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VEGETATION MANAGEMENT PLAN

FOR

**CARRINGTON CENTENNIAL HOSPITAL
– AGED CARE FACILITIES**

LOT 10 DP845472 AND LOT 201 DP734620

**WEROMBI ROAD,
GRASMERE**

**MAY 2006
(REF: 5223)**

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EXECUTIVE SUMMARY

Introduction

The Carrington Centennial Care is on the verge of a major development phase for its strategic land holdings at Grasmere. To prepare it for this phase and to ensure sustainability, Carrington has pursued a master planning exercise. The Masterplan has identified the need for the removal of some significant vegetation and ongoing conservation of major stands of enhanced bushland. To this end, Conacher Travers and Carrington have embraced councils Natural Assets Policy in establishing a proactive approach to development and conservation.

This Vegetation Management Plan has been prepared by *Conacher Travers Pty Ltd* to manage protection and restoration offsets as approved by Camden Council to compensate for the loss of Cumberland Plain Woodland and management of riparian zones.

This report incorporates the Offsetting Strategy prepared in accordance with Camden Council's Natural Asset Policy. This policy amongst other measures promotes ecological sustainable development through a trading scheme which aims to offset the removal of ecologically significant vegetation with conservation and restoration of native vegetation.

This VMP proposes measures to offset the removal of 7.4 hectares of Cumberland Plain Woodland & with 39 hectares of protection and restoration offsets. The Vegetation Management Plan identifies vegetation management issues, restoration strategies, guidelines for critical work tasks, staged protection and restoration works and preliminary costing and project schedule.

Proposed Protection and Restoration Works

The proposed protection and restoration works will enlarge the total area of Cumberland Plain Woodland habitat by 30 % enriching the site's floral and faunal habitat diversity. Existing Riparian Vegetation will be conserved as part of the offset strategy and significantly improved by weed removal and revegetation works. As a result, a continuous corridor of native vegetation will be created on the northern and eastern borders of the northern portion of the development area linking with Nepean River. A significant portion of high quality Cumberland Plain Woodland (7.58 ha) will be retained within the Southern portion of the development area protecting a viable population of Cumberland Plain Land Snail. All nominated riparian zones will also be protected or restored in accordance with the master plan for the site.

Program of Works

A staged program of works has been prepared covering a 10 year program that allows a removal of:

1. Vegetation affected by the Aged Care Facility.
2. Vegetation affected by future development of the southern portion of the subject site.

As outlined in the Restoration Strategy the proposed works are categorised as Protection Offsets, Restoration Offsets and Riparian Restoration Works. Each stage represents a two (2) year program which is spread over ten (10) years. The stages of works are as follows (Figure 2):

Protection Offset

PO1	Protection and rehabilitation of protection offsets	(25 hectares)
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Restoration Offset

RO1	Restoration offset area 1	(2.34 hectares)
RO2	Restoration offset area 2	(2.4 hectares)
RO3	Restoration offset area 3	(2.72 hectares)
RO4	Restoration offset area 4	(1.77 hectares)
RO5	Restoration offset area 5	(1.76 hectares)
RO6	Restoration offset area 6	(1.75 hectares)
RO7	Restoration offset area 7	(1.78 hectares)

Riparian Restoration Works

RR1	Lake foreshore and tributary	(1.15 hectares)
RR2	Southern Riparian Corridor	(0.72 hectares)

The riparian restoration works (RR1 & RR2) have been identified for the two key riparian areas which may need to be completed under the auspices of 3A permit from DIPNR.

Table 1 is provided as a summary of costs related to the restoration works. The costs are based on current knowledge of market rates, which will need to be confirmed with the submission of competitive quotations. Due to the extensive nature of weed infestations on site, a weed control budget has been allocated to address major weed infestations. The need to undertake further weed control works will be assessed as part of the environmental auditing program.

Maximising natural vegetation on site will substantially reduce the rehabilitation costs over 10 years. Whilst the works program incorporates direct seeding and planting, direct seeding with an effective irrigation system is likely to reduce the expected planting costs significantly. For costing purposes, the program assumes that significant planting will still need to occur although experience says that significant cost savings can be achieved through the promotion of natural regeneration.

A critical review program will be incorporated into a Restoration Project Plan to review all methods and potential costs at the end of each year. Given a 10 year program, all costs can be reviewed on an annual basis to identify more cost effective methods as the situation demands.

A Compliance Certification Program is critical for demonstrating that appropriate restoration works have been implemented prior to release of the construction certificate. The timing of compliance certification needs to be negotiated directly with Camden City Council.

Critical to the implementation of this program is the preparation of a Restoration Project Management Plan that controls the scope of works, costs and implementation.

Conclusions

The following planning works need to be undertaken to facilitate good landscape design.

1. Preparation of landscape plans in accordance with this VMP identifying recreational facilities (golf course), tracks and access ways.
2. Finalise location of proposed RFS building services.
3. Finalise Masterplan in accordance with the Offset strategy.

The landscape plan will identify works that are needed to create aesthetically pleasing and functional landscapes. An independent landscape designer should be engaged to prepare a landscape plan that retains the site's character.

The rehabilitation of riparian zones, protection and restoration offsets are to be undertaken under the control of a project ecologist whose role is to ensure the works are undertaken in accordance with this VMP, any regulatory permits and Council approvals. To facilitate the implementation of restoration works the Project Ecologist undertakes the following tasks:

1. To prepare and review a restoration project management plan to identify the most cost effective rehabilitation methods and to minimise the costs of each stage.
2. Preparation of contract briefs (inclusive of landscape plans) for Contractors.
3. Assessing/Revising submissions from appropriately qualified and experienced contractors.
4. Issuing compliance certificates at the successful completion of key tasks.
5. Monitor and audit key performance criteria and to report to the regulatory authorities.
6. Liaise with client, contractors, regulatory authorities and Camden Council where required.

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TABLE OF CONTENTS

SECTION 1	INTRODUCTION	1
	1.1 Objectives	1
	1.2 Previous Studies	1
SECTION 2	MANAGEMENT CONTEXT	3
	2.1 Site Description	3
	2.2 Native Vegetation of the Site	4
	2.3 Previous Landuse Impacts	4
	2.4 Proposed Development	5
SECTION 3	MANAGEMENT ISSUES	6
	3.1 General Issues	6
SECTION 4	MANAGEMENT STRATEGIES	11
	4.1 General Strategies	11
SECTION 5	PROTECTION & RESTORATION WORKS PROGRAM	20
	5.1 Restoration Strategy	20
	5.2 Proposed Protection & Restoration Works	20
	5.3 Works Program	22
	5.4 Summary of Project Costs	23
	5.5 Environmental Audit & Compliance Certification	25
	5.6 Timetable of works	25
	5.7 Impact Mitigation	25
SECTION 6	CONCLUSIONS AND RECOMMENDATIONS	27
	BIBLIOGRAPHY	
FIGURE 1	Offset Plan	
FIGURE 2	Vegetation Management Plan	
APPENDIX 1	Offsetting Strategy	
APPENDIX 2	Flora Characteristics of the Site	
APPENDIX 3	Planting Guide	
APPENDIX 4	Weed Management Techniques	
APPENDIX 5	Revegetation Methods	
APPENDIX 6	Bush Regeneration Methods	
APPENDIX 7	How to Collect Native Seeds	
APPENDIX 8	Preliminary Costings	
APPENDIX 9	Project Timetable	
APPENDIX 10	Environmental Audit Checklist	

SECTION 1

INTRODUCTION

The Masterplan has identified the need for the removal of some significant vegetation and ongoing conservation of major stands of enhanced bushland. To this end, Conacher Travers and Carrington have embraced councils Natural Assets Policy in establishing a proactive approach to development and conservation.

This Vegetation Management Plan has been prepared by *Conacher Travers Pty Ltd* to manage protection and restoration offsets as approved by Camden Council to compensate for the loss of Cumberland Plain Woodland and management of riparian zones. Through negotiation with Council an agreement has been reached in which areas within the site were traded as offsets to allow development to proceed within Cumberland Plain Woodland – an Ecologically Endangered Community. As a result of this process, 25 hectares of Cumberland Plain Woodland and Riparian Vegetation were conserved and 14 hectares are to be restored.

This Vegetation Management Plan (VMP) has been prepared by *Conacher Travers* to provide details on the staged implementation of protection and restoration works within lands owned by Carrington Centennial Hospital - Aged Care Facility, Grasmere in Camden LGA.

1.1 OBJECTIVES

The purpose of this VMP is to provide details in regards to:

- Management issues relevant to the protection and restoration offsets;
- Guidelines for restoration, revegetation and weed control activities to be carried out within the protection and restoration offsets;
- Proposed weed control and restoration works within riparian zones;
- Ongoing monitoring and maintenance activities to be carried out within the riparian zone, protection and restoration offsets;
- Relevant sediment/erosion control measures;
- Consideration of relevant bushfire issues and maintenance of asset protection zones; and
- Consideration of relevant sediment/erosion control measures.

1.2 PREVIOUS STUDIES

The following reports relating to environmental and ecological issues have been prepared for the subject site and provide background information on the ecology and management of the subject site:

1. *Flora and Fauna Assessment Report (Conacher Travers, October 2004, Ref: 4418F)*
2. *Bushfire Protection Assessment Report (Conacher Travers, March 2005, Ref: 4418B)*
3. *Offsetting Strategies Report (Conacher Travers, August 2005, Ref: 5223) – Appendix 1.*
4. *Urban Bushland Management Guidelines (Dept. of Planning, 1991)*

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.

5. *Bush Regenerator's Handbook (National Trust of Australia, NSW 1991)*

The Bush Regenerator's Handbook (National Trust of Australia, NSW 1991) contains a number of relevant strategies, which are aimed at maintaining and enhancing native flora and fauna and their habitats.

SECTION 2

MANAGEMENT CONTEXT

2.1 SITE DESCRIPTION

Location

The subject site consists of two lots (Figure 1). The north-eastern lot is situated between Werombi Road and the Nepean River. It is bounded to the east by Ferguson Lane and to the north by development fronting Centennial Lane. The site does not include DP 221387, which fronts Werombi Road. Approximate MGA coordinates of the subject site are 385500E and 6229500N. The eastern lot is bounded by residential land to the north and west and by rural land to the south and east.

The south-western lot is on the opposite side of Werombi Road, on the south western corner of Smalls Road and Werombi Road. It has frontage to Smalls Road of approximately 300 metres and to Werombi Road of approximately 200 metres. It has frontage to the ends of Rofe Place and Grassmere Grove. It is bounded to the north and west by residential development and to the south and east by rural lands. The entire study area encompasses a total area of approximately 100 hectares.

Geology

The geology of the subject site is characterised by Wianamatta Shales of the Triassic Period. As is typical of that sequence, the soils are deep and clayey with no rock outcrops.

The Wollongong-Port Hacking 1:100,000 Soil Landscape map sheet (Hazelton, Bannerman and King, 1990) shows that the subject site is located principally within the Blacktown Soil Landscapes, with areas of Hawkesbury Theresa Park Soil Landscape adjoining the river.

Topography and Drainage

The study area is situated on undulating land with gradients ranging between 5-15%. The approximate elevation of the site is 50-110 metres Australian Height Datum (AHD).

The north-eastern lot is crossed by a number of ephemeral drainage lines, which discharge directly into the Nepean River. A large dam has been constructed on the largest of those drainage lines.

The south-western lot is crossed by two prominent ephemeral drainage lines, with a small farm dam constructed on the eastern drainage line. The two main drainage lines rise in the south of the lot and flow in a north to north westerly direction, before combining near the intersection of Grasmere Grove and Cawdor Farms Road discharging into Sickles Creek. Most of the lot drains into these two drainage lines, while a small section to the south west drains westerly into an unnamed tributary of Sickles Creek.

Vegetation

Most of the vegetation within the subject site is disturbed, with a number of areas of residual bushland. Cumberland Plain Woodland found in the south-western corner of the south-western lot is in good condition. Apart from a narrow strip of vegetation along the Nepean River, all adjacent lands have been cleared.

Conservation Reserves

There are no nearby conservation reserves but the study area is adjacent to the Nepean River in the north eastern corner of the study area.

2.2 NATIVE VEGETATION OF THE SITE

Six vegetation communities were identified within the subject site using aerial photographic interpretation and extensive ground truthing:

- Mixed Woodland (EEC – Cumberland Plain Woodland)
- Grey Box Woodland (EEC – Cumberland Plain Woodland)
- Riparian Vegetation
- Grassland with Scattered Trees
- Parkland
- Aquatic Herbfield

No threatened flora species were recorded on site but one (1) endangered ecological community (Cumberland Plain Woodland) as listed in the *Threatened Species Conservation Act* (1995) was recorded within the study area.

A full flora species list and vegetation community descriptions are provided in Appendix 2 of this report.

2.3 PREVIOUS LANDUSE IMPACTS

The subject site landscape has been affected by the following impacts:

- *Improvements:* The eastern section of the subject site is being used as an aged care facility and contains numerous buildings, including self contained units, hostel, nursing home and associated offices. A large dam has been created in the eastern section of the subject site which has a major influence of the sites visual aesthetics.
- *Clearing:* Most of the subject site has been previously cleared but large areas of regional and locally significant vegetation remain of the site.
- *Bushfire:* There are no signs of recent bushfire.
- *Agriculture:* There is evidence of agricultural activities in the eastern lot, but it is assumed that the land was used for agricultural purposes before establishment of the current aged care facility. The western lot was being used for bovine grazing at the time of the survey.
- *Earthworks:* Apart from the dams, no major earthworks have been conducted within the subject site.
- *Introduced weeds:* Significant incursions of a variety of weeds, principally African Lovegrass and African Olive, have occurred throughout the subject site.
- *Feral, Introduced and Domestic Fauna:* Native fauna within the subject site is likely to have been impacted upon by the predation of European Red Fox (*Vulpes vulpes*), Cats (*Felis catus*) and Dogs (*Canis familiaris*). The vegetation of the site is heavily impacted by the local rabbit population (*Oryctolagus cuniculus*).

2.4 PROPOSED DEVELOPMENT

It is proposed to construct new Aged Care facilities to replace the existing Carrington Centennial Hospital on Lot 10 DP845472 and Lot 201 DP734620. The allotments to be developed, namely Lot 10 and Lot 201, occupy land to the north east and south west of the intersection of Smalls Road and Werombi Road.

In addition to new Aged Care facilities, land will also be developed for self care units and over 55's housing. A 6 hole golf course is proposed for the western foreshore of the existing lake as a recreational facility which will be integrated with the restored landscape.

A 1000-1500m² Rural Fire Service facility is proposed to be established on the eastern boundary of the north eastern lot. The location and area of this facility is to be confirmed at a later date.

SECTION 3

MANAGEMENT ISSUES

The general aim of this Vegetation Management Plan is to integrate the protection and restoration offsets with the Carrington Masterplan. As the Offsetting Strategy defines the limits of developments it is expected that the concept Masterplan will require modification which may cause adjustments to the proposed protection and restoration offsets. The outcomes from various meetings with Camden Council have resulted in the current offsetting strategy (Appendix 1). The Offsetting Strategy has led to a positive outcome integrating both for ecological and development requirements for the site.

The Offsetting Strategy identifies several areas to be set aside for conservation in accordance with Camden Council's Natural Asset Policy. These include two areas of regionally significant vegetation and two areas of locally significant vegetation (Figure 2). One of these vegetation communities is an endangered ecological community of Cumberland Plain Woodland. In addition to these areas an area to the east of the Lake and to the north of the conserved area of Cumberland Plain Woodland in the northern lot is to be restored. The conservation and restoration areas will create a vegetation corridor which extends from the Nepean River into the site. In the long term the restoration areas will provide significant habitat for native flora and fauna within the site.

3.1 GENERAL ISSUES

Large areas of Cumberland Plain Woodland will be conserved as part of the proposed development as shown in Figure 1 including habitat for Cumberland Plain Snail.

The location and extent of the Riparian Corridors as determined by DIPNR are largely located within protected offsets. The riparian zones located near constructions areas are covered under the *Rivers and Foreshores Improvement Act 1948* and may require a 3A permit and separate vegetation management plans to undertake construction works.

The main general environmental management issues relevant to this Vegetation Management Plan have been categorized into the following generic headings:-

- Weeds and Bushland Rehabilitation
- Soil Erosion and Sedimentation
- Bushfire Management
- Landscaping
- Pest Fauna Species Management
- Fauna Movement Opportunities
- Retention of Roosting, Shelter or Forage Habitat

3.1.1 Weeds and Bushland Rehabilitation

The vegetation condition of the protection areas varies from fair to very poor. Dominant weeds in shrub / subcanopy layer is African Olive (*Olea europea ssp. Africana*), representing up to 90% canopy coverage in some areas. Dominant weeds in groundlayer are *Cirsium vulgare*, *Chamaesyce supina*, *Eragrostis curvula*, *Hypochaeris* sp., *Modiola caroliniana*, *Plantago lanceolata* and *Stenotaphrum secundatum*, representing groundlayer coverage of approximately 90% in many areas. These weeds need to be targeted for removal within the protection offsets as shown in Figure 2.

Weeds are to be progressively removed in accordance with the low impact weed control techniques (also known as Bush Regeneration).

The vegetation condition of the restoration offsets varies from fair to very poor. Dominant weeds in shrub / subcanopy layer are African Olive (*Olea europea ssp. Africana*) representing canopy coverage of up to 90% in some areas. Dominant weeds in the groundlayer are *Bromus hordaceus*, *Cirsium vulgare*, *Dactylis glomerate*, *Eragrostis curvula*, *Hypochaeris* sp., *Lolium perezii*, *Modiola caroliniana*, *Paspalum dilatatum*, *Plantago lanceolata* and *Vulpia myuros*, representing shrub and subcanopy groundlayer up to 100% in many areas.

The principal mechanisms for weeds establishing in an area include:

- Provision of weed seed/vegetative source
- Elevated nutrients in stormwater run off e.g. from horse manure, chicken coops, septic tank drainage, sediments
- Physical disturbances to the soil
- Increased soil moisture from shading and ponding of water
- Increased light at the margins of vegetation

In general to maintain the current condition of the remnant bushland and riparian zones, the following restrictions need to be enforced including:

Weed Management

- All weeds need to be eradicated and controlled.
- Garden waste, weed propagules (seeds, tubers etc.) need to be periodically collected and disposed of at an approved waste transfer facility, and should not be dumped on adjacent bushland.
- Rubbish and vegetative waste dumping is to be prevented.

Nutrient Management

- Lawn fertilizers, manure (horse or chicken) are not to be contained, spread or stockpiled within 40m of a drainage line or the bushland.
- Drainage from lawns, manure and animal enclosures should be allowed to filter through a 40m grassed bio-swale prior to discharge into local drainage lines.

Erosion Control/Sedimentation Management

- All bare soil areas need to be stabilised with locally sourced native grasses.
- Sediment fences are to be installed around all construction works.
- Sediment basins or erosion control banks (if necessary) are to be installed prior to commencement of construction and restoration works.

Restoration of disturbed areas

- Maintain canopy increase shrub and groundlayer diversity through enrichment planting and direct seeding.
- Revegetation of areas due to installation of storm water pipes and outlet.
- Close any redundant fire trails or tracks.
- Install filter or sediment fences at key drainage points.
- Brush mat bare areas with seed laden native brush harvested from the site.
- Maintain in a weed-free condition for a minimum of 2 years or longer if needed.
- Promote natural regeneration of locally occurring native plants by application of low impact (bush regeneration) methods.

3.1.2 Soil Erosion and Sedimentation

Erosion and sedimentation of soils from the proposed works into the creekline is an undesirable result and should be mitigated to reduce impacts such as:

- Loss of top soil;
- Sedimentation of waterways, drainage lines or wetlands; and
- Promotion of exotic weed and pests through dispersal, changes in habitat or germination of weed species.

It is considered that the potential impact on the natural environment will be largely restricted to the period of the construction phase or until all exposed soils have been stabilised and revegetated and the post construction phase for up to two (2) years from the completion of the construction works.

The minimisation of soil erosion will be achieved through soil stabilisation measures, sediment fencing and water control techniques. Soil stabilisation measures that may be implemented include, immediate revegetation of cleared surfaces via seeding, planting of locally occurring native (endemic) species, mulching and the installation of biodegradable blankets if required installation of contour banks filter fences and sediment basins. It is expected that all soil stabilisation, erosion controls and sediment control works will be undertaken according to Council's guidelines.

Erosion and sediment control measures are to be installed prior to approved clearing of site vegetation or the commencement of any construction works. These measures will be maintained in accordance with Council's codes and guidelines. The measures will also follow best management practices in accordance with the NSW Department of Housing's *Managing Urban Stormwater: Soils and Construction* (1998) manual (the "Blue Book"). These measures will be maintained for as long as necessary after the completion of works to prevent sediment and turbid water entering the natural environment for up to two (2) years post construction or until all exposed soil has been stabilised.

Materials which are unsuitable for reuse will be disposed off-site at an approved disposal facility. No fill material is proposed to be imported to the site. If the need for fill importation arises, it will be conducted in accordance with Council's guidelines.

All land that has been disturbed by earthworks will be spray-grassed or similarly treated to establish a grass cover with locally sourced native grasses. Temporary silt fences and hay bale barrels will be installed strategically throughout the riparian corridor to trap sediment on site. All bare areas of soil will be seeded and stabilised with open weave jute mesh or jute mat.

3.1.3 Bushfire Management

A Bushfire Protection Assessment (*Conacher Travers, 2005*) has been prepared in order to appropriately manage bushfire and fuels within the proposed development area. This plan outlines suitable measures for the protection of humans and the associated infrastructure within the subject site, and provides for the management of fuels within the nearby bushland through the establishment and maintenance of an Asset Protection Zone (APZ) to Inner Protection and Outer Protection Area standards, and suitable construction standards for the buildings.

Adjoining the conservation zone 2c are two areas of asset protection zones to be managed as outer protection zones (*Conacher Travers, 2005*). These areas should be managed in accordance with the asset protection guidelines as set out Section 5.2.2.

3.1.4 Landscaping

Based on the species present, site characteristics and proposed development the species listed in Appendix 1 have been identified as suitable for planting. Areas of exotic vegetation can also be incorporated into landscape plans but these areas are to be kept separate from the proposed protection and restoration offsets, buffers and riparian zones. In any areas where the soil disturbance may be high, rehabilitation and stabilisation works will need to be undertaken.

For successful revegetation of disturbed areas the soil type, aspect and native species suitability must be considered. See Appendix 5 for revegetation specifications.

3.1.5 Pest Fauna Species Management

Due to the open nature of the site and adjoining residential and rural lands, the site and local area is expected to be impacted on by domestic and feral animals such as European Red Fox (*Vulpes vulpes*), Cats (*Felis catus*), Dogs (*Canis familiaris*) and Rabbits (*Oryctolagus cuniculus*).

Fencing of the site is not likely to be a practical measure to control wandering dogs and cats, as this would also limit the movement of ground dwelling fauna. The ownership of dogs and cats within the proposed development is unlikely to be an issue as the development is a hospital and aged care facility. Ownership could be restricted, however, given the nature of the surrounding landscape and the location of adjoining residential development this option is not considered beneficial or appropriate.

Rabbit control works are to be undertaken on site in order to maximise the survival of all installed native vegetation. This will be in the form of baiting throughout the restoration and protection sites under licence from Council and NPWS.

3.1.6 Fauna Movement Opportunities

Fauna movement through the riparian corridors, protection and restoration offsets can be accommodated through the following measures:

1. Retention of canopy vegetation and ground refugia (logs, rocks, dense grass and shrub layer).
2. Retention or replacement of selected trees to provide a "connected canopy" or viable "flight paths".
3. Strategic tree and shrub plantings throughout the proposed development to provide connectivity with the remnant vegetation and the riparian corridors.
4. Re-creation of riffle and pool habitats to protect and promote movement of aquatic fauna.

3.1.7 Retention of Roosting, Shelter or Forage Habitat

Tree hollows provide critical roosting and overnight shelter for fauna. Any trees which contain hollows may be considered as Ecologically Significant and should be retained as a high priority. Any hollow bearing trees that need to be removed can be compensated by re-locating existing hollows or installing nest boxes of similar size in nearby remaining trees.

The proposed works may require the removal of understorey vegetation and the thinning of the canopy. In this case the tree protection guidelines (Section 4.11) and mitigation measures for the replacement of hollows may need to be implemented.

Guidelines for ameliorating the loss of nesting hollows are as follows:-

- I) Where possible and practical, hollow bearing trees identified for removal should have the hollow sections collected and re-erected. Where this is not feasible, due to unstable decaying timber, artificial nest boxes are to be erected in their place in suitable locations;
- II) Glider and bat nest and roost boxes will be of the same dimensions, 50cm wide, 50cm long with a depth of 20cm but the entrance spacing on the underside of the box shall be sized according to the species requirements. An internal roosting support made of pegboard or shade cloth is to be fixed inside the box;
- III) All replacement nest boxes are to be secured to trees at a minimum height of four metres above ground level facing the east to northeast direction. An experienced person is required to install the nest boxes. Nest boxes and re-erected limbs are not to be placed near locations where public access is planned along reserve areas. All nest boxes and re-erected limbs will be inspected annually and any damaged, or in danger of falling, are to be repaired or replaced.

A fauna ecologist is to locate appropriate trees and locations for installing the nest boxes. The locations of all nest boxes and re-erected hollows are to be included on plans provided and audited as part of the regular auditing for the development. Each box is to be identified with a readable, weather resistant number (75mm) in size for identification and recording purposes.

On ground refugia should consist of rocks, logs, and dense understorey native vegetation.

3.1.8 Access and Signage

The bushland is to be maintained as an area protected from detrimental impacts of construction works, motor vehicles, rubbish dumping and nutrient run-off. Appropriate signage will be erected to notify construction staff of the bushland conservation status of the Cumberland Plain Woodland and inform the public of the significance of the threatened fauna species and ecological endangered community present within the bushland. These signs could also inform the public of the activities permitted within Cumberland Plain Woodland.

A timber post and wire fence should be constructed around the Cumberland Plain Woodland to restrict pedestrian and vehicle movement within the bushland. Recommended fencing should be permanent post and wire fence and shall provide access for maintenance and fire fighting vehicles.

3.1.9 Hydrological Environment

The hydrological environment within study area is unlikely to experience significant change from pre- to post-construction. Whilst the riparian corridors will receive stormwater runoff from the adjacent developments, the drainage lines will continue to function as an intermittent stream.

Threats from proposed development activities on the hydrological environment such as land clearing, increased nutrients, and water supply which are present in areas adjacent to the bushland and creekline areas will be ameliorated in accordance with this Plan.

SECTION 4

MANAGEMENT STRATEGIES

4.1 GENERAL STRATEGIES

The following strategies will apply to protection & restoration offsets and restored riparian zones.

- Proposed Weeding Activities
- Maintenance
- Monitoring and Review
- Soil Erosion and Drainage
- Site Management
- Tree Protection

4.1.1 Proposed Weeding Activities to be carried out within the retained vegetation onsite.

It is recommended that natural recruitment of the tree, shrub and groundcover layers be allowed within areas presently occupied by, or adjacent to, native vegetation. This is achieved by utilising low impact (bush regeneration) methods within the restoration areas

There are currently a number of bush regeneration techniques used in bushland management for the removal of weeds. The *Bush Regeneration Process* is explained in more detail in Appendix 4. These include (Buchanan, 1989):

- The Bradley Method of minimal soil disturbance during weed removal;
- Clearing and stabilising techniques;
- The use of herbicides;
- The use of fire; and
- Biological controls.

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 of the site makes it susceptible to erosion once plant cover has been removed; and
- 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 where weeds have been removed with locally occurring native (endemic) species.

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 bird, wind, water transport and other seed or propagule dispersal mechanisms within 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.

If required, regeneration of dominant natural plant species is expected to occur over a 2 year period, provided ongoing management works are maintained. To allow regeneration to occur the majority of weed infestations need to be controlled within 2 years of commencing weed control works. Follow-up maintenance weeding is required on a needs basis from 2 to 10 years.

The use of herbicides is needed where hand removal of weeds is impractical. The use of Glyphosate based herbicides is recommended in accordance with the manufacturers labels. Within 5m of a drainage line only Roundup, Bi-active or equivalent formulations can be used.

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 herbicides by bush regenerators are Glyphosate 340 ®, Roundup ®, Bi-active® and Weed Master ®.

Other regularly used herbicides include, Grazon DS ®, Brushoff ®, Brush Killer ® and Starane 200 ®. These non-glyphosate based herbicides are not to be used adjacent to water bodies subject to site conditions and the herbicide label.

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. The disadvantage is that no single herbicide is effective on all weed species, thus the herbicide used needs to be carefully selected to achieve an effective kill.

In general, *Conacher Travers Pty Ltd* recommends that the use of herbicides should be considered when:

- There are small areas of dense weeds with few or no native plants to protect;
- There are large areas of weeds; and
- Weeds are growing too rapidly for physical removal.

The potential for destabilizing and causing erosion as a result of spraying vegetation needs to be considered prior to commencement of weed control works.

Only operators with Chemcert or equivalent training must undertake the spraying of weeds. The operator must evaluate the success of each treatment after a set period of time according to the labelled effectiveness for each herbicide. Care must be taken when applying herbicides near water bodies due to the sensitivity of the waterways, and flora and fauna, to runoff containing these herbicides.

All herbicides must be applied according to the herbicide label and provisions of the *Protection of the Environmental Operations Act 1997* and the *Pesticides Act 1999*.

Exotic species targeted for removal throughout the duration of the management plan are listed in Table 1. These species are exotic species that have either been observed on site or are known in the local area.

Table 1 - Exotic Species Targeted For Removal

Scientific Name	Common Name
<i>Agapanthus praecox</i>	Agapanthus
<i>Alteranthera philoxeroides</i> *	Alligator Weed
<i>Ambrosia artemisifolia</i>	Annual Ragweed
<i>Anagallis arvensis</i>	Scarlet Pimpernel
<i>Araujia sericifera</i>	Moth Plant
<i>Avena fatua</i>	Wild Oats
<i>Bidens pilosa</i>	Cobbler's Pegs
<i>Briza subaristata</i>	-
<i>Bromus cartharticus</i>	Prairie Grass
<i>Bromus hordaceus</i>	Soft Brome
<i>Bryophyllum delagoense</i>	Mother of Millions
<i>Capsella bursa-pastoris</i>	Shepherd's Purse
<i>Carthamus lanatus</i>	Saffron Thistle
<i>Cerastium glomeratum</i>	Mouse-ear Chickweed
<i>Chenopodium murale</i>	Nettle-leaf Goosefoot
<i>Chloris gayana</i>	Rhodes Grass
<i>Chloris gayana</i>	Rhodes Grass
<i>Cinnamomum camphora</i>	Camphor Laurel
<i>Cirsium vulgare</i>	Spear Thistle
<i>Conyza albidia</i>	Fleabane
<i>Crataegus monogyna</i>	Hawthorn
<i>Cyperus eragrostis</i>	Umbrella Sedge
<i>Dactylis glomerata</i>	Cocksfoot
<i>Eragrostis curvula</i>	African Lovegrass
<i>Foeniculum vulgare</i>	Fennel
<i>Gamochaeta spicata</i>	Cudweed
<i>Gomphocarpus fruticosus</i>	Narrow Leaf Cotton Bush
<i>Hypericum perforatum</i> *	St John's Wort
<i>Jasminum polyanthum</i>	Jasmine
<i>Juncus acutus</i>	-
<i>Lantana camara</i>	Lantana
<i>Ligustrum lucidum</i>	Broad-leaved Privet
<i>Ligustrum sinense</i>	Small-leaved Privet
<i>Lilium formosanum</i>	Formosan Lily
<i>Lolium perenne</i>	Perennial Ryegrass
<i>Lonicera japonica</i>	Honeysuckle

Table 1 - Exotic Species Targeted For Removal (Cont.)

Scientific Name	Common Name
<i>Ludwigia peruviana</i>	-
<i>Lycium ferocissimum</i>	African Boxthorn
<i>Medicago</i> sp.	Medic
<i>Modiola caroliniana</i>	Red-flowered Mallow
<i>Myrisphyllum asparagoides</i>	Bridal Creeper
<i>Nephrolepis cordifolia</i>	Fish-bone Fern
<i>Olea europea</i> ssp. <i>africana</i>	African Olive
<i>Opuntia stricta</i>	Prickly Pear
<i>Opuntia vulgaris</i>	Prickly Pear
<i>Paspalum dilatatum</i>	Paspalum
<i>Paspalum urvillei</i>	Vasey Grass
<i>Pennisetum clandestinum</i>	Kikuyu
<i>Phytolacca octandra</i>	Inkweed
<i>Pinus radiata</i>	Radiata Pine
<i>Pinus</i> sp.	Exotic Pine
<i>Plantago lanceolata</i>	Ribwort
<i>Populus nigra</i>	Lombardy Poplar
<i>Protasparagus aethiopicus</i>	Asparagus Fern
<i>Rosa rubiginosa</i>	Briar Rose
<i>Rubus anglocandicans</i>	Blackberries
<i>Rumex crispus</i>	Curled Dock
<i>Salix babylonica</i>	Weeping Willow
<i>Salvinia molesta</i> *	Salvinia
<i>Senecio madagascariensis</i>	Fireweed
<i>Senna pendula</i> var. <i>glabrata</i>	Cassia
<i>Setaria gracilis</i>	Slender Pigeon Grass
<i>Setaria pumila</i>	Pale Pigeon Grass
<i>Sida rhombifolia</i>	Paddy's Lucerne
<i>Solanum nigrum</i>	Black Nightshade
<i>Sonchus asper</i>	Prickly Sowthistle
<i>Sonchus oleraceus</i>	Common Sowthistle
<i>Sporobolus africanus</i>	Parramatta Grass
<i>Stenotaphrum secundatum</i>	Buffalo Grass
<i>Taraxacum officinale</i>	Dandelion
<i>Tradescantia fluminensis</i>	Wandering Jew
<i>Trifolium repens</i>	White Clover
<i>Verbena bonariensis</i>	Purple Top
<i>Verbena rigida</i>	Veined Verbena
<i>Vicia sativa</i>	Common Vetch
<i>Xanthium occidentale</i>	Noogoora Burr
<i>Xanthium spinosum</i>	Bathurst Burr
<i>Zantedeschia aethiopica</i>	Arum Lily
* indicates noxious weed within Camden LGA	

The primary stages of the weeding phase of this plan are estimated to take approximately 6 months, while the secondary and ongoing maintenance stage for the restoration process should continue for at least 2 years in order to achieve effective control. Maintenance and regeneration should continue after 2 years on a needs basis.

4.1.2 Maintenance

Maintenance activities are aimed at providing a framework for the maintenance of the riparian zone in terms of exotic species removal, maintenance of structures and other tasks such as watering. These activities will continue to operate for a period of two (2) years after the Construction Phase of the development.

Maintenance activities include:

- Weed control;
- Waste control;
- Watering and revegetation maintenance;
- Repairs to protection and sedimentation fencing; and
- Cleaning of any permanent anti-sedimentation structures or traps.

Maintenance activities will occur on a monthly basis during the Construction Phase and on a quarterly basis during the Post-Construction Phase.

4.1.3 Monitoring and Review

It is recommended that regular monitoring inspections be undertaken at 6 months, 1 year and 2 years post construction. This will allow the determination of the condition of the vegetation and may include identification of any areas suffering from disturbance or in need further rehabilitation, weed control, sediment or storm water control, bank and soil stabilisation or maintenance of rehabilitated or regenerating areas. Monitoring will occur on a biannual basis during the construction phase, with the submission of a report by the Project Ecologist to Council detailing the performance restoration works upon completion of the Construction Phase and at one year intervals during the Post-construction Phase.

4.1.4 Ecological Fire Regime

Given the size, structure and location of the native vegetation remnants within and adjacent to the subject site, an ecological burning regime can be incorporated into the management of the protection offsets to promote the regeneration of native species. This would be in the form of pile burns to remove unwanted vegetative waste as required.

Ecological or Bushfire Hazard Reduction burns require appropriate assessment, planning and execution and are only undertaken with the advice, direction and assistance of the Rural Fire Service and Council. To facilitate ecological or prescribed burns, a Hazard Reduction Application is to be assessed and submitted in accordance with RFS guidelines

4.1.5 Soil Erosion and Drainage

If required erosion and sediment control measures are to be implemented to minimise adverse effects as a result of increased erosion and sediment loading. These include:

- Coordinated work practices aimed at minimising land disturbance;
- Identification of potential erosion areas;
- Control of nutrients through construction of grassed swales and nutrient retention basin/s;
- Control of sediment through construction of sediment basin/s;
- The minimisation of groundcover disturbance through the dedication of vegetation protection zones;
- Installation and maintenance of flow, erosion, sediment and nutrient control structures;

- Routine site inspections of drains, channels, sediment control structures and water quality;
- The safe disposal of all waste products; and
- The disposal of 'clean' water off site.

The minimisation of soil erosion will be achieved through soil stabilisation measures, including spray seeding, sediment fencing, water control techniques and revegetation of cleared surfaces via seeding, planting of native species, mulching and the installation of biodegradable blankets.

4.1.6 Site Management

Inspections of the site by the project ecologist should be undertaken prior to, during and post-construction operations to ensure that vegetated areas designated for protection and restoration zones are adequately marked and that other appropriate protection procedures are being maintained.

A suitably qualified bush regeneration contractor is to be appointed to supervise restoration works under the direction of the project ecologist.

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. A vegetation protection zone will be established surrounding native vegetation in accordance with the tree protection guidelines (refer to Section 4.11) using star pickets and suitable high visibility marking tape or orange plastic net fencing or temporary chain-link fencing panels. This will reduce the effects of soil compaction by prohibiting vehicle access and the stockpiling of construction material such as soil and woodchips within the vegetation protection zone.

Silt Fencing

Erosion and sediment control measures are to be implemented to minimise adverse effects of increased erosion and sediment loading. Erosion and sediment control measures are outlined in Section 4.9.

The minimisation of soil erosion will be achieved through soil stabilisation measures and water control techniques. Suitable soil stabilisation measures to be implemented include the immediate revegetation of cleared surfaces via seeding, planting of native species, mulching and the installation of biodegradable blankets. Suitable water control measures include construction of earth banks, catch drains, detention and sediment ponds (including Gross Pollutant Traps), grassed or armoured waterways, rock earth and sand-bag dams and outlet protection systems to prevent scouring.

Mulching

Whilst, mulching is an efficient method to impede the establishment of weed species, soil erosion, compaction and desiccation it is undesirable to place mulch within flood affected areas and it impedes the regeneration of opportunistic native species. Woodchip or other suitable mulch is to be placed at a depth of 75-100mm covering any nominated landscape areas as a border treatment of the North-South Riparian Corridor. Areas surrounding the stems/trunks of plants are to be kept free from mulch, thereby reducing the incidence of collar rot on retained or planted flora.

Instream Sedimentation Control

As a minimum, cross channel silt fences and hay bales are to be installed and maintained during the establishment period of native grasses and groundcovers (6 months). In addition, jute mesh or jute matting is to be laid in areas likely to be affected by surface erosion.

4.1.7 Tree Protection Guidelines

The following guidelines are proposed in relation to trees on the site and the proposed development:

- i. Implementation of an adequate Tree Protection Zone (TPZ) will be required surrounding any retained tree or group of trees. This tree protection zone can generally be provided by preserving an area around the tree/s with a radius of at least 1.25 x the average canopy radius from the trunk (of typical tree forms) or 0.5 x the tree height. British Standard BS 5837 (1991);
- ii. For trees observed on this site the tree protection zone can be provided by preserving the area within the drip line (directly under the canopy);
- iii. Tree Protection Zones should be adequately marked and sign posted using star pickets and 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 qualified Arborist;
- v. Stumps are to be ground - not dozed or dug out;
- vi. All trenches footings and major earth movement should avoid tree protection zones;
- vii. Stockpiling materials and soils within tree protection zones is to be avoided;
- viii. Machinery is to avoid tree protection zones during all operations; and
- ix. Any trenching or construction works undertaken within tree protection zones should be witnessed, supervised and recorded (photographed and documented) by a qualified Arborist.

4.1.8 Revegetation Within The Riparian Zone

The sensitive nature of a riparian corridor requires specific methods of revegetation. A guide for recommended species for revegetation works within the riparian corridor is provided within Appendix 2. These species consist of a diverse range of trees, shrubs and groundcovers, which will provide a fully diverse and structured riparian zone.

Within Asset Protection Zones, it is recommended that species identified within the planting guide be utilised but in accordance with the requirements for asset protection zones.

Table 2 - Site Preparation of Riparian Zone

Action	Description
Protection of existing vegetation	Minimise disturbance to the existing riparian vegetation by minimizing clearing for construction works and maintaining appropriate sediment control fencing during and post construction.
Site Re-grading	Re-grade the site after construction to a natural batter, spreading loose topsoil previously excavated from the site back over the top of the area to be revegetated adjacent the bridge and roadway within the riparian zone. All sediment storage areas, disturbed or bare areas as a result of these works within the riparian zone are to have sediment control structures and management carried out according to the guidelines provided in the Soil Conservation Service of NSW publication "Urban Erosion and Sediment Control Handbook".
Fibre Matting	Fibre matting will be used in steep areas on the banks where additional soil stabilisation is required as per the Soil Conservation Service of NSW publication "Urban Erosion and Sediment Control Handbook".
Mulching	If required, spread native chip mulch over the disturbed site to a depth of 75mm.

Table 3 - Revegetation within the Riparian Zone

Action	Description
Planting	The revegetation will extend from the waters edge back to a distance of 10m either side of the creek. Plant tubestock seedlings at rate of one tree or one shrub per square metre (in equal proportions) and 4 grasses per square meter within the riparian zone as per the species-planting guide. Infill planting may be needed as a contingency measure subject to the plant cover achieved.
Tree Guards	Plantings of trees and shrubs will be protected 2 L cardboard guards as tree guards rather than the less biodegradable plastic sleeves. Plastic guards are not suited to local conditions resulting in increased heat stress and fungal damage to plants. Two 45cm bamboo stakes will fix each guard. A weed mat of native chip mulch will be spread over the disturbed site. This in combination with the tree guards will reduce the potential impacts of frost, drought, weeds and grazing by rabbits and hares.
Direct Seeding	Sow the area by hand with provenance groundcover and shrub seed at a rate of approximately 25g of native mixed seed per 100 square metres. On germination, this may provide a groundcover density greater than four plants per square metre.

4.1.9 Provision of Aquatic Habitat

Creeklines and adjacent riparian vegetation naturally provide aquatic habitat niches for a variety of macroinvertebrates, fish, reptiles and amphibians. Instream aquatic habitat is promoted by recreating natural riffle and pool structures within the drainage line. The construction of the detention basins within the open space areas is unlikely to facilitate the creation of habitat as outlined below. Frog habitat, however, will be created within several sections of the detention basins.

As a guideline, riffles should be placed at an interval of 6 times the bank full width. Riffles consist of Rock Rubble overlaying geotextile. Pools are created by digging a depression immediately upstream and downstream of the riffle, stabilising the upstream and downstream ends of the pool with the next riffle.

Sedges, macrophytes and grasses are then planted within the drainage line to stabilise the bed and provide biological habitat. Figure 1, below, provides a model for natural pool and riffle sequences that should be used as a guideline for the creation of pools and riffles within the drainage channels.

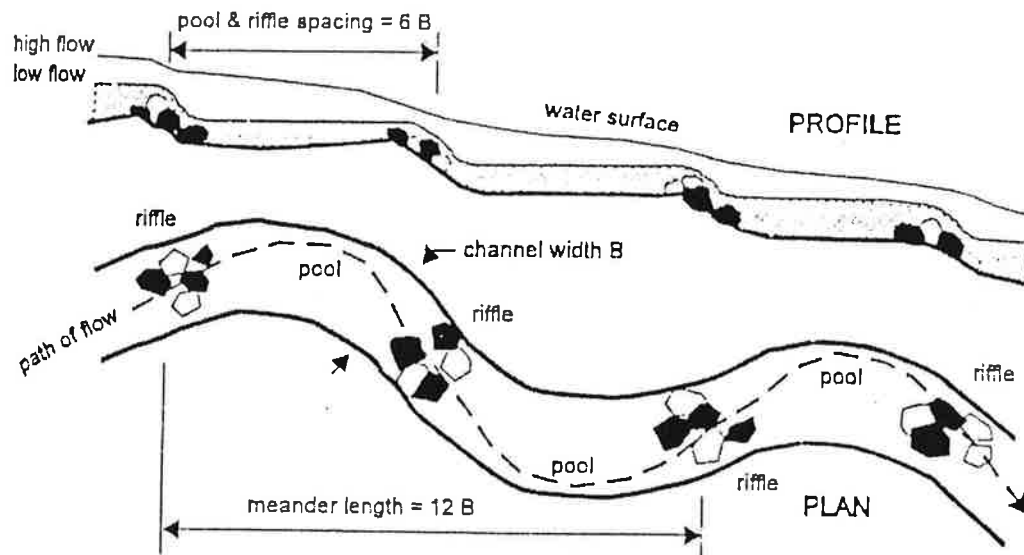


Figure 1: Indicative pool and riffle sequences that should be used as a guide for riparian restoration works.

SECTION 5

PROTECTION AND RESTORATION WORKS PROGRAM

5.1 RESTORATION STRATEGY

As discussed previously a 10 year restoration program has been prepared which is inclusive of Protection and Restoration Offsets, and Riparian Restoration Works. Each stage represents a 2 year program of works (Table 4) as follows.

Protection Offset

PO1	Protection and rehabilitation of protection offsets	(25 hectares)
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Restoration Offset

RO1	Restoration of Area 1	(2.34 hectares)
RO2	Restoration of Area 2	(2.4 hectares)
RO3	Restoration of Area 3	(2.72 hectares)
RO4	Restoration of Area 4	(1.77 hectares)
RO5	Restoration of Area 5	(1.76 hectares)
RO6	Restoration of Area 6	(1.75 hectares)
RO7	Restoration of Area 7	(1.78 hectares)

Riparian Restoration Works

RR1	Lake foreshore and tributary	(1.15 hectares)
RR2	Southern Riparian Corridor	(0.72 hectares)

As a total of 39 hectares of land will be protected and restored, a staged program of works has been prepared covering a 10 year program that allows a removal of:

- Vegetation affected by the Aged Care Facility (2.45 hectares).
- Vegetation affected by future development of the southern portion of the subject site (6.5 hectares).

Vegetation affected by the proposed aged care facility will be removed in year 2, after the Protection Offset (PO1) is established within year 1.

Restoration Offsets are staged over the next 8 years which allow the release of approximately 1 hectare of vegetation at the completion of primary works for each offset stage. A total of 6.5 hectares of Cumberland Plain Woodland will be removed at the end of the Restoration Offset program (RO1 –RO7).

5.2 PROPOSED PROTECTION & RESTORATION WORKS

5.2.1 Proposed Restoration Works Within Protection Offsets

The following works are required within protection offsets:

1. Primary weed control, planting, high volume spraying and selective cut and point.
2. Enrichment planting utilising locally occurring native plant species where works or weed control have resulted in the loss of native plant ground covers in accordance with Appendix 6 and species contained in Appendix 3.
3. To eradicate all weeds within the conservation areas in accordance with the weed control and bush revegetation methodology – Appendix 4 and Section 5.1.1.

4. Continued monitoring and maintenance (weed control) of the vegetation within the conservation zone;
5. The Asset Protection Zone maintenance work will be undertaken in accordance with the Program of Works by a vegetation contractor (Table 4) and Section 5.2.2 under the direction of an appropriate project ecologist;
6. Disposal of all rubbish such as vegetative waste at authorised waste transfer stations or tip;
7. Site maintenance in accordance with Section 5.1.2;
8. Monitoring and review in accordance with Section 5.1.3;
9. Soil erosion and damage in accordance with Section 5.1.5;
10. Site management will be undertaken in accordance with Section 5.1.6;
11. Tree protection will be undertaken in accordance with Section 5.1.7.

5.2.2 Vegetation Management of Asset Protection Zone (APZ).

The asset protection zones (APZ) which extend from the edge of the northern protection offset will retain the existing canopy cover. Initially, the majority of the vegetation within the APZ will need to be under-scrubbed in accordance with the relevant bushfire protection measures. To meet the requirements of the Rural Fire Service the following proportions of clearing need to be applied within the proposed asset protection zones (Inner and Outer Protection Areas).

Inner Protection Area (IPA)

- Retain 15-25% of the understorey and shrub layers in one or more discontinuous clumps.
- Ensure canopy gap of 2 metres to the next tree.
- Remove all ground layer litter on an annual basis.

Outer Protection Area (OPA)

- Retain 50-75% of the understorey and shrub layers in one or more discontinuous clumps.
- No canopy removal required.
- Remove all ground layer litter on an annual basis.
- The removal of weeds within the asset protection zone will largely achieve the required fuel reduction.

5.2.3 Proposed Restoration Works with Restoration Offsets

1. Collection of locally occurring native seeds in accordance with Appendix 7 and species contained in Appendix 3;
2. Primary weed control – slashing, high volume spraying and selective cut and point works;
3. Bed preparation, install erosion control banks and filter fences;
4. Install protective fencing / erosion control fences;
5. Revegetation using direct seeding, utilising locally occurring native plant species in accordance with Appendix 5 and species contained in Appendix 3 to promote and enrich local biodiversity;
6. Enrichment planting of tree and shrub species;
7. To eradicate all weeds within the restoration zones in accordance with the weed control and bush revegetation methodology – Appendix 4 and Section 5.1.1;
8. Continued monitoring and maintenance (weed control) of the vegetation within the subject site;
9. Disposal of all rubbish such as vegetative waste at authorised waste transfer stations or tip;

10. Site maintenance in accordance with Section 5.1.2;
11. Monitoring and review in accordance with Section 5.1.3;
12. Soil erosion and damage in accordance with 5.1.5;
13. Site management will be undertaken in accordance with Section 5.1.6;
14. Tree protection will be undertaken in accordance with Section 5.1.7;
15. Engagement of a Project Ecologist / Environmental Project Manager to implement and co-ordinate works in accordance with Section 7.

5.2.4 Proposed Restoration Works Within Riparian Zones

The following works are required with Riparian Restoration Zones:

1. Stabilisation of the stream bed and banks that controls bed and bank erosion;
2. Collection and propagation of species collected from local occurring native species utilising species from Appendix 3;
3. Adopting a "low-impact" approach to weed control to promote the revegetation of opportunistic native species;
4. Revegetation using direct seeding, planting and bush regeneration to promote and enrich local biodiversity in accordance with the methodology in Appendices 5 and 6;
5. To eradicate all weeds within the riparian zones in accordance with the weed control and bush revegetation methodology – Appendix 4 and Section 5.1.1;
6. Recreation of aquatic habitat to suit a range of reptilian, amphibian, macroinvertebrate, fish and avian wildlife (includes construction of riffle / pool sequences Section 4.4.3);
7. Controlling public access to minimise soil compaction and plant losses.
8. Disposal of all rubbish such as vegetative waste at authorised waster transfer stations or tip;
9. Site maintenance in accordance with Section 5.1.2;
10. Monitoring and review in accordance with Section 5.1.3;
11. Soil erosion and damage in accordance with 5.1.5;
12. Site management will be undertaken in accordance with Section 5.1.6;
13. Tree protection will be undertaken in accordance with Section 5.1.7.

5.3 WORKS PROGRAM

Table 4 identifies a typical works program for a 2 year restoration project which equates to one stage of the proposed restoration works at Carrington Centennial Hospital.

Table 4 - Typical Works Program (2 year)

Action	Responsibility
<i>Pre-construction</i>	
• Identification (flagging) of vegetation areas to be retained (TPZ). • Erection of erosion control fencing. • Installation of protective fencing and signs around vegetation to be retained (TPZ). • Identification of potential habitat trees. • Commencement of seed collection and propagation. • Commencement of weed control & regeneration • Commencement of revegetation works • Preparation of a landscape/tree planting program.	Project Ecologist/Arborist Contractor under supervision of Project Ecologist Contractor under supervision of Project Ecologist Project Ecologist Qualified Bushland Regenerator Qualified Bushland Regenerator Contractor under supervision of Project Ecologist Contractor under supervision of Project Ecologist

Table 4 - Typical Works Program (2 year) (Cont.)

<i>Construction – construction certificate released</i>	
• Monitor erosion control fencing (monthly – especially after heavy rain) and replace if required. • Inspect habitat trees during clearing and relocate fauna if required, prior to clearing • Mulching and shredding of removed vegetation in developed and rehabilitated areas • Monitor tree protection fencing and signs and replace if required. • Continuation of revegetation works within restoration zones • Continuation of weed control and regeneration	Contractor under supervision of Project Ecologist Project Ecologist Contractor under supervision of Project Ecologist Contractor under supervision of Project Ecologist Contractor under supervision of Project Ecologist Qualified Bushland Regenerator
<i>Post-construction</i>	
• Plant new trees recognised within Landscape Master Plan. • Remove tree protection fencing and signs. • Enrichment planting and monitoring of regeneration • Enrichment planting and monitoring of revegetation of restoration zones. • Monitoring of retained trees at <i>12 months and two years</i> post construction. – conduct maintenance if required.	Contractor under supervision of Project Ecologist Contractor under supervision of Project Ecologist Contractor / Qualified Bushland Regenerator Contractor / Qualified Bushland Regenerator Project Ecologist

This program demonstrates the division of tasks which determine the release of a construction certificate after the pre-construction phase. This ensures that the minimum site preparation and seed collection works are undertaken prior to the removal of vegetation on-site.

Timetable of works (Section 5.6) will need to be implemented cognisant of the construction program. This will be resolved with the finalisation of the construction programs for the aged care facility, self care units and over 55's housing.

5.4 SUMMARY OF PROJECT COSTS

The following table is provided as a summary of costs related to the restoration works. The costs are based on current knowledge of market rates, which will need to be confirmed with the submission of complete quotations. Due to the extensive nature of weed infestations on-site – a weed control budget has been allocated to address major weed infestations. The need to undertake further weed control works will be assessed as part of the environmental auditing program.

Maximising natural regeneration on-site will substantially reduce the rehabilitation costs over 10 years. Whilst the works program incorporates direct seeding and planting, direct seeding with an effective irrigation system is likely to reduce the expected planting costs significantly. For costing purposes, the program assumes that significant planting will still need to occur although experience says that significant cost savings can be achieved, the promotion of natural regeneration.

A critical review program will be incorporated into a Restoration Project Plan to review all methods and potential costs at the end of each year.

Table 5 - Summary of Rehabilitation Costs (excluding GST)

Site	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
PO1 (25.0 ha)	\$211,757	\$52,939									\$264,696
RO1 (2.34 ha)			\$164,737	\$41,184							\$205,921
RO2 (2.40 ha)				\$147,048	\$36,762						\$183,810
RO3 (2.72 ha)					\$194,742	\$48,685					\$243,427
RO4 (1.77 ha)						\$130,062	\$32,516				\$162,578
RO5 (1.76 ha)							\$129,379	\$32,345			\$161,723
RO6 (1.75 ha)								\$128,700	\$32,175		\$160,875
RO7 (1.78 ha)									\$134,256	\$33,564	\$167,820
RR1 (1.15 ha)		\$98,114	\$24,529								\$122,643
RR2 (0.72 ha)				\$87,818	\$21,954						\$109,772
Total (ex. GST)	\$211,757	\$151,054	\$189,266	\$276,050	\$253,458	\$178,748	\$161,894	\$161,044	\$166,431	\$33,564	\$1,783,265
GST	\$21,176	\$15,105	\$18,927	\$27,605	\$25,346	\$17,875	\$16,189	\$16,104	\$16,643	\$3,356	\$178,327
Total (Inc GST)	\$232,932	\$166,159	\$208,192	\$303,655	\$278,804	\$196,622	\$178,084	\$177,149	\$183,074	\$36,920	\$1,961,592

Note: The split of costs for each stage of works is split at the ratio of 80:20 for year 1 & year 2 respectively

5.5 ENVIRONMENTAL AUDIT AND COMPLIANCE CERTIFICATION

The environmental audit and compliance certification (Appendix 10) is the responsibility of the project ecologist. It identifies typical auditing tasks that are expected by Local Government & regulatory agencies in implementing the works.

Typical audits include:

1. Receipt of seed collection licence.
2. Certification of Provenance for all seed stocks used in the project.
3. Certification of correct installation of protective and erosion control fencing.
4. Issue of compliance certificates in accordance with 3A permits for band release.
5. Auditing plant survival, species diversity, plant cover and weed control.
6. Monitor the impact of animal grazing and restoration areas and recommend appropriate protection and control measures.
7. To certify landscape plans / construction plans are consistent with the approved vegetation management plans.

The Project Ecologist plays a critical role of ensuring the successful implementation of restoration works and to advise on the most cost effective methods.

5.6 TIMETABLE OF WORKS

The Timetable of works (Appendix 9) identifies the staging of the protection and restoration works that are need to be undertaken in conjunction with construction within developable areas.

The staging numbers represent the order of implementation eg. Stage 1 works are undertaken with year 1 whilst stage 2 undertaken in year 3. As a result the first 2 years are a critical period to ensure the establishment of protection offsets and commencement of restoration works.

As each stage consists of a 2 year program of tasks, the stages overlap by 1 year resulting in a 10 year restoration program. This approach limits financial exposure and enables more cost effective methods to be implemented for the later stages.

5.7 IMPACT MITIGATION

The mitigation of potential adverse impacts of works adjacent to protection and restoration zones will be implemented through the following procedures:

- Implementation of erosion and sediment control measures
- Identification and marking of areas to be cleared and areas to be protected before and during development / construction / regeneration works
- Protection of trees and native vegetation outside of the development areas
- Application of correct clearing techniques incorporating:
 - Avoidance of *tree protection zones*
 - Identification and protection of hollow-bearing trees during clearing operations
 - Appropriate chipping of cleared vegetation and spreading of chips on-site

- Removal of weeds and weed propagules in such a manner that they are not spread to other areas
- Regular inspections and reports on native vegetation protection and vegetation management measures
- Retention or replacement of natural logs and rocks
- Regeneration and enrichment planting of disturbed areas
- Retention of up to 25% of ground and shrub vegetation for fauna refugia
- Relocation or replacement of tree hollows into nearby trees that are in good condition
- Subject to the availability of suitable planting sites, those trees to be removed are to be replaced by endemic native species at a 2:1 ratio within suitable locations

SECTION 6

CONCLUSIONS AND RECOMMENDATIONS

This Vegetation Management Plan has been prepared to satisfy the requirements identified in the Masterplan as well as council requirements pursuant to the Camden Council's Natural Asset Policy and The Rivers and Foreshore Improvement Act administered by the Department of Natural Resources (NSW). This VMP proposes measures to offset the removal of 7.4 hectares of Cumberland Plain Woodland and with 39 hectares of protection and restoration offsets.

The proposed protection and restoration works will enlarge the total area of Cumberland Plain Woodland habitat by 30 % enriching the site's floral and faunal habitat diversity. Existing Riparian vegetation will be conserved as part of the offset strategy and significantly improved by weed removal and revegetation works. As a result, a continuous corridor of native vegetation will be created on the northern and eastern borders of the northern portion of the development area linking with Nepean River. A significant portion of high quality Cumberland Plain Woodland (7.58 ha) will be retained within the Southern portion of the development area protecting a viable population of Cumberland Plain Land Snail. All nominated riparian zones will also be protected or restored in accordance with the Masterplan for the site.

The rehabilitation of riparian zones, protection and restoration offsets are to be undertaken under the control of a project ecologist whose role is to ensure the works are undertaken in accordance with this VMP, any regulatory permits and Council approvals.

To facilitate the restoration works the Project Ecologist will undertake the following tasks:

1. To prepare and review a restoration project management plan to identify the most cost effective rehabilitation methods and to minimise the costs of each stage.
2. Preparation of contract briefs (inclusive of landscape plans) for Contractors.
3. Assessing/Revising submissions from appropriately qualified and experienced contractors.
4. Issuing compliance certificates at the successful completion of key tasks.
5. Monitor and audit key performance criteria and to report to the regulatory authorities.
6. Liaise with client, contractors, regulatory authorities and Camden Council where required.

The following planning works need to be undertaken to facilitate good landscape design.

4. Preparation of landscape plans in accordance with this VMP identifying recreational facilities (golf course), tracks and access ways.
5. Finalise location of proposed RFS building services.
6. Finalise Masterplan in accordance with the Offset strategy.

The Landscape plan that identifies works needed to create aesthetically pleasing and functional landscapes. An independent landscape designer should be engaged to prepare a landscape plan that retains the site's character.

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APPENDIX 1

OFFSETTING STRATEGY

