contain cleared land and exotic pasture areas. A patchy cover of a variety of exotic and planted native trees and shrubs are present and the ground layer contains predominantly exotic grasses and herbs. Large areas of hardstand with no vegetation are included within this community. This community is not representative of any locally occurring natural vegetation type.

1.5 PROPOSED DEVELOPMENT

The proposed development is for a residential subdivision. Although the current proposal is for the subdivision of land and provision of roads and services, assessments within this report have taken into account the potential future construction of dwellings and associated infrastructure such as driveway access, landscaping, asset protection zones, and the provision of services within each new allotment. As part of the proposal a riparian corridor will be established within the southern section of the site and will be subject to management in accordance with a Vegetation Management Plan. Detailed plans of the proposed development have been provided as separate documentation to this report.

1.6 COMPLIANCE WITH NSW OFFICE OF WATER CRITERIA FOR PREPARING A VEGETATION MANAGEMENT PLAN ON WATERFRONT LAND

The criteria addressed below relates specifically to the designated Riparian Corridor area of the site. The criteria addressed, follows the Guidelines for Vegetation Management Plans on Waterfront Land (DPI Office of Water 2012).

TABLE 1.2 NSW OFFICE OF WATER GUIDELINES FOR VEGETATION MANAGEMENT PLANS CRITERIA ASSESSMENT	
Criteria	Where Addressed in this Report
An appropriate width for the riparian corridor should be identified by consulting the development consent, the relevant environmental planning instrument or the NSW Office of Water guidelines for riparian corridors. The VMP should consider the full width of the riparian corridor and its functions including accommodating fully structured native vegetation.	The riparian corridor has been identified following consideration of the approved development areas and consultation within the NSW Office of Water.
Maps or diagrams which clearly identify the riparian corridor; the existing vegetation; the vegetation to be retained; the vegetation to be cleared; the footprint of construction activities; and areas of proposed revegetation etc. should be prepared.	See Figure 1.
The location of the bed and banks or foreshore of waterfront land and the footprint of the riparian corridor should be clearly identified. Vegetated riparian zones must be indicated.	See Figure 1.
Photographs of the site should be supplied and photo points should be identified. To assist with future monitoring and reporting requirements, the photo points should be identified by GPS coordinates or by survey. This is particularly important for large scale earthworks or extractive industries.	Photographs of the site are provided in Appendix 1. Locations for future monitoring points are shown in Figure 1. Due to the relatively small size of the site, identification of photo monitoring points by GPS coordinates or survey is considered not necessary.
Measures for controlling long term access and encroachments (bollards, fences, etc.) into the riparian corridor should be identified.	See Section 2.4.4.
Vegetation species composition, planting layout and densities should be identified. The required mix of plant species relates to the actual community to be emulated and the size of the area or areas to be rehabilitated but mature vegetation communities are generally well structured, comprising trees, shrubs and groundcovers species. Planting densities should achieve quick vegetative cover and root mass to maximise bed and bank stability along the subject watercourse.	See Section 2.4.2.
Seed or plant sources should be identified. Where possible, native plants and seed sources of local provenance should be used.	See Appendix 2.
Exotic vegetation should be avoided. The use of exotic species for temporary soil stabilisation is permitted provided they are sterile, non-invasive and easily eradicated when permanent vegetation is established.	Use of exotic vegetation is not proposed.

TABLE 1.2 NSW OFFICE OF WATER GUIDELINES FOR VEGETATION MANAGEMENT PLANS CRITERIA ASSESSMENT	
Criteria	Where Addressed in this Report
Details of the planting program, rehabilitation methods and staging should be provided. Techniques such as hydro-seeding, direct seeding, brush matting or assisted natural regeneration may be considered.	See Section 2.4 and Appendix 2.
Maintenance requirements should extend for a minimum of two years after the completion of works or until such time as a minimum 80 per cent survival rate of each species planted and a maximum 5 per cent weed cover for the treated riparian corridor controlled activity is achieved.	See Section 2.5.
Project tasks should be defined and described, including a schedule detailing the sequence and duration of works necessary for the implementation of the VMP.	A works program is provided in Section 3.
Costings for the implementation of all components and stages of the work including materials, labour, watering, maintenance which includes plant replacement, monitoring and reporting should be prepared.	Costings have not been provided as part of this report. A qualified Bushland Regenerator should be consulted to determine the costs associated with implementing this Plan.
Processes for monitoring and review, including a method of performance evaluation should be identified. This should include replacing plant losses, addressing deficiencies, problems, climatic conditions and successful completion of works.	See Section 2.5.
Regular reporting on the implementation and status of works covering progress, success or failures and completion should be provided. The number and duration of reporting periods will be identified in the CAA. Works as executed plans and reports detailing how the components of the VMP have been implemented will be required prior to the release of any security held by the NSW Office of Water.	Reporting requirements are detailed in Section 2.5.

SECTION 2

VEGETATION MANAGEMENT STRATEGY

2.1 IDENTIFIED MANAGEMENT ISSUES

Management requirements for the area of the site designated as a Vegetated Riparian Corridor follow the Guidelines for Vegetation Management Plans on Waterfront Land (DPI Office of Water 2012).

The riparian corridor area contains Cleared Land and Disturbed Swamp Forest vegetation which contains high to moderate levels of weeds and cleared areas incorporating areas of dumped rubbish, hardstand and introduced fill material.

In order to restore and rehabilitate the riparian corridor area the following works will be required:

- Land amelioration works including:
 - Removal of introduced fill material and reshaping of the riparian corridor area to emulate natural topographical conditions;
 - Removal of hardstand areas and dumped rubbish;
 - Topsoil amelioration and management works.
- Weed management;
- Supplementary planting of endemic vegetation.

The extent of soil amelioration works required shall be determined by a geotechnical consultant and may need evaluation following removal of fill material. For areas where it is determined that the topsoil is not adequate to support replanting of vegetation, an organic soil mix and soil stabilisation matting should be utilised within the riparian corridor area.

2.2 RIPARIAN CORRIDOR AREA MANAGEMENT DETAILS

The Riparian Corridor Area (VMA) will be managed to enable the establishment of a Vegetated Riparian Zone in accordance with Controlled Activity Guidelines for Riparian Corridors on Waterfront Land (NSW DPI Office of Water 2012). A suitable Vegetated Riparian Zone width to Narrabeen Creek was determined at the rezoning stage for the Warriewood Valley Urban Land Release Area. The riparian corridor identified has a width of 25-35 metres from the top of bank of Narrabeen Creek, as identified in Figure 1.

2.2.1 Land Amelioration Works

The site has been subjected to extensive soil and land disturbances including dumping of fill material, concreting of land surfaces and storage and dumping of materials and rubbish.

The works required for rehabilitation include removal of stored and dumped materials from the riparian zone, decontamination and/or removal of introduced fill material and removal of concreted hardstand areas. The extent of soil amelioration works will be determined by a geotechnical consultant and are likely to be undertaken prior to any vegetation rehabilitation works.

2.2.2 Primary Weed Management

The weed management technique that is most suitable for this situation is a variation of the Bradley Method. This method identifies that weed removal should be accomplished with minimal disturbance to the soil and surrounding native plants, an ideal situation in areas sensitive to erosion and where native plants can regenerate.

The Bradley Method incorporates three basic philosophies:

- Work from areas containing less disturbed native vegetation towards more weed infested areas;
- Minimal disturbance to the soil and surrounding native plants. This is an important aspect especially in this situation as the topography and riparian morphology of the site makes it susceptible to erosion once plant cover has been removed;
- Allow natural native plant regeneration to occur throughout the native plant community. In some cases it may be necessary to assist regeneration by replanting areas of weed removal with locally occurring native species.

High levels of weed invasion are present within the site and adjoining lands within the local area. The total eradication of weeds within the BVMA is unlikely to be an achievable outcome due to the influence of irrepressible external weed dispersal mechanisms. As such it is recommended that a weed minimisation management strategy is adopted for noxious and significant environmental weeds, particularly Weeds of National Significance.

Weeds targeted for management are listed in Table 2.1. Management is to be undertaken in accordance with the guidelines provided within the NSW Government Industry and Investment (2009) Noxious and Environmental Weed Control Handbook.

Primary weed management is to extend for a minimum of two years from the commencement of works or until such time as a maximum 5 per cent weed cover of the species listed in Table 2.1 is achieved. Detailed guidelines for weed management are provided in Appendix 2 of this report.

TABLE 2.1 EXOTIC SPECIES TARGETED FOR REMOVAL WITHIN WMA			
Scientific Name	Common Name	Status	Removal Technique
Trees			
<i>Cinnamomum camphora</i>	Camphor Laurel	-	Physical removal and treatment of cut stump
<i>Erythrina crista-galli</i>	Cockspur Coral Tree	-	Physical removal and treatment of cut stump
<i>Erythrina sykesii</i>	Coral Tree	-	Physical removal and treatment of cut stump
<i>Ficus benjamina</i>	Weeping Fig	-	Physical removal and treatment of cut stump
Shrubs			
<i>Hedychium gardnerianum</i>	Ginger Lilly	-	Mechanical control / herbicide control
<i>Lantana camara</i>	Lantana	-	Mechanical control / herbicide control
<i>Ligustrum lucidum</i>	Large-leaved Privet	C4	Mechanical control / herbicide control

TABLE 2.1 EXOTIC SPECIES TARGETED FOR REMOVAL WITHIN WMA			
Scientific Name	Common Name	Status	Removal Technique
<i>Ligustrum sinense</i>	Small-leaved Privet	C4	Mechanical control / herbicide control
<i>Musa acuminata</i>	Banana	-	Mechanical control / herbicide control
<i>Solanum mauritianum</i>	Wild Tobacco	-	Mechanical control / herbicide control
Groundcovers			
<i>Ageratina adenophora</i>	Crofton Weed	-	Mechanical control / herbicide control
<i>Asparagus aethiopicus</i>	Asparagus Fern	C4	
<i>Brassica fruticosus</i>		-	Mechanical control / herbicide control
<i>Colocasia esculenta</i>	Taro	-	Mechanical control / herbicide control
<i>Conyza bonariensis</i>	Flax-leaf Fleabane	-	Mechanical control / herbicide control
<i>Conyza sumatrensis</i>	Fleabane	-	Mechanical control / herbicide control
<i>Erigeron karvinskianus</i>	Mexican Daisy	-	Mechanical control / herbicide control
<i>Hydrocotyle bonariensis</i>	Pennywort	-	Mechanical control / herbicide control
<i>Lantana camara</i>	Lantana	C4 / WON	
<i>Monstera deliciosa</i>	Fruit-salad Plant	-	Mechanical control / herbicide control
<i>Paspalum spp.</i>	Paspalum	-	Mechanical control / herbicide control
<i>Pennisetum clandestinum</i>	Kikuyu	-	Mechanical control / herbicide control
<i>Plantago major</i>	Large Plantain	-	Mechanical control / herbicide control
<i>Ricinus communis</i>	Castor Oil Plant	C4	Mechanical control / herbicide control
<i>Syngonium podophyllum</i>		-	Mechanical control / herbicide control
<i>Tradescantia fluminensis</i>	Wandering Jew	-	Mechanical control / herbicide control
<i>Anredera cordifolia</i>	Madiera Vine	C4	Mechanical control / herbicide control
<i>Araujia sericifera</i>	Moth Vine	C4	Mechanical control / herbicide control
<i>Ipomoea indica</i>	Morning Glory	C4	Mechanical control / herbicide control
<i>Lonicera japonica</i>	Japanese Honeysuckle	-	Mechanical control / herbicide control
<i>Pandorea pandorana</i>	Wonga Vine	-	Mechanical control / herbicide control
<i>Trachelospermum jasminoides</i>	Star Jasmine	-	Mechanical control / herbicide control
Herbicides suitable for aquatic use must be utilised where contact with a water body is likely.			

2.2.3 Supplementary Plantings

Supplementary replanting will be required throughout the Riparian Corridor area. Supplementary plantings should emulate the ecotone of vegetation naturally or previously occurring within the subject site. Locally occurring native species are to be used and selected from the species list provided in Table 2.3. Recommended planting densities are provided with the Revegetation Methods specified in Appendix 2. The required mix of

species provided relates to the actual community to be emulated and the size of the areas to be rehabilitated.

Any areas requiring supplementary plantings shall be replanted by a qualified Bushland Regenerator. Planting techniques, plant establishment and plant maintenance are to be directed by the Bushland Regenerator in accordance with Appendix 2. Locally occurring native species are to be used and selected from the species list provided in Table 2.3.

Maintenance requirements for plantings should extend for a minimum of two years after the completion of works or until such time as a minimum 80 per cent survival rate of each species planted is achieved.

TABLE 2.3 RECOMMENDED SPECIES FOR REVEGETATION	
Scientific Name	Common Name
Shrub Species	
<i>Acacia longifolia</i>	-
<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge
<i>Leptospermum juniperinum</i>	Prickly Tea-tree
<i>Livistona australis</i>	Cabbage Tree Palm
<i>Phragmites australis</i>	Common Reed
Groundcover Species	
<i>Baumea articulata</i>	Jointed Twig-rush
<i>Baumea juncea</i>	
<i>Carex appressa</i>	Tall Sedge
<i>Dianella caerulea</i>	Blue Flax-lily
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
<i>Juncus krausii</i>	
<i>Juncus usitatus</i>	
<i>Isolepis nodosa</i>	Knobby club-rush

2.2.4 Secondary Weed Control and Regeneration

It is recommended that natural regeneration of the tree, shrub and groundcover layers be encouraged. Secondary weed control should be undertaken surrounding supplementary plantings to prevent suppression by weeds. These works are to be undertaken either by or under the supervision of a qualified Bushland Regenerator. Details of bush regeneration techniques are provided in Appendix 2.

2.2.5 Access Management

Inspections of the site by the supervising consulting bush regenerator/ecologist are to be undertaken prior to and during the construction operations to ensure that vegetated areas designated for retention and exclusion zones are adequately marked and that other appropriate protection procedures are being maintained. Construction and landscape works are likely to alter the environment and soil properties surrounding the vegetation retained on site. Therefore, the following management strategies are proposed to minimise damage to native vegetation retained during the construction period.

Exclusion zones

The compaction of soil surrounding retained vegetation is detrimental to root growth by reducing water infiltration and soil oxygenation rates. The riparian corridor area shown in Figure 1 will be managed as a vegetation protection zone.

The vegetation protection zone is to be established in accordance with the vegetation protection guidelines (Section 2.6) with a 1.8 metre temporary chain-link fence. This will reduce the effects of soil compaction by prohibiting unauthorised vehicle access and the stockpiling of construction material such as soil and woodchips within the vegetation protection zone.

All construction waste material is to be disposed of offsite. No construction waste materials are to enter the RCA.

Vegetation Protection

The following guidelines are proposed in relation to retained vegetation on the site within the RCA:

- i. Implementation of an adequate **Vegetation Protection Zone (VPZ)** will be required surrounding any retained vegetation. The VPZ can generally be provided by preserving an area around the vegetation with a radius of 12 x DBH (the trunk diameter measured at 1.4 metres above ground). The radius of the VPZ should be measured from the centre of the stem at ground level. A VPZ should not be less than 2 metres nor greater than 15 metres (except where crown protection is required) and the VPZ of palms, other monocots, cycads and tree ferns should not be less than 1 metre outside the crown projection (Australian Standard AS 4970—2009).
- ii. The boundary of the Vegetation Protection Zone is to be established at the outer boundary of the riparian corridor and the outer edge of any area of vegetation to be retained;
- iii. Before construction commences vegetation protection zones are to be adequately marked and sign posted using star pickets and wire or high visibility tape or plastic net fencing;
- iv. All trees not nominated for retention are to be removed prior to any construction activity or bulk earthworks. Approved tree removal operations in the vicinity of retained trees are to be undertaken in a manner that avoids canopy damage and soil compaction. Such works are to be supervised by a consulting ecologist / or arborist;
- v. All trenches footings and major earth movement should avoid vegetation protection zones;
- vi. Stockpiling materials and soils within vegetation protection zones is to be avoided;
- vii. Machinery is to avoid vegetation protection zones during all operations;
- viii. Any trenching or construction works undertaken within vegetation protection zones should be witnessed, supervised and recorded (photographed and documented) by a consulting ecologist;
- ix. Post-construction access control can be achieved using bollards, fences or retaining walls to limit pedestrian access and to control unauthorised vehicular access.

Following construction works permanent fencing or bollards are to be installed to restrict unauthorised access within the riparian corridor areas and allow for the free movement of native terrestrial and arboreal wildlife. Any fencing is to be free of barbed or razor wiring.

2.2.6 Stormwater Outlet Structures

All stormwater outlet structures are to be designed and implemented in accordance with the NSW DPI Office of Water (2012) Guidelines for Controlled Activities – Outlet Structures.

2.2.7 Watercourse Crossings

No watercourse crossings are proposed within the riparian corridor area.

2.3 ASSET PROTECTION ZONE DETAILS

Asset protection zones have been identified by Conacher Environmental Group (2013b) and will be located outside of the riparian corridor area. Asset protection zones are to be managed in accordance with the provisions of Appendix 4 of Planning for Bushfire Protection (RFS 2006).

2.4 SOIL EROSION AND DRAINAGE ISSUES

The objective of stormwater management is to ensure drainage from the construction area does not have a negative impact on vegetated areas and surrounding waterways.

Erosion and sediment control measures are to be implemented prior to the commencement of the development to minimise adverse effects as a result of increased erosion and sediment loading. Erosion and sediment control measures to be implemented during construction include:

- Coordinated work practices aimed at minimising land disturbance;
- The minimisation of groundcover disturbance through the dedication of vegetation protection zones encompassing the riparian corridor area as shown in Figure 1;
- Implementation of sediment erosion control fencing as per Councils requirements;
- Routine site inspections of drains, channels, sediment control structures and water quality;
- Identification of potential erosion areas;
- Installation and maintenance of flow control structures and soil stabilising vegetation wherever required;
- Construction of all outlet structures in accordance with the published guidelines.

The minimisation of soil erosion will be achieved through soil stabilisation measures, sediment erosion control fencing and water control techniques. Soil stabilisation measures to be implemented include immediate revegetation of cleared surfaces via seeding, planting of native species and the installation of biodegradable blankets.

2.5 ONGOING MONITORING AND MAINTENANCE ACTIVITIES

It is recommended that regular monitoring inspections be undertaken at 6 monthly intervals for 2 years after weeding and replanting works have been undertaken. This will allow for the assessment of the health of the vegetation and may include identification of any areas suffering from disturbance or in need of additional rehabilitation, weed control, sediment or storm water control, bank and soil stabilisation or maintenance of rehabilitated or regenerating areas.

Monitoring and review will include a performance evaluation of the works and will include assessment for replanting where losses have occurred, addressing any deficiencies observed, and determining a successful outcome. A successful outcome is usually defined

as a minimum of 80% survival rate for all plantings and a maximum of 5% weed cover for the treated areas.

Following these monitoring inspections a report with accompanying photos (taken at standard locations) will be submitted to Council and the NSW Office of Water. Photo points will be located by GPS or shown on survey maps.

Maintenance is to be undertaken within the rehabilitated areas every month for the first 12 months. Maintenance will include watering, replacement planting, weeding (herbicide or low impact physical weed removal as required), re-erecting sediment erosion control fencing, mulching, removing rubbish and regular inspections and performance assessment.

All monitoring and maintenance post development is to be the responsibility of the owner / manager of the facility or their contractors / agents.

SECTION 3

WORKS PROGRAM

3.1 WORKS PROGRAM

A proposed works program is outlined in Table 3.1.

TABLE 3.1 PROPOSED WORKS PROGRAM		
Action	Responsibility	Funded By
<i>Pre-construction</i>		
<ul style="list-style-type: none"> • Collection of seed/plant propagation. 	- Contract grower	Developer
<ul style="list-style-type: none"> • Identification (flagging) of vegetated areas to be retained (Riparian Corridor) 	- Project Supervisor	Developer
<ul style="list-style-type: none"> • Erection of erosion control fencing. 	- Contractor with advice of Project Supervisor	Developer
<ul style="list-style-type: none"> • Installation of protective fencing and signs around Riparian Corridor 	- Contractor with advice of Project Supervisor	Developer
<ul style="list-style-type: none"> • Soil amelioration works 	- Contractor / geotechnical consultant	Developer
<ul style="list-style-type: none"> • Commencement of weeding / regeneration within Riparian Corridor 	- Contractor / suitably qualified Bushland Regenerator	Developer
<i>Construction</i>		
<ul style="list-style-type: none"> • Ongoing weeding / regeneration of Riparian Corridor 	- Contractor / suitably qualified Bushland Regenerator	Developer
<ul style="list-style-type: none"> • Monitor erosion control fencing (weekly – and after rain) and replace if required 	- Contractor with advice of Project Manager	Developer
<ul style="list-style-type: none"> • Monitor vegetation protection fencing and signs and replace if required 	- Contractor with advice of Project Supervisor	Developer
<ul style="list-style-type: none"> • Implementation of supplementary planting program 	- Contract landscaper / bush regenerator	Developer

**TABLE 3.1
PROPOSED WORKS PROGRAM**

Action	Responsibility	Funded By
<i>Post-construction</i>		
<ul style="list-style-type: none"> • Remove temporary vegetation protection fencing and signs and install permanent access controls 	- Contractor	Developer
<ul style="list-style-type: none"> • Continuation of weeding / regeneration within retained vegetation. 	- Contractor / suitably qualified Bushland Regenerator	Developer
<ul style="list-style-type: none"> • Monitoring of retained vegetation <i>at 3, 6, 9, 12 months, and annually thereafter for 2 years</i> – conduct maintenance if required. 	- Qualified Ecologist / Bushland regenerator	Developer
<ul style="list-style-type: none"> • A yearly report on the status of the bushland including photographs shall be sent to Council. 	- Qualified Ecologist	Developer

REFERENCES

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APPENDIX 1

SITE PHOTOGRAPHS (PHOTO POINTS 1-7)



Photo Point 1.



Photo Point 2.



Photo Point 3.



Photo Point 4.



Photo Point 5.



Photo Point 6.



Photo Point 7.

APPENDIX 2

WEED MANAGEMENT / BUSH REGENERATION AND REVEGETATION TECHNIQUES

PART 1

WEED MANAGEMENT TECHNIQUES FOR USE IN AREAS OF VEGETATION RETENTION

Employing the Bradley Method for regeneration requires the removal of weeds in phases. Stages of weed removal can be broken into three components:

Primary Weeding

Primary weeding is the initial weeding. It is recommended that primary weeding should be carried out on the subject land to remove the majority of dominant weeds. This involves removal of weeds through herbicide use and hand removal. It is important to note primary weeding usually initiates new growth of both weeds and native species. Primary weeding of the site may take up to four weeks and it is recommended that this work either be carried out by a licensed bushland regeneration company or by the owners under the direction of a qualified Bushland Regenerator.

Secondary or Follow-up Weeding

Secondary or follow-up weeding involves intensive weeding in areas that have already received primary work to remove weed regrowth or overlooked weeds. It is recommended that secondary weeding be conducted 3-6 months after primary weeding. Secondary weeding of the site may take up to two weeks and should be carried out by either a licensed bushland regeneration company or by the owners under the direction of a qualified Bushland Regenerator.

Maintenance Weeding

After primary and secondary weeding and natural regeneration of the bushland, the area should be able to resist most weeds. However, weeds will re-establish on the site from birds, wind and water transporting seed and other propagules into the site. Maintenance weeding should be undertaken once or twice a year until such time as the resistance of the bushland to weeds increases, then only requiring hand-weeding every two to three years. Maintenance weeding of the site may take up to one week and should be carried out by either a licensed bushland regeneration company or by the owners under the direction of a qualified Bushland Regenerator.

Natural regeneration of the dominant native plant species is expected to occur over time provided ongoing management works are maintained.

Weed removal should be undertaken using small tools such as spades, mattocks, garden forks and saws to reduce soil disturbance and minimise damage to nearby plants. In addition to hand removal of weeds in some situations where weeds are abundant, such as for many of the grass species and when native plants will not be affected by spray drift, the use of Glyphosate herbicide is recommended in accordance with the manufacturers specifications. Herbicides should not be applied prior to rain occurring as this reduces the herbicides' effectiveness and increases the potential to enter creeks and drainage lines in runoff.

Weeds are to be progressively removed in accordance with the following techniques recommended by the National Trust, NSW National Parks and Wildlife Service and Australian Association of Bush Regenerators.

Woody Weeds Removal Techniques:

Cut and Paint (Woody weeds to 10 cm basal diameter)

- Make a horizontal cut close to the ground using secateurs, loppers or a bush saw; and
- Immediately apply herbicide to the exposed flat stump surface.

Considerations:

- Cuts should be horizontal to prevent herbicide from running off the stump, sharp angle cuts are hazardous;
- Herbicide must be applied immediately before the plant cells close (within 30 seconds) and translocation of herbicide ceases;
- If plants resprout cut and paint the shoots after sufficient regrowth has occurred; and
- Stem scraping can be more effective on some woody weeds.

Stem Injection

- At the base of the tree drill holes at a 45 degree angle into the sapwood;
- Fill each hole with herbicide immediately; and
- Repeat the process at 5 cm intervals around the tree.

Frilling or Chipping

- At the base of the tree make a cut into the sapwood with a chisel or axe;
- Fill each cut with herbicide immediately; and
- Repeat the process at 5 cm intervals around the tree.

Considerations:

- Plants should be actively growing and in good health;
- Deciduous plants should be treated in spring and autumn when leaves are fully formed;
- For multi-stemmed plants, inject or chip below the lowest branch or treat each stem individually; and
- Herbicides must be injected immediately before plant cells close (within 30 seconds) and translocation of herbicide ceases.

Small Hand-Pullable Plants Removal Techniques:

Hand Removal

- Remove any seeds or fruits and carefully place into a bag;
- Grasp stem at ground level, rock plant backwards and forwards to loosen roots and pull out; and
- Tap the roots to dislodge any soil, replace disturbed soil and pat down.

Considerations:

- Leave weeds so roots are not in contact with the soil eg. hang in a tree, remove from site or leave on a rock.

Vines and Scramblers Removal Techniques:

Hand Removal

- Take hold of one runner and pull towards yourself;
- Check points of resistance where fibrous roots grow from the nodes;
- Cut roots with a knife or dig out with a trowel and continue to follow the runner;
- The major root systems need to be removed manually or scrape/cut and painted with herbicide; and
- Any reproductive parts need to be bagged.

Stem Scraping

- Scrape 15 to 30 cm of the stem with a knife to reach the layer below the bark/outer layer; and
- Immediately apply herbicide along the length of the scrape.

Considerations:

- A maximum of half the stem diameter should be scraped. Do not ringbark;
- Larger stems should have two scrapes opposite each other; and
- Vines can be left hanging in trees after treatment.

Weeds with Underground Reproductive Structures Removal Techniques:

Hand Removal of Plants with a Taproot

- Remove and bag seeds or fruits;
- Push a narrow trowel or knife into the ground beside the tap root, carefully loosen the soil and repeat this step around the taproot;
- Grasp the stem at ground level, rock plant backwards and forwards and gently pull removing the plant; and
- Tap the roots to dislodge soil, replace disturbed soil and pat down.

Crowning

- Remove and bag stems with seed or fruit;
- Grasp the leaves or stems together so the base of the plant is visible;
- Insert the knife or lever at an angle close to the crown;
- Cut through all the roots around the crown; and
- Remove and bag the crown.

Herbicide Treatment – Stem Swiping

- Remove any seed or fruit and bag; and
- Using a herbicide applicator, swipe the stems/leaves.

Considerations:

- Further digging may be required for plants with more than one tuber;
- Some bulbs may have small bulbils attached or present in the soil around them which need to be removed;
- It may be quicker and more effective to dig out the weed;
- Protect native plants and seedlings; and
- For bulb and corm species the most effective time to apply herbicide is after flowering and before fruit is set.

Exotic vegetation should be removed and stockpiled in a clear area away from adjoining bushland. This stockpile should be removed from the site at a convenient time. As part of the regular maintenance of the restored area any regrowth of the exotic plant species should be removed and disposed of appropriately.

Use of Herbicides

There are various categories of herbicides currently used (Buchanan, 1989), specifically those that kill on contact (contact herbicides), and those that must move through the tissue of the plant (systemic herbicides). Other herbicides include those that are non-selective and those that are selective. There are also those herbicides that kill all existing plants and those that prevent germination (Buchanan, 1989). The most commonly used biodegradable

herbicides by bush regenerators are those containing glyphosate (ZERO ®, Glyphosate 340 ® and Roundup ®).

An advantage of herbicide use is the low time taken to spray weeds as compared to physically removing them, particularly for large infestations of weeds. Another advantage is that the dead weeds may provide some measure of soil stabilisation for a short period of time.

Herbicides should not be applied prior to rain occurring. This reduces the herbicides effectiveness as well as being transported in runoff to creeklines and waterways.

An advantage of herbicide use is the low time taken to spray weeds as compared to physically removing them, particularly for large infestations of weeds.

Buchanan (1989), recommends that the use of herbicides should be considered when:

1. there are small areas of dense weeds with few or no native plants to protect;
2. there are large areas of weeds;
3. the weeds are growing too rapidly for physical removal; and
4. the weeds are located in areas with a high potential for erosion if vegetation is removed.

The spraying of weeds must only be undertaken by experienced persons. The success of each treatment must be evaluated by the operator after a set period of time according to the labelled effectiveness for each herbicide. Care must be taken when applying herbicides near drainage lines to avoid excess use due to the sensitivity of the wetlands and waterways into which runoff will eventually flow.

PART 2

BUSH REGENERATION METHODS

General Description of Work

This document outlines the general principles to be used in a bush regeneration and rehabilitation program. The term bush regeneration includes both weed control and revegetation (planting) in bushland and semi-bushland areas.

Definitions

Bush regeneration is defined as “the practice of restoring bushland by focusing on reinforcing and reinstating the ecosystem's on-going natural regenerative processes” (Australian Association of Bush Regenerators).

Aims of Bush Regeneration

- To create an environment where native plants are able to re-colonise degraded/cleared areas.
- To restore degraded areas as far as possible, to viable, manageable ecosystems.
- To protect the bushland from further external disturbance events.
- To preserve and enhance local and regional biodiversity.
- To enhance and extend habitat for native fauna.
- To protect the site's special features (natural, geological, landscape and cultural)

Process

The Bush Regeneration process involves:

- *Primary Weeding* - initial weed clearance, through hand weeding and/or the use of herbicides.
- *Secondary or Follow-up Weeding* - maintenance of sites which have already received primary weeding.
- *Maintenance weeding* - monitoring/removal of weed re-growth and care of native plant seedlings (naturally occurring and planted).
- *Re-vegetation* - the use of locally indigenous species to restore an area via tubestock planting, direct seeding, transplanting and/or brush matting.

In areas where degradation has been serious enough to severely deplete or extinguish native regenerative capacity, it may be necessary to reconstruct or fabricate a plant community as close as possible to the original. This will involve a variety of techniques, including weeding, soil remediation, planting and on-going site maintenance. Small-scale soil stabilisation, earthworks, and remedial drainage works are often required.

Weed Control

Weed removal shall include any species likely to significantly invade bushland, prevent natural regeneration, or impede native seedling growth. Priority shall be given to species listed as 'noxious plants' within the LGA in the Schedules of the *NSW Noxious Weeds Act 1993*.

Weeding Techniques

See Part 1 for detailed weed control techniques. Within the bush regeneration context weed control is described as the removal or control of weeds using hand removal and/or the application of selected herbicides. In specific circumstances, the use of machinery is used when the extent of the infestation is very large and will not cause significant erosion or destabilisation. Weeding techniques should be appropriate to the weed type, growth form and to the existing site conditions.

Wherever possible, weed removal should be carried out prior to annual seed set. Herbicide application via stem injection or foliar spray must not be applied to plants bearing ripe or semi-ripe fruit. It is important to plan herbicide control of target species according to a weeding calendar that recognises the weed's life form and seasonality (i.e. flowering, fruiting and seed set). The techniques and methodologies used for bush regeneration shall conform to those identified in the National Trust Bush Regenerators Handbook (1991) and currently taught through the NSW TAFE Bushland Regeneration Certificate Course.

Labour

Bush regeneration work shall be carried out in a competent manner by experienced and qualified bush regenerators. A minimum 50% of the workforce must have completed a TAFE Bushland Regeneration Certificate Course or equivalent, and have suitable field experience (e.g. Minimum 200 hours prior employment as a bush regenerator). In assessing tenders, preference will be given to bush regeneration contractors with prior experience in the rehabilitation of bushland in the local area.

Use of Herbicides

The herbicide of choice for bush regeneration work is glyphosate (Roundup). Roundup Biactive shall be used in wet areas (e.g. drainage lines, sediment basin). The Bushland Regenerator shall not use any other herbicide or chemical contrary to herbicide label. Herbicide application shall be limited to the following techniques:

- Cut-stump and poison (cut and dab)
- Stem injection
- Stem-scrape and poison
- Basal bark painting
- Selective spot-spraying

Mulch and Cut Brush

Any mulch imported onto the site shall be weed-free eucalyptus leaf mulch or woodchip. Mulch from Privet, Camphor laurel, Coral Tree, Poplar, Willow, aquatic or declared noxious weeds is not to be used. The Bushland Regenerator shall ensure that any mulch used is properly composted before use.

Brush cut for erosion control and/or re-vegetation purposes shall be used only when cut branches are seed-laden. Branches shall be spread as quickly as possible to reduce seed loss during stockpiling. The collection of cut brush shall be limited to species occurring naturally in the bushland area. If seed and or brush are required to be collected from nearby Reserves, written permission must be obtained from the Bushland Management Officer, at the local Council. Collection sites are to be agreed between the Bushland Regenerator and the Proponent prior to any collection of brush.

Weed Debris and Rubbish

Disposal of weed debris and other rubbish generated as a result of the work shall be the responsibility of the Bushland Regenerator. Costs for disposal of rubbish (collection and tipping fees) shall be clearly stated in the tender proposal. Disposal of weed material via burns piles is permitted only after approval has been obtained from the local Council. Any burning must be carried out as advised by the Environment Protection Authority and NSW Fire Brigade.

Soil Erosion

Where bush regeneration works have the potential to destabilise slopes or embankments, action such as the use of fiber matting and/or the placing of logs across the slope and fixing in place shall be employed to minimise the problem. Erosion matting and/or silt fencing may be required in a number of sites. These sites are to be identified in the tender document and allowance made for the purchase and placement of erosion control matting.

Reconstruction of Bushland (planting)

The Bushland Regenerator is required to supply a set number of locally indigenous plants to be used in the vegetation protection areas. All plant material used on-site shall be grown from seed or cuttings collected in local bushland. Plant material may be supplied as tubestock, hikos or virocells. The method of delivery (as above) should be clearly stated in the tender documents. Planting methods are to conform to the *Revegetation Methods*.

PART 3 REVEGETATION METHODS

1 Timetable of Work

The Bushland Regenerator shall provide a preliminary planting schedule which incorporates a draft timetable of works for the planting activities. This shall be submitted at the time of tendering. A final planting schedule shall be prepared in consultation with the Proponent. This schedule should be designed to minimise the time the sites are exposed and take into account seasonal factors, availability of tubestock plants, and timing of construction works.

2 Site Preparation

Site preparation activities for all planting sites will include preliminary weed control, rubbish removal and (where necessary) minor earthworks (levelling, ripping). It is expected that any bare soil areas will be sown with a nurse crop to provide temporary soil stabilisation, and (where applicable) soil erosion control measures installed.

3 Plant Material

Plant material used for revegetation within the project area shall be sourced only from local bushland areas. The Bushland Regenerator is responsible for obtaining all necessary permits and licenses. All plants are to be provided in a healthy condition. They must have good root development and a sturdy shoot system. Plant with an elongated or yellowed shoot system shall not be accepted. Planting shall be undertaken immediately after delivery. If this is not possible, the Bushland Regenerator shall be required to provide appropriate storage to keep the plants in good condition on the site, adequately protected from frost, wind, sun and vermin, and secured from vandals.

4 Planting Guidelines

Planting Densities and Niche species

The Bushland Regenerator shall be responsible for planting according to the Site Planting Plan prepared by in consultation with the Proponent. This Plan will detail the required species and their distribution across the planting area. The Bushland Regenerator shall be responsible for ensuring planting densities and appropriate niche species.

Only locally indigenous plants will be used. Niche preferences shall be considered in planting, with plants being placed in the correct position with regard to soil type, moisture, aspect and slope. Plantings should be at a density which will result in a near natural canopy density at all structural levels (strata). Plants will be placed at average 2-3 units/m² in order to achieve the following densities.

- Canopy Trees @ 1 unit / 5m²
- Sub-canopy (small trees / large shrubs) @ 1 unit / 2 m²
- Shrubs @ 1 unit / 1.5 m²
- Grasses and Ground Covers @ 2-3 units / m²

Within riparian zones the planting density of 5 plants/m² should be achieved by increasing the grass and ground cover to 4 units per m².

Planting Methods

Planting holes shall be excavated to a depth of 150 mm and a diameter of 200 mm. Slow release native plant fertiliser (low phosphorous formulated native plant fertilizer tablet/granules) shall be placed into the planting hole. In poorly structured soils, approximately 200 cubic centimetres of native plant soil mix is to be placed and incorporated into the planting hole with fertiliser and water storing granules. Plants must be placed into moistened soil preferably by soaking 1-2 litres of water into each hole. After planting the soil shall be replaced and carefully firmed, leaving a slight depression around each plant to allow for water collection. Soil is to be replaced in the hole so that the base of the stem is level with the soil surface, not set below the soil, or sitting above.

All plants are to be thoroughly watered before planting and again after planting. If the weather is hot, a third watering shall be carried out within two (2) days or a t-tape or drip irrigation system set up to water plants on a weekly basis.

Plant Protection

The Bushland Regenerator shall be responsible for adequately protecting plant material from frost, wind, sun, vermin and animals. Two (2) Litre cardboard guards (including 2 stakes) shall be around each plant and maintained throughout the maintenance period of up to 3 years. The use of Jute mats (mulch mats) is recommended where annual or grass regrowth is expected.

Mulching

After planting, the exposed ground should be thickly mulched with low-nutrient mulch such as chipped eucalyptus. A depth of approximately 75 mm and a diameter of 400 mm around each plant are recommended. No exotic plant material is to be used. Pine bark is not considered to be a suitable mulch material. The provenance of all mulch material must be known and approved by the Bushland Regenerator. Mulch is not to be used in sand dunes ecosystems as the mulch inhibits plant establishment and provides a nutrient source for the growth of weeds in dune ecosystems. Care should be taken to keep mulch material away from the stems of the newly planted tubestock. Alternately, a light sowing of a suitable nurse crop (Rye Corn or Japanese Millet) can be made between plantings to provide a protective microclimate. Sowing rates to be used are those recommended by the supplier and agreed with the Bushland Regenerator.

Maintenance and Weed Control

Tube stock must be suitably maintained (watering and weeding) are to be maintained over a 3 year period on the following basis:-

- 1-3 months post planting – weekly watering and maintenance;
- 4-12 months post planting – monthly watering and maintenance;
- 13-36 months post planting – quarterly watering and maintenance.

During the maintenance phase any plant losses in excess of 15% of the total number planted must be replaced at the expense of the Bushland Regenerator.

Site maintenance shall consist of the following tasks:

- Weeding throughout the planting area;
- Watering tubestock;

- Replacing lost plants (as required); and
- Removing wind-blown or other rubbish from the planting area.

The Bushland Regenerator shall provide a preliminary maintenance schedule which incorporates a timetable of works for each of the activities listed above.